

Community Quest

An Interdisciplinary Educational Program Designed to Facilitate the Exploration of Community in
Greenville, South Carolina

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Community Quest

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An Interdisciplinary, Place-based Approach to Exploring Concepts of Community and Sustainable Development for Greenville, SC

Healthy communities are an essential part of a healthy city. For an individual, their environment can be defined as everything, living and non-living that affects them for their entire life. Both the built portion of a community and the living portion (the people) within a community have a huge impact on children born into that community. The opposite is also true; that individuals within a community, through their actions and values, have a huge impact on the built and natural environment of that community. The community as an entity cannot be separated from the urban environment. For an individual, developing an understanding of the systems that make up and support their community and its connections within the urban environment is the first step in developing a sense of place and responsibility for the future.

The Community Quest program has been developed by the Livability Educator for the City of Greenville as part of the Connections for Sustainability Grant Project and is designed to provide educators and students with the tools that they need to begin exploring the built and human environment that makes up a community.

Acknowledgments

The development of the Community Quest Program has involved collaboration from a number of individuals including City of Greenville Staff, Planners, Educators, Students, and many more. Thanks go out to all of the people who have helped to create, test, and edit the information and activities included in this program.

Specifically, I would like to thank Amanda LeBlanc, Librarian at A J Whittenberg Elementary School, Furman University Interns Emily Hays and Gillian Small, and the Connections Project staff team members Wayne Leftwich, Christa Jordan, and Nathalie Schmidt. Without the hard work and dedication of these individuals, this program would not have been possible.

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Introduction

About Community Quest

Community Quest has been developed as a series of activities and background information related to the built environment and the human aspects that make up and connect a community to the greater urban environment. Community Quest is part of the Curriculum for Sustainability developed by the Livability Educator for the City of Greenville as part of the Connections for Sustainability project. This program can be used as part of an informal or formal education program as a stand-alone program or in coordination with other lesson plans.

Program Objectives

Community Quest is designed to provide formal and informal educators with a variety of information and activities designed to:

- Introduce students to the concept of “Community” as an interconnected unit made up of the built, natural, and human environment within the larger entity of “City”

- Foster a sense of responsibility for the future of the community through place-based activities designed to show students how they are intricately connected to their environment and that the choices of the individual are reflected in the makeup of the community

- Integrate Livability Principles and Sustainability concepts into the formal and informal classroom

- Emphasize the connections of health, policy, and history (of both the land and the people) to the various aspects that make up a community and how all of these pieces come together to affect the community as a unit

- Encourage teamwork, inquiry, observation, and curiosity while forming a connection to the urban environment

- Develop an appreciation for the complex nature of the systems that make up a community within the urban environment



Photos page 4: **Top:** A community center student shows off the picture she drew of her home. **Middle:** Greenville’s Livability Educator demonstrates how land use impacts water quality using a model watershed for Boys and Girls club students. **Bottom:** Community center students with the recycled T-shirt dog toys that they made to donate to an animal shelter following a lesson on philanthropy.

Photos page 5: **Top:** fourth grade students decorate rain barrels as part of a water quality and conservation project. **Middle:** a student thanks city planners following a special lesson on how Greenville has changed. **Bottom:** second graders draw the main street bridge as part of a project on Greenville’s downtown.

How to use Community Quest

Community Quest was developed to be a program that can span age groups and educational settings. Multiple activities are provided to relate each topic to the learner. Though designed with the formal classroom in mind, the activities and supplemental materials also fit well with afterschool programming, summer, and weekend camps.

The background information provided is meant to be comprehensive without being overwhelming, and it is up to the individual educator to determine how much of the information they wish to convey to the age group they are working with. Multiple activities and supplemental materials have been offered to fit with the background information in each chapter. It is up to the individual instructor how to present the background information to their students and how much time to spend on each topic.

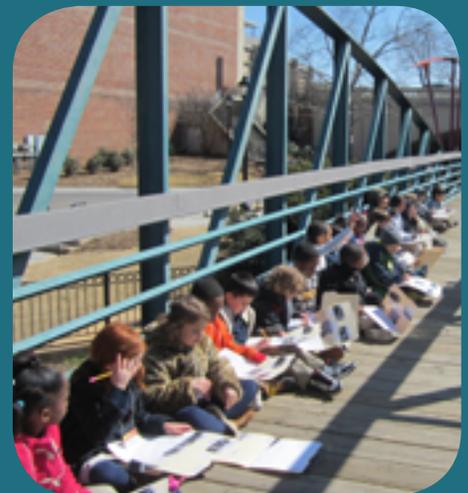
Each chapter includes multiple concepts that fit together under a general theme. The lessons and activities in the Community Quest program all explore ideas that will be revisited and reinforced in other lessons. Background information and concept development is place-based and specific to South Carolina and the City of Greenville whenever possible. The background materials include information related to health, policy, and history for each chapter, as these three components are essential aspects of understanding the factors that influence a community.

Chapter Elements:

Vocabulary/Word Bank – A word bank of associated terms will be provided with each chapter. Not all of the words will be appropriate for every group of learners. The word bank is intended to be a starting point and a way to draw connections. It is up to the individual educator to determine how to use the word bank.

Journal – Whether the journal is a daily activity, homework, a blog, or in some other form, writing and reflecting upon the experience is an important part of community quest. Multiple ideas for writing prompts that tie into the activities and information provided will be offered in each chapter. Students should be encouraged to also write anything extra that they would like to add to their journal.

Quests and Scavenger Hunts – An essential part of this program is the “quest” aspect. Scavenger hunts are a vehicle for exploration of the community that is both fun and informative. The Community Quest program includes multiple types of quests such as traditional scavenger hunts paired with questions and topics designed to provide the student with starting points for research and exploration. Not every chapter will include a scavenger hunt, and it is up to the individual teacher on how to use the materials provided here. Some ideas would be to incorporate the scavenger hunts as group activities, as part of a field trip, or as examples for the student to develop their own “quest” project.





Top: Students sort items into piles according to what natural resource they are made from.



Bottom: Second grade "Green Team" students collect recycling bins

The "My Community Journal"

As part of the community quest series, ask students to keep a "My Community Journal". Whether digital or on paper, explain that the journal will be a place to write their thoughts daily as they explore their community. The journal will include a daily required writing section that corresponds to the lesson and may include other assignments. It should also be a place where students can record any thoughts and questions that they may have as they are exploring their community.

A variety of possible questions and writing prompts have been offered for each section. Writing in the journal should be a regular activity. The instructor may want to choose a topic for the class to write about, or give the students a choice. How journal writing is incorporated into the program, such as homework, morning work, group brainstorming, a weekly blog, or a mix of ways, is up to the individual instructor.

Livability and Sustainability Principles

A major challenge regarding sustainability is communicating the key concepts in a way that people understand, relate to, and engage with. Like many environmental, economic, and social concepts, people often form strong opinions about sustainability before they have a concrete grasp of what it means. One of the core components of sustainability is that it calls for engagement of many different stakeholders and encourages interaction between different circles of influence that are working toward similar goals with different strategies. This is one of the reasons that there has been such difficulty in creating a single concrete definition of sustainability.

Definitions of Sustainability Include:

Brundtland Report: In 1987, "Our Common Future," was published, defining sustainability as, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." In this report, environmental protection, economic growth, and social equity were coined as the three pillars of sustainable development.

<http://www.un-documents.net/ocf-02.htm>

U.S. Environmental Protection Agency (EPA): "Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations. Sustainability is important to making sure that we have and will continue to have, the water, materials, and resources to protect human health and our environment"

<http://www.epa.gov/sustainability/basicinfo.htm>

U.S. Center for Disease Control (CDC): The CDC's Sustainability Planning Guide, defines sustainability as "a community's ongoing capacity and resolve to work together to establish, advance, and maintain effective strategies that continuously improve health and quality of life for all." This definition of sustainability goes beyond the goals of public health, as it also encompasses social justice and socioeconomics.

http://www.cdc.gov/healthycommunitiesprogram/pdf/sustainability_guide.pdf

Dictionary Definition of Sustainability: “a method of harvesting or using a resource so that the resource is not depleted or permanently damaged; of or relating to a lifestyle involving the use of sustainable methods.”

<http://www.merriam-webster.com/dictionary/sustainable>

The International Institute for Sustainable Development very basically defines sustainability as “environmental, economic, and social well-being for today and tomorrow.”

<http://www.iisd.org/sd/>

“The environment must be protected... to preserve essential ecosystem functions and to provide for the wellbeing of future generations; environmental and economic policy must be integrated; the goal of policy should be an improvement in the overall quality of life, not just income growth; poverty must be ended and resources distributed more equally; and all sections of society must be involved in decision making.” (The Real World Coalition 1996, a definition based on the work of the World Commission on Environment and Development)

There are many more definitions available for sustainability, but it should be clear from this list that all of the definitions share a common thread. To be sustained, something must be long lasting, so the well-being of future generations and the consequences of today’s actions on tomorrow must be considered. In addition to time, the three components of most definitions of sustainability are people, the environment, and economics. Finding the places where there can be a balance between these three components is the secret to sustainability. If something is not economically sensible but is good for the environment, in the long run it will not be sustainable. If something is good for the economy but harms the environment, then the end result is also not sustainable. The goal of sustainability is a system that provides a high quality of life for all people while maintaining a healthy environment and economy.

In applying the idea of sustainability to modern society, conservationists, scientists, social scientists, planners, and others are trying to work towards a goal of connected development where people and the environment can exist in concert with one another, where all levels of society can have a high quality of life with minimal impact on the environment in an economically sustainable way. This is a very complex idea, and as such it requires a shift in the way that we think about growth, development, infrastructure, and community. Rather than considering one piece of the puzzle, sustainable development requires that we consider the whole, from start to finish, and all of the connected parts. Throughout this program, we will emphasize connections between lessons, topics, and issues. This is an essential part of Community Quest, as a community cannot truly be understood as a single piece but as an interconnected network of people, infrastructure, and the built, natural, and social environment that work together to make a whole.

Sustainability is complex, much more complex than any single program of study can address. The places where sustainability really comes into play are the interactions between the built, the social, and the natural environment, and these are some of the starting points that Community Quest attempts to tackle. The information and activities provided are meant to be integrated with each other and with other classroom curricula in order to help students begin the journey of considering sustainability in all aspects of daily life.

Chapter 1: Defining Community

Defining what exactly makes up a community is a difficult task. “Community” is a social science construct without exact physical parameters. No two communities are exactly alike, and each one is unique. A community is generally made up of a group of people joined by common goals, ideology, history, ethnicity, or geography. Sometimes those people live near one another, but sometimes they do not. Communities change over time and can move.

A community in an urban environment is especially difficult to define, as one community may exist within another. Communities may overlap, and an individual may belong to different communities. The internet has now made possible the existence of extensive virtual communities, networks of individuals united by a common purpose who may never even meet in the real world.

DEFINING COMMUNITY

Learning Objectives

Students will

- develop a general understanding of the concept of community
- recognize that there are many different definitions of “community,” that communities come in all shapes and sizes, and that an individual can simultaneously belong to multiple communities
- research a community that they belong to and present their research findings to the class through a short oral presentation

Background Information

The term community is a social science construct that implies a connection between individuals. For simplicity’s sake, this lesson divides the concept of community into 3 main categories: Place, People, and Interest. There may be a significant amount of overlap in the members of these communities, but discussing and defining these three categories should make a good starting point.

- **Place** – A community defined by place is a group of people that share a common geographic boundary.

Neighborhoods – A neighborhood of homes is defined by geographic boundaries. Neighborhoods can be different sizes, much the same way that communities can be. Within the City of Greenville, neighborhoods are mainly delineated by the choice of the individuals that live in that neighborhood.

Some neighborhoods grow and develop around a specific central

Word Bank

Community
Neighborhood
Resident
Government
City Council
Mayor
Affiliation
Ideology
Boundary
Grist Mill
Legislative
Term
Network
Geography
Society
Virtual
Concrete
Delineation
Civic
Municipality
Society
Population
Region
Proximity

Defining Community Journal Prompts

What do you think of when you hear the word “community?”

What is the difference between a community and a neighborhood?

Why are communities important?

What is special about the neighborhood that you live in?

Do you feel like the neighborhood that you live in is a community? Why or why not?

What different types of communities do you belong to?

Can a group of people who have never met belong to the same community? Why or why not?

point, such as a church, a center of industry, or a hub of transportation. In order to understand why specific groups of houses or businesses are located in a certain place, it is beneficial to understand the social and geological history of the area.

For example, *the City of Greenville grew up around the falls on the Reedy River because the river is a natural corridor for travel and the falls provided the power needed to run the grist mills that ground grain for early settlers’ food. Over time, the river became a central point for a variety of industries, such as ironworks, public bath houses, and the cotton mills that made Greenville the “textile capital of the South.” The community of Greenville is historically centered around the Reedy River. The ruins of some of mills and the old mill villages, communities built up around a mill to provide homes for the workers and their families, can still be found in Falls Park on the Reedy River.*

- **People** – A community defined by people is a group of people that come together regularly that are united by a common goal.

Examples: co-workers, friends, family, church groups, classmates, sports teams.

These delineations are when the concept of community becomes difficult to define. Groups of people that come together as a community may have been brought together by a specific interest or place.

- **Interest** – A community defined by interest is a group of people that share a specific interest, value, hobby, or ideology.

The community defined by interest may have significant overlap with the community defined by people; for example, a local quilting group that meets regularly may be a community defined by people within the larger construct of people interested in preserving the folk arts of quilting. Or, a community defined by people may be a group that never meets in real life, such as an online gaming community or those with a common political affiliation.

- Communities are large and small.
- Communities may be imbedded within other communities.

Expanding Definitions:

By definition, an ecological community is a group of animals and plants that occur in close enough proximity to one another that there is potential for them to interact. Explore the ecological definition of community and the social science definition of community. How are they similar and different? From a sustainability science perspective would you consider the plants and animals in an area an important part of the human community? Why or why not?

Using the lists that the students brainstormed of communities that they belong to, **create a diagram showing how the communities are connected**. Write the names of each community in a circle (you may have to generalize i.e.: youth groups, sports teams, instead of each specific group or team), and arrange those circles in a larger circle (see example below). Then connect the circles that each student belongs to.

- If you have a smart board available, this could be done digitally, with each student picking a color, coming up to the board and drawing lines to connect their communities.
- If creating a physical art piece, the students could use yarn or ribbon to connect their communities with those of their classmates. This would show how connected each student really is.
- Depending on the number of students you have and how many communities they listed, this may be more appropriate as a small group activity.

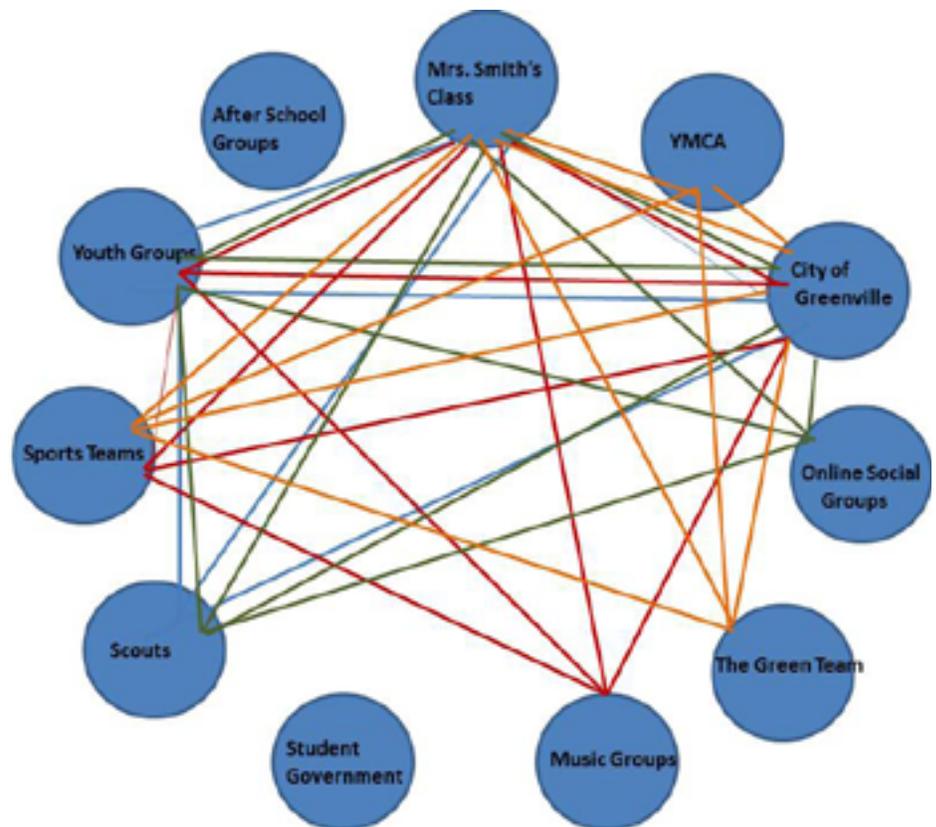


Figure 1.1: Hypothetical Community Map. Each color represents a single student.

Research Project: A Community of Mine

As homework or class extension following the “What is a Community?” lesson, ask students to consider or research a community that they belong to and present their findings to the class during the 1st class period of “Defining my Community.” Research questions may include:

What is the name or definition of the community?

Are there physical boundaries to the community and if so, where are these boundaries?

Estimate how many people are in the community. Who are the leaders of the community?

What is the history of the community?

What do the members of this community have in common?

Are there any goals that this community shares?

What is unique or special about this community?

Create a “my favorite place” community tour. Ask each student to choose a favorite spot or object from their community and introduce it to the class.

*Extend this activity by having students include pictures and a paragraph describing their connection to the favorite place or object and make an interactive map using Google maps.

Develop community caricatures. Ask students to pick a community that they belong to and pretend that community is a single person. Choose the defining characteristics of the person and draw a caricature of their community to present to the class.

THE URBAN ENVIRONMENT

The Urban Environment Journal Prompts

Describe a habitat in the urban environment that is suitable for an animal to live in. What animals might you find there?

Describe a habitat in the urban environment that would be difficult for animals to live in. What about that habitat makes it a difficult place to live?

Think of an animal that you acted out in charades. What type of habitat might it live in the city?

Would your animal's urban habitat be different than its natural habitat in the wild? How would they differ?

What challenges do you imagine that animals may face living in the city that they wouldn't have to face living in their natural environment?

Are there any advantages for animals living in the city over living in the wild?

Learning Objectives:

Students will

- learn the general definition of environment and apply it to themselves
- discuss the differences between the urban environment and a "natural" environment (for the purposes of this discussion, define natural as "unaltered by people")
- use previous knowledge of animals and their habitats to determine the challenges that animals face when living in an urban environment

Background Information

An organism's environment is defined as all factors that influence that organism throughout its life. An organism's environment includes the air, water, land, and other organisms that it interacts with from birth to death.

Greenville, SC is located in the piedmont ecoregion of South Carolina. The natural landscape types in this area include hardwood forest, oak hickory forest, pine oak forest, savannah, bottomland hardwood forest, and cove forest.

Much of the land in this area has a long history of use and development by people, from early clearing and agricultural use to the current mix of industrial, agricultural, and urban habitats that dot the landscape. Urban and suburban development in the piedmont has been and continues to be one of the major threats to populations of animals and plants native to the region.

Urban development alters the natural landscape in a variety of ways such as:

Habitat Alteration

Habitat alteration occurs when people change the land in a way that affects the organisms living there. Habitat destruction and habitat fragmentation are types of habitat alteration.

Habitat destruction

Habitat destruction occurs when a habitat is completely removed. An example would be if a building was built in a place where a small wetland used to be. There would be nothing left of that wetland, and animals and plants that lived there would lose their habitat completely.

Habitat fragmentation

Habitat fragmentation occurs when suitable habitat is broken into pieces by some sort of boundary such as a road or a dam. If fragments

are large enough, animals and plants may still be able to survive, depending on their range requirements. If the habitat fragments are small, species that require larger ranges either cannot survive there any longer or must travel between fragments. Habitat fragmentation is a very common form of habitat alteration in urban environments.

Altered hydrology

Changes in the way the land is shaped, soil structure, changes in vegetation, and other consequences of development all affect the way that water moves through an ecosystem (the hydrology of an ecosystem). By altering the rate and way that plants take up water, the rate that water infiltrates the ground, and rates of evaporation and transpiration, development can have a drastic effect on hydrology.

Alteration or loss of fire regime

Historically, many of the ecosystems in the Southeast experienced relatively frequent fires, mostly as the result of lightning strikes. As a consequence, many of the plants and animals that live in these ecosystems have adapted to frequent fires, some so much so that we term them “fire dependent.” When people develop an area, they generally alter the frequency and scale of fire events as a consequence of development.

There are a variety of places where animals may live in the urban environment. These urban habitats may be similar to the habitat the animal may live in the wild, or they may be very different. Some examples of urban animal habitats include: ornamental pools, gardens, yards, ponds, road sides, abandoned lots, back yards, parks, trails, and buildings.

Animals that live in urban environments must deal with a variety of challenges that are different from the challenges they would face in their natural environment. The animals that can survive in the urban environment have adapted in a variety of ways to live alongside humans and deal with landscape changes associated with development.

Some examples of the challenges animals living in the urban environment face may include:

Roads

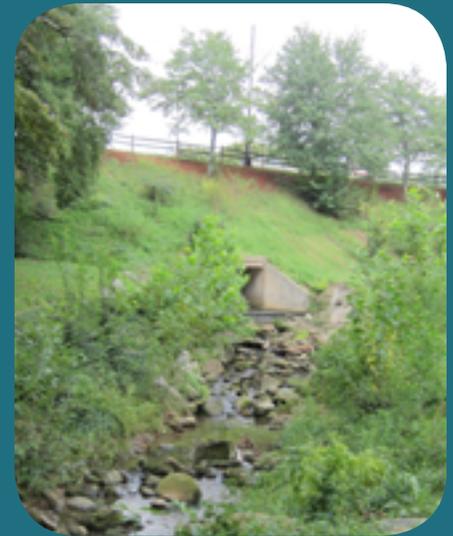
- As a barrier to movement
- As a source of mortality

Buildings

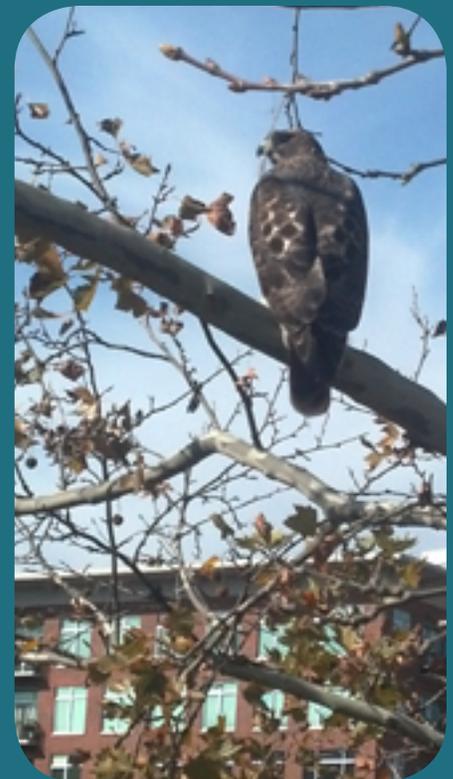
- As a barrier to movement or flight
- As a possible shelter or nest site

Finding food

- Scarcity of natural food
- Crossing roads or lawns to find food
- Foraging in trash = plentiful food for some animals



Urban streams often have lower base flow rates than streams in natural areas



Some animals adapt well to life in cities



Imagine you are a small animal, like a mouse or a lizard. Train tracks may be a major barrier to movement for some animals.

Raising young

- Must find den/nest/spawn sites that may be very different from natural sites

Dams

- Altered hydrology including a change in the location or frequency of flooding
- Barrier to movement for aquatic organisms
- Altered water temperature downstream of dams (higher or lower water temperatures immediately downstream of dams due to the release of water from the top or the bottom of the upstream body of water)

Pollution

- Air pollution from cars, factories, construction, and more
- Water pollution
- Trash
- Light pollution from buildings and other night time activities may alter the patterns of animals, or make it easier or harder for nocturnal animals to forage for food or hide from predators
- Noise

Soil alteration

- Compacted soil
- Erosion
- Disturbance

Landscaping

- Use of non-native plants in landscaping may reduce shelter sites and availability of suitable food
- Short grass may look pretty to people, but imagine being a mouse or a beetle and having to cross a cropped lawn to forage. Predators may enjoy the benefits of fewer obstructions
- Chemicals used in maintaining landscaping may be dangerous

People

People welcome some animals, such as butterflies and birds, while considering other animals pests or dangerous, such as rats and wasps. People actively alter their immediate environment through many mechanisms designed to attract or repel animals; including traps, poisons, bird houses, bird baths, landscaping, and more.

This is not a complete list, but should be enough to begin a thought provoking discussion of the differences between urban animal habitats and natural animal habitats.

More background information about habitats:

<http://www.fi.edu/tfi/units/life/habitat/habitat.html>

The Urban Environment Activities

Discuss the meaning of the word environment.

Ask students to brainstorm words that they associate with the word “environment” and create a word cloud on the board.

Go around the room and ask each student to tell the class the name of their favorite animal and what that animal’s habitat is. After everyone has spoken, ask the students to consider the difference between an animal’s habitat and its environment.

Define environment as all of the factors that influence an organism throughout its life. Use that definition to explain that an animal’s habitat is a part of its environment.

Play urban animal charades:

Print and cut out the urban animals charade cards on the next two pages.

Divide the class into two groups. Have the groups pick team names and explain the rules of charades and that they will be dealing ONLY with *wild* animals that can be found in the urban environment in South Carolina.

They can choose an animal to act out for 5 points OR they can choose an animal and an action (what the animal is doing) for 10 points.

A member of the team will come up and pick a card and act out the animal or the animal and action that is on the card.

While they are acting, their team will have one minute in which to guess what they are. If they do not guess correctly, at the end of 1 minutes, the other team has a single chance to steal the points. If the card is an animal and action, they must get both the animal and the action correct in order to receive the points. As in normal charades, they may not use any sounds.



Community center students play urban animal charades

Urban Animal Charade Cards

PRAYING MANTIS	OWL
WASP	CHIPMUNK
FISH	MOUSE
WHITE-TAILED DEER	SNAKE
LIZARD	CATERPILLAR
OPOSSUM	BUTTERFLY
VULTURE	HAWK
BAT	COCKROACH

Urban Animal Charade Cards

Woodpecker tapping on a tree to find food	Duck diving for food
Bee pollinating a flower	Raccoon knocking over a trash can
Turtle hiding in its shell	Rabbit eating lettuce
Spider building a web	Squirrel burying acorns
Bird building a nest	Robin eating worms
Spider trapping a fly	Frog catching a fly
Hummingbird sipping nectar from a flower	Skunk spraying a predator
Pigeon eating seeds	Fox chasing its prey

Urban Animals Worksheet

List five urban animals that you might find in each urban habitat (*answers will vary*)

Habitat					
Grassy Park					
Garden					
Back Yard					
River					
Alley/Roadside					
On/In/Under Buildings					
Small patch of trees					

Choose one of the Urban Habitats listed above: _____

1) Describe the characteristics of the habitat:

2) Do the animals that you listed for that habitat have anything in common? What?

3) Why might the habitat you chose be a difficult place for an animal to live?

4) What type of adaptations (physical or behavioral) would be beneficial to an animal living in this habitat?

Urban Animals Worksheet: *Teacher's Copy*

List five urban animals that you might find in each urban habitat (*answers will vary*)

Habitat					
Grassy Park	<i>Rabbit</i>	<i>Mouse</i>	<i>Beetle</i>	<i>Mole</i>	<i>Ant</i>
Garden	<i>Butterfly</i>	<i>Rabbit</i>	<i>Bee</i>	<i>Spider</i>	<i>Lady Bug</i>
Back Yard	<i>Squirrel</i>	<i>Rabbit</i>	<i>Owl</i>	<i>Chipmunk</i>	<i>Deer</i>
River	<i>Duck</i>	<i>Turtle</i>	<i>Fish</i>	<i>Goose</i>	<i>Dragonfly</i>
Alley/Roadside	<i>Raccoon</i>	<i>Rat</i>	<i>Spider</i>	<i>Opossum</i>	<i>Chipmunk</i>
On/In/Under Buildings	<i>Song Bird</i>	<i>Bat</i>	<i>Spider</i>	<i>Mouse</i>	<i>Lizard</i>
Small patch of trees	<i>Hawk</i>	<i>Squirrel</i>	<i>Owl</i>	<i>Song Bird</i>	<i>Snake</i>

Choose one of the Urban Habitats listed above: _____

1) Describe the characteristics of the habitat:

Answers will vary based on habitat

2) Do the animals that you listed for that habitat have anything in common? What?

General characteristics of many urban animals: small, generalist feeders, nocturnal, camouflage, fast, don't require large territory

3) Why might the habitat you chose be a difficult place for an animal to live?

General challenges of living in an urban environment: finding food, finding shelter, roads and buildings as barriers to movement, compacted soil, noise, light, lots of people, pollution (water, air, land/trash), manicured lawns reduce the availability of hiding places

4) What type of adaptations (physical or behavioral) would be beneficial to an animal living in this habitat?

General adaptations that may benefit urban animals: Small size = ability to hide, fast movement = ability to get away, good eyesight and sense of smell = ability to find food and hide from predators, needing only small territory = ability to live in truncated natural spaces, flight, generalist feeders



Community Center students create terrariums after discussing the meaning of the word "environment"

Make an "Environment in a bottle" terrarium.

Before building the terrariums, remind the students that an organism's environment is everything that affects that organism throughout its life. Next, ask them to list the things that a plant needs throughout its life to survive and introduce the terrarium as a way to create a closed environment for a small plant.

Materials:

- 2 Liter plastic bottles
- A craft knife and scissors
- A marker
- Pebbles (for drainage)
- Activated charcoal
- Sphagnum moss
- Potting soil
- Small plants or seeds



Directions for building a plastic bottle terrarium

- 1) Rinse the plastic bottle well.
- 2) When dry, use the marker to draw a line around the bottle.
- 3) Carefully use the craft knife to make an incision on the line. Then, use scissors to cut the bottle into two pieces.
- 4) Place two or three inches of pebbles in the bottom of the bottle to act as drainage.
- 5) Cover the pebbles with a layer of sphagnum moss to help keep soil out of the drainage layer.
- 6) Add a small amount of activated charcoal (available from an aquarium or pet-store) on top of the moss. This step is optional, but if you plan on keeping your terrarium for a while, activated charcoal will filter the water.
- 7) Add a little soil and place the plant in your terrarium, then fill in around the plant with soil. If planting seeds, go ahead and add a few inches of soil and plant your seeds.
- 8) Water your terrarium. Add enough water so that a little water pools in the base of your terrarium, but not so much that the base fills.
- 9) Optional - add some decorations before placing the top of the bottle back on the base and closing your terrarium.

Greenville, SC is located in the Piedmont region of the state. For an overview of the habitats and some of the conservation issues in the Piedmont, download:

<http://www.dnr.sc.gov/cwcs/pdf/habitat/PiedmontHabitat.pdf>

Divide the class into 5 small groups and provide them with a copy of the description of one of the 5 main categories of habitat in the Piedmont from the above document. Ask each student in the group to **research one of the animals listed as a priority associated species for their habitat.**

Provide each student with a milk jug, glue, markers, and other craft materials, and have them create a mask of their animal and present the animal to the class.

How to make a mask out of a plastic milk jug:

First, clean the milk jug out with soap and water. Next, using a craft knife, carefully cut around the handle of the milk jug. The handle can be set aside to use for an eye mask, and the full jug can be used as a full face mask. The bottom of the jug will rest on the student's head. Measure and cut out eye holes, and then decorate with paint or markers.

EXPLORING MY COMMUNITY

Exploring My Community Journal Prompts

What are your favorite things about the City of Greenville?

What makes the City of Greenville special?

Write a short advertisement about the City of Greenville. The advertisement should tell someone why they should move to the City to live.

What makes the City of Greenville a community?

What are your least favorite things about the City of Greenville. How do you think people in Greenville should go about changing these things to make the City better?

City Council members are elected by the people they represent. Why is it important to vote? If you could tell a City Council member about one problem in your community, what would it be?

Learning Objectives:

Students will

- become more comfortable with the concept of community
- learn about the governing structure of Greenville, SC
- research a community that they belong to and present important defining characteristics of that community to the class
- create a class bulletin board or art wall dedicated to their community

Background Information

When beginning any type of research, the first and most important aspect of the research is to define the boundaries of the item being studied. Due to the “fuzzy” nature of the term community, for the purposes of Community Quest, the “Community” will be bounded by the geographical boundaries of the City of Greenville. Students may wish to study a smaller portion of the physical community for their “exploring my community” research project, but for the sake of simplicity, unless specifically stated, when the term “Community” is used throughout the rest of the program, we will be referring to the places within and people that live, work, or play in the City of Greenville.

In any community, there are individuals that take leadership roles. Whether leadership roles are defined with a set job description (such as community president, or pastor) or are less well defined (such as “host” or “team captain”) depends on the type, size, and purpose of the community. Many different people may cycle through leadership roles.

Leadership Roles and Government in The City of Greenville:

The City of Greenville as a Community has a Governing body that utilizes the Council-Manager form of Government.

The **Mayor** acts as the presiding officer at City Council meetings and represents the City and Council at a variety of functions, but the Mayor has no more legislative power than any other member of the city council.

In Greenville, the Mayor and two other Council members are elected from the city at large, meaning that every citizen who lives in the City can vote for these 3 positions.

The remaining four Council members are elected by district, meaning that only the people that live in a defined area within the City can vote for these Council positions.

The City Council and the Mayor set policy for the city and appoint a City Manager, City Attorney, and Municipal Judge.

The **City Manager** is responsible for overseeing the daily operations of the city and implementing the policy and decisions made by the City Council. All employees of the City answer to the City Manager.

The **City Attorney’s** office provides legal counsel to the Mayor, City Manager, City Council, City employees, and boards. The City Attorney is also responsible for managing jury trials, prosecuting cases before the Municipal Court, and providing a wide variety of legal services

to the City, employees, and citizens. The City employs one full time Municipal Judge and several part-time assistant Municipal Judges. They are responsible with impartially dispensing justice on crimes committed within the city limits of Greenville, SC in accordance with City and State laws and regulations.

Exploring My Community Activities

Define the City of Greenville as the Community that will be explored throughout the rest of the Community Quest series.

Discuss the Council-Manager form of Government including the roles of the Mayor, City Council, and City Manager and the current members of City Council.

Ask students to **present** the results of their research project "A Community of Mine" to the rest of the class.

Research the City of Greenville:

Students may explore the City of Greenville's website <http://www.greenvillesc.gov/>

Ask small groups of students to find 5 important facts about the City of Greenville to present to the class.

Record all of the facts that the students found. Once all of them are on the board, hold a class vote to decide which 10 facts would be the most important for a stranger to the City to know.

Host an important visitor.

Invite a member of County Council to speak to your class

<http://www.greenvillesc.gov/CityCouncil/default.aspx>

Interview a community leader:

Have the students use their letter writing skills to send an email to a leader of their choice in their community and request an interview. The interview may be done via email, in person, or on the phone.

You may wish to use the interview worksheet on the next page as a starting point, and/or have students create their own questions.



2nd grade classes explore downtown Greenville

Students may wish to use their research to help them write the City of Greenville advertisement journal entry.

Or, have small groups create a brochure about Greenville. Make sure each group includes:

- *List of facts and figures*
- *At least two important attractions with a descriptive paragraph about each*
- *Information about a historic figure*
- *A description of Greenville's climate and geography*
- *A picture*

COMMUNITY LEADER INTERVIEW
WORKSHEET

Instructions: Familiarize yourself with the questions that you will be asking by reading over them before your interview. Email or call your community leader ahead of time in order to schedule your interview. Be polite.

During your interview, Introduce yourself and thank your interviewee for taking the time to speak with you. If you wish to record your interview, make sure that you ask their permission first. Use the questions below to guide your interview. Make sure to take notes.

Name _____

Date _____

Time _____

Title _____

Email _____

What are your main responsibilities?	Is your leadership position a full time job? If not, how much time do you estimate that you devote to it?
What training or education did you have prior to attaining this leadership position?	What is your favorite thing about what you do?
How does your position impact the broader community?	What advice would you give to someone who is interested in pursuing a leadership position like yours in the future?

After your interview is over, thank your community leader again for taking the time to speak with you. Make sure you have their email address so that you can send them a final thank you email.

“MY COMMUNITY” QUESTS

Introducing the my community scavenger hunt:

Present students with the list of scavenger hunt items and either assign groups or individuals to find and bring in each of the items.

You may want to add or change some of the items on the scavenger hunt. Ideally, each student should choose at least 5 items on the list that they will be responsible for attaining. Some overlap is necessary. There should be no reason that any student has to spend money to complete this scavenger hunt. Make sure that students have access to digital cameras before assigning them a photograph.

The scavenger hunt could be an ongoing class project or be completed as an introductory assignment at the beginning of the Community Quest unit. Allow at least a weekend for the collection of scavenger hunt materials. Ask students to upload digital photographs to a class folder and create a photo-collage (many free programs are available for doing this on the computer) for the class website or print the photos and allow students to combine them with the other items from their scavenger hunt to create a bulletin board or wall art titled; “Our Community.”

Introducing Discover Greenville: A Downtown Scavenger Hunt:

The “Discover Greenville” series has been developed by the Livability Educator for the Connections for Sustainability Project as a tool for engaging families, visitors, and students with the built environment in Greenville’s downtown. The scavenger hunt deals primarily with public art and history and encourages exploration of the various functions of public artwork and the connection that people have with the built environment. As part of Community Quest, the “Discover Greenville” series can be used in whole or in part as individual or group assignments to further engage the students with exploration of their community.

Download “Discover Greenville: A Downtown Scavenger Hunt” from the connections website.

Two pre-made quests are available for the Exploring Community section of this program. The first, “My Community Scavenger Hunt” is a simple, traditional scavenger hunt that could be used in any community, while the second, “Discover Greenville: A Downtown Scavenger Hunt,” is a more in depth program specific to downtown Greenville.

“Discover Greenville” may be more appropriate for older students, as a group project, or as an extension during a field trip.

In order to use it in a class setting, copy the document without the answers page or copy only the pages that you wish the students to answer. Many of the answers can be found online, and your students could participate in a virtual scavenger hunt.

*For younger students, you may want to excerpt the two page spread dedicated to Linky Stone Children’s Garden and include it as part of a field trip.

My Community Scavenger Hunt

- ___ A take-out menu from your favorite restaurant
- ___ A crayon rubbing of a historic marker
- ___ A photograph of your favorite place to play
- ___ A local business card
- ___ A drawing of an important place in your community
- ___ A map of something in your community
- ___ A brochure from a museum in your community
- ___ A photograph of an important building in your community and a description of why it is important
- ___ A crayon rubbing of a date from a building in Greenville
- ___ A photograph of one of the Mice on Main
- ___ A photograph of a Greenlink Bus
- ___ A drawing of the Reedy River
- ___ The front page of a local magazine or newspaper
- ___ A list of famous people from Greenville, SC
- ___ A photograph of a park in your community
- ___ A photograph of something that you would change about your community
- ___ Crayon rubbings of leaves from 10 different types of trees in Greenville
- ___ Something from a sporting event in Greenville
- ___ A photograph of a statue, and a description of the statue
- ___ The signature of someone important to your community
- ___ A flyer for a public event in Greenville
- ___ A picture of an interesting sign in your community
- ___ An item that shows the logo of a local sports team
- ___ Something from your community printed in a language other than English

Chapter 2: Land Use and Urban Surfaces

Close to 30% of the Earth's surface is land. Many different geologic processes go into creating landforms. The land is constantly changing as a result of these processes. Sometimes land is formed or destroyed quickly through processes like volcanic activity and earthquakes, and sometimes land is created or destroyed over a very long period of time by processes like plate tectonics or weathering.

For millions of years, geologic processes and other natural occurrences such as glacier movement, rain, wind, and the growth and death of plant and animal life were the major driving forces in how the land looked and what it was made up of. Then people came along. Early man probably altered the land little more than other animals, mainly building shelters and gathering food. Approximately ten thousand years ago, with the domestication of the first crop plants, humans began to alter the natural environment more drastically. Today, people are a major driving force in shaping what the land looks like and what it is made up of.

The sections in this chapter will focus on human interaction with the land, how we change and alter the land, the consequences of poor land use, and some land use issues specific to an urban environment.

WHAT IS LAND USE

Learning Objectives

Students will

- understand the general concept of land use and become familiar with some of the most common types of land use
- explore the concept of land use in their community and discuss the types of land use that they see on a daily basis
- research an area in the City of Greenville and determine how the land has changed over time

Background Information

People alter the land around them all of the time in a variety of ways. The way in which people use the land is described by the term *land use*.

Land use as a delineation technique is used in many fields by people like planners, law and policy makers, resource managers, and scientists. In an urban environment, land use is often designated and "zoned."

Land use is an extremely complex issue. The scope of this lesson is to explore some of the most common land uses that might be found in and around Greenville, SC, specifically, agriculture, forestry, developed/urban, mining, and industrial.

Word Bank

Land Use
Urban
Agriculture
Silviculture
Forestry
Mining
Environment
Cultivate
Clear Cut
Legacy
Infiltrate
Barrier
Soil Profile
Humus
Top Soil
Hydrology
Water Table
Ground Water
Conservation
Monoculture
Topography
Desertification
Development
Ecosystem
Permeable
Impermeable
Urban Heat Island
Remediation
Brownfield

What Is Land Use Journal Prompts

List 10 reasons that people need land.

Describe a way that people use land, and explain why this land use type is important to society.

List five differences between the way that the land looks in a city and the way that land looks in an undeveloped area.

Pretend that you are an explorer from a place with no cities and you are visiting the City of Greenville. Write a letter home describing the City. Make sure to use imagery that describes the way the City looks, smells, and sounds.

Research an energy source that people use and describe the impacts that the harvesting of that energy resource have on the land. (coal, natural gas, solar, oil, geothermal, hydroelectric, nuclear, wind, biofuels)

Agriculture: growing crops or raising livestock for human consumption or use. One of the first ways that people altered the land was through agriculture. Agriculture is the world's oldest industry.

There are two main types of agriculture: growing crops and raising livestock.

Growing Plant Crops

- Land alteration to grow plant crops has a long history. Ancient people purposefully altered the land to grow crops by cutting trees, forming slopes into terraces, diverting streams for irrigation, and through the planting of crops.
- Modern agriculture takes land alteration even further. Conventional agriculture (large farms) clear large areas of land, use machines to aerate and move soil, alter the soil nutrient content through chemical fertilizers, and draw water from rivers, lakes, and underground aquifers for irrigation.

Raising Livestock

- Early farmers that raised animals may have cleared land and built fences.
- Modern livestock operations can have large impacts on the land. Land is still often cleared. The vegetative community of an area may be altered drastically by the grazing of large numbers of animals. Animals also alter the soil through a variety of ways. Some animals aerate the soil and add nutrients while others may compact the soil. Animal operations also require large amounts of water and can have a high impact on the chemical makeup of nearby water bodies through nutrient loading of the water in the form of animal waste being washed into streams, rivers, and ponds.

The consequences of various types of land use are discussed in more detail in the next lesson in this series. For this lesson, it is most important that students are introduced to many of the ways that people alter the land.

Forestry: the management of forests for the harvest of forest products as well as conservation of forests as ecosystems.

People use trees and forests for a variety of things. Trees alone provide people with food products in the form of nuts, seeds, fruit, and syrups, as well as other materials including dyes, paper, medicines, and wood.

Forests are complex ecosystems. The management of forests and study of forestry is a complex science. The way a forest is managed depends on what it is being managed for. Some forests are primarily managed for the harvest of trees for lumber or paper while other forests are managed as habitat for wildlife like white-tailed deer, quail, or rabbit. Often, forestry management is complex and takes into account a variety of needs such as harvesting, recreation, aesthetic values, and ecosystem services (water quality, protection or restoration of soil, and air quality).

Plantation forestry – areas are planted with a single species of tree specifically for harvest. In South Carolina, the most common species of tree planted in plantations for harvest is the loblolly pine. These trees are mainly harvested for lumber, pulp, and paper.

- Single age stand – plantations are seeded at the same time, and every tree is the same age.
- Multi age stand – more than two different age classes of trees are grown in an area.
- Clear cut – a large stand of trees or an area of forest is completely cleared. Usually for timber harvest, but clear cuts are also often done prior to new development or agriculture.
- Selective logging practices – there are a variety of techniques for harvesting trees that do not involve clear cutting an area. Sometimes less desirable trees are removed to allow the desired trees to grow, or trees of a certain size or age class may be harvested. Areas managed for selective logging are often managed for other uses such as recreation, ecosystem services, and wildlife conservation. Selective logging practices can be less impactful than clear cutting because they leave much of the forest intact and may take into account the habitat needs of other plants and animals present in the ecosystem.

Mining: the extraction of resources from within the Earth.

Though it is most common to think of a mine as a place where precious metals such as gold and silver are removed from the Earth, many resources are mined including coal, salt, stone, oil, clay, lead, natural gas, copper, and more. Mining provides people with many of the raw materials we use in everyday life. There are two major categories of mining:

- Surface mining - a method of removing earth materials from close to the surface of the land by removing the plants and soil covering the material being mined in strips.
- Subsurface mining – a method of mining that involves drilling into the earth to reach and extract the material.

Mining in South Carolina:

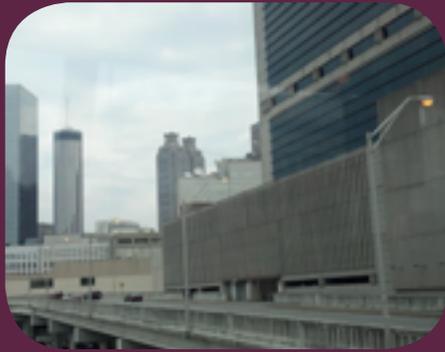
According to SC Department of Health and Environmental Control (DHEC), there are 540 active mine operating permits in South Carolina as of 2012. The South Carolina Mining act, passed in 1974, states that mined lands must be reclaimed into usable land following the mine’s decommission. South Carolina has no subsurface mining operations but has a variety of surface mining operations including open pit mines and strip mines. The commodities mined in South Carolina include clay, sand, granite, limestone, shale, vermiculite, peat, gravel, kaolin, and gold.

Online Resources

<http://www.dnr.sc.gov/geology/images/Mining-pg.pdf>

<http://www.scdhec.gov/environment/lwm/html/mining.htm>

<http://www.scmines.com/education.html> (Video on mining in South Carolina)



*Urban development examples
Top: City of Atlanta, GA
Bottom: A silt fence to help control
erosion in Greenville, SC*

Developed: Cities are defined as areas where development is concentrated. Land that is developed for a city is changed in many ways. Often, the physical structure of the land is altered when it is graded or terraced in order to build buildings. Roads, parking lots, buildings, and other structures are placed on top of the land. Plants are cleared, and other plants are brought in for landscaping purposes, altering the natural community structure of the area. In some urban areas, rivers and streams are canalized, moved, or dammed to harvest water.

Urban areas are important centers of development for people and can include land used for a variety of purposes such as residential, industrial, recreational, and green space.

Industrial: the use of land for manufacturing, factories, powerplants, refineries, and other activities that usually require large equipment. Industrial land use can occur in rural or urban areas. Industrial land use often requires a large amount of space dedicated to buildings and heavy machinery. Industry creates most of the materials, technology, and power that people use on a day to day basis.

Other

Conservation: land set aside for the protection of natural areas, communities, and resources.

There are many more categories that land use could be placed into, but these represent some of the most widely used and impactful.

What is Land Use Activities

Brainstorm categories for how people use land.

Before discussing the major types of land use, divide the class into groups and assign or allow the groups to choose a major type of land use. Ask the students to brainstorm in their group to answer the following questions as best they can.

- Why do people use the land this way?
- In using the land for this purpose, is it changed from its natural state?
- How?
- Have you seen this type of land use? If so, describe it.
- Is this type of land use taking place today? In the state of South Carolina? Greenville County? In the City of Greenville?

After the brainstorming session, present each type of land use to the class.

The Land I See

Take a class walk and note the ways that people use the land.

What are the defining features that tell us how people use the land?

Brainstorm what the land might look like if there was no city here.

Research an area in the City of Greenville to see how the land has changed over time. Depending on the accessibility of internet access, this could be a small group or a class wide project.

Use the City of Greenville's historic imagery database to see how the land has changed over the last 60 years.

<http://gis64.greenvillesc.gov/historicalimagery/>

Bring the website up for the class and demonstrate how to use the various tools to search, zoom, move around the map, mark a spot, and change years. Once the class is familiar with the site, either use the worksheet on the next page, or develop your own set of locations and questions for the class to use to explore how Greenville has changed.

Read the news, and discuss the ways that the article mentions that Greenville has changed. Discuss why change can be a good thing, and why change can be a negative thing for a city.

Greenville News Article: Though treasures have been lost, downtown finds value in history

<http://www.greenvilleonline.com/apps/pbcs.dll/article?AID=2013304280002>

Bring in a bag full of simple household items (pencil, cotton ball, paper clip, paper bag, plastic bag, etc) and ask students to **sort the items into categories** of resource type and then into categories of land use.

Example: Paper clip: metal (nonrenewable): mining
Paper bag: plant (renewable): forestry

HOW LAND USE CHANGES USING HISTORIC IMAGERY TO EXPLORE LAND USE PATTERNS OVER TIME

Directions:

Look up the address of your assigned location and go to the City of Greenville's historic imagery database: <http://gis64.greenvillesc.gov/historicalimagery/>.

Type the address for your location into the search feature.

Use the push pin icon to place a "pin" on the structure that is the focus of your investigation.

Next, use the sliding arrows to view aerial photos from 1955 to the present.

<p>A J Whittenberg Elementary School: 420 Westfield Street</p> <p>1) After what year was the school built?</p> <p>2) What do you think this land was used for in 1989?</p> <p>3) Between which years was Academy Street built?</p> <p>4) Between which years does it look like the largest change in land use occurred in this area? Explain</p>	<p>The BiLo Center: 650 N. Academy</p> <p>1) After what year was the BiLo Center Built?</p> <p>2) What did the land that the BiLo Center is on now look like in 1955?</p> <p>3) Between which years does it look like the largest change in land use occurred in this area?</p> <p>4) Other than the building of the BiLo Center, how did the land in this location change between 1965 and the present?</p>
<p>Fluor Field: 945 S. Main St</p> <p>1) After what year was Fluor Field built?</p> <p>2) What is the name of the road that used to cross the land that Flour Field is now on?</p>	<p>Location of choice Address: _____</p> <p>1) Has their been a change in the way the land was used at this location?</p> <p>2) If so, describe the land use before and after the change.</p>

Describe a way that land use has changed in the City of Greenville over time. How do you feel about the way the land has changed?

HOW LAND USE CHANGES USING HISTORIC IMAGERY TO EXPLORE LAND USE PATTERNS OVER TIME

Directions:

Look up the address of your assigned location and go to the City of Greenville's historic imagery database: <http://gis64.greenvillesc.gov/historicalimagery/>.

Type the address for your location into the search feature.

Use the push pin icon to place a "pin" on the structure that is the focus of your investigation.

Next, use the sliding arrows to view aerial photos from 1955 to the present.

<p>210 S. Main Street (old City Hall)</p> <p>1) What was this building in the 1920's?</p> <p>2) After what year was this building demolished?</p> <p>3) Where is the current City Hall building in relation to the old?</p> <p>4) How has main street changed since the 60s?</p>	<p>Falls Park: 601 S. Main Street (approximate)</p> <p>1) What is the name of the road that went through the area that is now falls park?</p> <p>2) After what year was the road from question 1 built, and after what year was it removed?</p> <p>3) What other observations can you make about the land where Falls park is now located?</p>
<p>540 Buncombe Street: Heritage Green</p> <p>1) Describe 3 major changes that occurred in this area of Greenville and list the years in which that change occurred.</p>	<p>Location of choice Address: _____</p> <p>1) Has their been a change in the way the land was used at this location?</p> <p>2) If so, describe the land use before and after the change.</p>

Describe a way that land use has changed in the City of Greenville over time. How do you feel about the way the land has changed?

HOW LAND USE CHANGES: **TEACHER'S COPY**

USING HISTORIC IMAGERY TO EXPLORE LAND USE PATTERNS OVER TIME

Directions:

Look up the address of your assigned location and go to the City of Greenville's historic imagery database: <http://gis64.greenvillesc.gov/historicalimagery/>.

Type the address for your location into the search feature.

Use the push pin icon to place a "pin" on the structure that is the focus of your investigation.

Next, use the sliding arrows to view aerial photos from 1955 to the present.

<p>A J Whittenberg Elementary School: 420 Westfield Street</p> <p>1) After what year was the school built? 1997</p> <p>2) What do you think this land was used for in 1989? Vacant/underutilized: answers may vary</p> <p>3) Between which years was Academy Street built? 1965 and 1979 (must zoom out some to locate academy street)</p> <p>4) Between which years does it look like the largest change in land use occurred in this area? answers will vary</p>	<p>The BiLo Center: 650 N. Academy</p> <p>1) After what year was the BiLo Center Built? 1997</p> <p>2) What did the land that the BiLo Center is on now look like in 1955? residential neighborhoods. Many small buildings</p> <p>3) Between which years does it look like the largest change in land use occurred in this area? Answers will vary</p> <p>4) Other than the building of the BiLo Center, how did the land in this location change between 1965 and the present? Beatie Pl was extended, while other roads were removed. More impermeable surfaces today</p>
<p>Flour Field: 945 S. Main St.</p> <p>1) After what year was Flour Field built? 1997</p> <p>2) What is the name of the road that used to cross the land that Flour Field is now on? Green Avenue</p>	<p>Location of choice Address: _____</p> <p>1) Has their been a change in the way the land was used at this location?</p> <p>2) If so, describe the land use before and after the change.</p>

Describe a way that land use has changed in the City of Greenville over time. How do you feel about the way the land has changed?

HOW LAND USE CHANGES **TEACHER'S COPY** USING HISTORIC IMAGERY TO EXPLORE LAND USE PATTERNS OVER TIME

Directions:

Look up the address of your assigned location and go to the City of Greenville's historic imagery database: <http://gis64.greenvillesc.gov/historicalimagery/>.

Type the address for your location into the search feature.

Use the push pin icon to place a "pin" on the structure that is the focus of your investigation.

Next, use the sliding arrows to view aerial photos from 1955 to the present.

<p>210 S. Main Street (old City Hall) 1) What was this building in the 1920'S? Post office (1920's street map)</p> <p>2) After what year was this building demolished? 1965</p> <p>3) Where is the current City Hall building in relation to the old? On the same block on Main St. (current street view)</p> <p>4) How has main street changed since the 60s? The road is now 2 lanes with parking on either side instead of four lanes</p>	<p>Falls Park: 601 S. Main Street (approximate) 1)What is the name of the road that went through the area that is now falls park? Camperdown Way</p> <p>2) After what year was the road from question 1 built, and after what year was it removed? 1955 and 1997</p> <p>3) What other observations can you make about the land where Falls park is now located? Answers will vary</p>
<p>540 Buncombe Street: Heritage Green 1) Describe 3 major changes that occurred in this area of Greenville and list the years in which that change occurred. Answers will vary: Major changes include 1955 - 65 - buildings on college street demolished. Parking lot built on Marshall 1965 - 79 - new buildings built on college st, more parking on Marshal, and new rd: Heritage Green 1997 - 2011: parking lots removed and garage built. Large building (library) constructed. Atwood and Butler streets connected</p>	<p>Location of choice Address: _____</p> <p>1) Has their been a change in the way the land was used at this location?</p> <p>2) If so, describe the land use before and after the change.</p>
<p>Describe a way that land use has changed in the City of Greenville over time. How do you feel about the way the land has changed?</p>	

Picture the Difference

Greenville's Reedy River is a prime example of the way that development and the changing needs of society alters the land. The river was once utilized to power the textile mills that led to much of Greenville's early development and recognition as the "textile capital of the South." The Reedy River has been bridged, canalized, polluted by industry, and recently, restored and cleaned.

Imagine what the river would look like if Greenville had never been developed?

Use the photograph cards showing various types of land use to promote discussion (*example below*).

Ask students to note all of the ways they can see that the land has been changed by people. How can they tell? What do they think would the land look like if it was undisturbed by human development?

Landscape plants planted in specific places rather than natural plants

Bridge, road, fence, and other man made structures

Lawn: short, perfectly green grass is not found in the wild



River channel not natural: flow altered by people









LAND USE LEGACY

Learning Objectives

Students will

- explore the possible impacts that various types of land use can have on the land
- discuss ways that people can continue to use the land to meet their needs while protecting the environment and human health from negative land use effects

Background Information

The way that we use land has a huge impact on the natural environment. Different types of land use alter the land in a variety of ways. Most notably, land uses can have long lasting effects on topography, soil composition, hydrology, and the plant and animal communities that inhabit an ecosystem.

*Though all of these impacts interact, we will consider each separately for ease of comprehension.

The following informational sheets may be used as critical reading exercises, or for background for your lesson. Each sheet provides background information on a major land use category and then explores some of the ways that type of land use alters the land.

Critical thinking questions follow the background information sheets and could be used as individual or group assignments, as the basis for a class report, or as journal prompts.

The term legacy often refers to a gift or characteristic that is left behind once a person has passed away. Why do you think that this section is titled “Land Use Legacy?”

Imagine that it’s the year 2150, and there are no longer any people living in Greenville. The City has been empty for 100 years. What do you think the City would look like? Would you be able to tell that a city once stood here, and how?

Why is minimizing our impact on the land a goal of sustainable development? Is it possible to develop without impacting the land at all? Explain your answer.

Research the term “old field succession.” Use what you have learned to describe what an abandoned field from the 1800s might look like today. Do you think the same process would occur in a city? Why or why not?

Land Use Legacy: Agriculture

Agriculture: Background

When people use land to grow crops or raise animals for harvest, it is considered an agricultural land use. One of the first ways that people began using the land was for agriculture, and agriculture is considered by many to be the world's oldest industry.

Most modern agricultural systems plant crops in large groups of a single type of plant, called monocultures. Soil is tilled and often planted using large machines. Large machines are also used to harvest crops at the end of the growing season. Crop fields are usually irrigated, meaning that water is brought to the field through a series of pipes and sprayed or dripped onto the crops. These large farm operations,

sometimes called agribusinesses, also often use chemical fertilizers to enhance plant growth. Pesticides and herbicides are used to control pests and weeds that may reduce a farmer's yields.

Modern animal operations are often similar to plant operations in that a large number of animals are kept together, machinery is used for much of the care and harvest of the animals or animal products, and chemicals are employed to reduce pests and diseases. Conventional farm operations using the methods outlined above make up the majority of the agricultural land use in the US, but they are not the only way to grow plants and animals. Many farmers use other methods ranging from multi-crop systems where more than one

plant is grown in the same space to small farms using organic methods and free range animal operations.

Agriculture is an extremely important type of land use. Before agriculture, humans were hunters and gatherers that would have to move frequently to find food. Society as we know it would not be able to exist without agriculture. Farmers raise plants and animals that provide us with food, clothing, dyes, medicines, and much more. Yet, agriculture also comes at a price to the land.

Modern agricultural systems modify the topography, soil composition, hydrology, and plant and animal diversity of the land in a variety of ways.

Topography: The Shape of the Land

The topography, or shape of the land, is important for a variety of reasons. The shape of the land can affect which species of animals and plants can live there, how water moves over and through the land, and even the weather. Agriculture alters the shape of the land in many ways.

When farmers clear land for crops, they remove trees and large stones and boulders that were on the land. The space that will be farmed is graded

with large machines so that it is as flat as possible. Sometimes if an area is really steep or hilly, that includes building terraces, flat spaces that drop off quickly to another flat space. Terraces look like really large stair cases on the sides of hills. Sometimes stone or packed earth walls are used to hold the soil in place. Imagine how differently water moves over land that is a gently sloping hill compared to land that has been terraced.

Fields used for raising animals may not need to be terraced or tilled, but

many animals grazing in one space may compact the soil. Low-lying areas and wetlands also may be filled in order to use those spaces for agriculture.

Areas that were once farmed in the past but have reverted back to forests can often be distinguished from natural areas due to the altered shape of the landscape from terracing, clearing, and compacted soil. Old stone walls, dams, fences, and other structures from farming may also remain part of the landscape long after the farm is gone.

Hydrology: How water moves on and through the land

A natural ecosystem has plants and animals that have adapted to the amount of rainfall that the area receives. Plants grow by absorbing water from the ground, and their roots help increase the infiltration of rainwater into soil. Tree canopies and leaf litter slow rainfall, also increasing the amount of time water has to infiltrate the soil, joining the ground water.

Conventional agricultural systems, on the other hand, compact the soil, making it more difficult for rainwater to

infiltrate the soil and increasing surface runoff following a rain event.

In order to grow crops or animals, farmers need water. The water for irrigation or watering animals is often pumped from underground, removing water from underground storage areas called aquifers. Spray irrigation increases evaporation and thus water loss. Sometimes, aquifers receive more water from rainfall, which is known as recharge. If the soil is too compacted or too much water is removed from aquifers, the ground water may dry up, causing destabilization of the ground which can result in sinkholes where the ground itself collapses, and reducing

water input to streams.

Some farm operations dam streams or rivers. Dams alter the rate of flow and the composition of the water and create a barrier to movement for aquatic organisms. Finally, the input of animal waste, soil, and chemical pesticides and fertilizers can drastically affect water quality and the ability of aquatic systems to support life.



Soil Composition: The Physical and Chemical makeup of the soil

A natural grassland or forest that has not been farmed has soil that is made up of deep layers of organic matter built up over the course of many years. When plants and animals die and decompose, they become nutrients and organic matter in the soil. The roots of native trees or plants in forests and grasslands hold the soil in place and shade it. When plants die, the organic matter and nutrients that they used to grow go back into the soil to be used again.

When the land is cleared and farmed, at harvest time, organic matter is permanently removed from the soil since the plants are harvested and not

allowed to decompose. The soil is also exposed to sunlight which heats the soil, speeding up the decomposition of organic matter, and rainfall, which may wash away some of the soil in a process called erosion. Plowing and tilling also turn and expose soil to light and air which also speeds up decomposition and nutrient loss.

Growing the same plants year after year depletes the soil of certain nutrients and can also encourage the growth of insect pests and pathogens in the soil. Crop rotation systems minimize the risk of disease and some plants, such as beans, fix nitrogen, putting valuable nutrients back into the soil.

Areas that have been farmed for years often have less defined soil layers and less healthy soils than land that has

not been farmed. Over time, intensive farming in an area can lead to an overall loss of soil.

In order to combat soil nutrient loss, conventional farming makes use of chemical fertilizers to put nutrients back into the soil. Organic fertilizers and compost soil amendments, the use of winter cover crops to prevent erosion, (as well as shade the soil, and increase organic matter input), no-till agriculture, and rotational grazing are all agricultural practices that help reduce the negative impact of farming on soil composition.

Natural Communities: plant and animal diversity

Many of the ways that agriculture affects the land in turn alter the composition of animal and plant communities. Clearing land for crops or grazing animals removes trees and shrubs and excludes the animals that live in and among them.

Compacted soil is harder for water to infiltrate and harder for plants to grow in, because plant roots may not be able to penetrate compacted soil. So, due to soil compaction, grazing, and altered hydrology, agriculture can change

which plants are able to survive in an area.

The loss of soil nutrients due to agriculture also changes which plants are able to grow in the soil.

Large monocultures of plants encourage population explosions of insects and other pests that feed on those plants. Plants that grow quickly in high sunlight are often considered weeds in agricultural systems because they compete for water and nutrients with crop plants. Farmers use chemical pesticides and herbicides in order to control pests and weeds. If the pesticides and herbicides aren't

specifically formulated to kill just one species, they can kill non-target plants and animals, further altering the species composition of natural communities.

Finally, water runoff from farms carries chemical pesticides, fertilizers, soil, and animal waste into streams. All of these materials cause reduced water quality and alter the species composition of aquatic communities which are the basis for many terrestrial and aquatic food chains.



Land Use Legacy: Urban Development

Urban Development: Background

When people develop a large area of land for commerce, industry, and living, this is considered urban development. Historically, urban areas, also called cities, often grew up around centers of transportation, where people would congregate to trade goods that they could not make or grow themselves. Walls made the city more defensible than the surrounding countryside. Cities eventually became areas where centers of learning, religion, and art were concentrated.

A city can be thought of as an



area of concentrated population and development. The buildings within a city are generally taller than buildings in more rural areas in order to fit the activities of more people into less space.

Cities have a wide variety of effects on the natural environment. Since development is concentrated, cities tend to have higher rates of pollution than rural areas. Cities generally

have fewer plants and trees and more buildings, roads, parking lots and other structures than rural areas. These alterations in the landscape result in urban areas being warmer than surrounding rural areas, a phenomenon known as the “urban heat island effect.” Cities are made up of a network of transportation corridors, buildings, infrastructure, and green space. Each of these has its own purpose and associated environmental effects. Thus, urban development can be thought of as a combination of multiple types of land use with a wide range of possible land use legacies.

Topography: The Shape of the Land

When people build cities, they alter the shape of the land in many ways. In order to place a building, parking lot, or road on the land, plants are removed from the land, and then the land must be flattened. This is often done with large machines which first move the soil around and then grade and compact it. In order to develop a large section of land, low lying areas and wetlands are often filled in and vegetation and large boulders are removed. Features such as rivers or ravines are sometimes moved, and other times bridged.



Hydrology: How water moves on and through the land

Urban development can have many effects on the hydrology of an area. Often, when cities were built in the past, they were built along bodies of water. Rivers are natural transportation corridors, allowing the movement of people and goods along the river from one place to another. Rivers also provided power for early grist mills and may still provide power in the form of hydroelectricity. Sometimes, people physically alter the shape and placement of rivers by building canals, dredging, or moving the river.

In some urban areas, dams or locks have

been built along rivers to either harness electricity or create reservoirs for water storage or recreation. Dams have many effects on the way that water moves and the downstream ecosystem. Dams are physical barriers to movement and may keep animals such as fish from moving upstream to breed. Often, when water is released from the dam, it is a different temperature than water in the river. Temperature can alter the water’s ability to support aquatic life. Dams also change the rate of flow in the river downstream of the dam.

The large amount of buildings, parking lots, and roads in urban areas also alters the hydrology of the area. These surfaces, called impermeable surfaces,

do not allow water to soak into the soil, but instead funnel water into drains that run directly to rivers and streams. Large amounts of impervious surfaces result in lower base flows for rivers because less water is reaching the ground water table in urban areas. Also, during rain events, there is an increase in the amount of water reaching the river due to surface runoff. That surface runoff is often polluted because it flowed over roads and parking lots, picking up trash and chemicals on the road. High surface runoff may result in flooding and reduced water quality in rivers and streams.

Soil Composition: The Physical and Chemical makeup of the soil

When land is prepared for development, the top layer of soil is often moved and the remaining soil is compacted and



graded so that it is flat. Without the protective layer of plant covering that is usually present, soil is vulnerable to wind and rain and erosion is increased. When soil is washed into rivers and streams, it can harm the animals and plants that live in the rivers and streams, and it can also raise the level of the water, leading to flooding. Soil in developed areas is often compacted. Soil compaction can occur quickly when machinery is driven over an area or over a long period of time by heavy foot

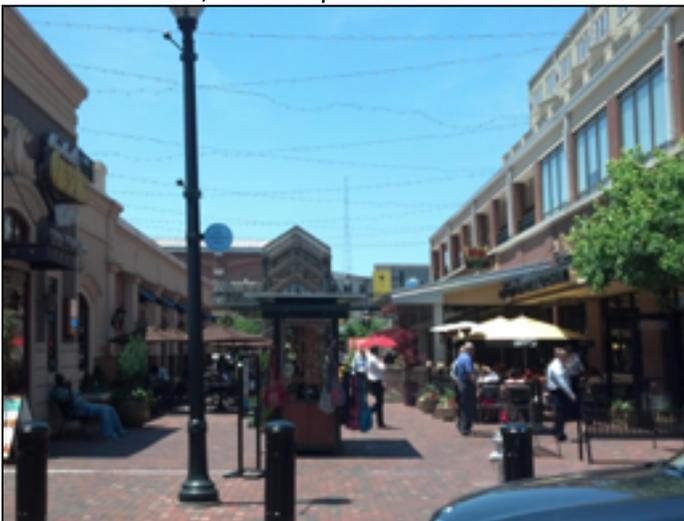
traffic. Wet soils are more vulnerable to becoming compacted than dry soils. Compaction occurs when soil is pressed, removing air pockets. Compaction makes it more difficult for plant roots to become established and for water to infiltrate the soil. Less plant cover and lower rates of water infiltration result in increased erosion, increased storm water runoff, and lower surface water quality. Soil compaction is very important and necessary for buildings and roads. Without a compacted, stable base, buildings and roads settle and crack over time, which can be dangerous. But, in areas of land left undeveloped, soil compaction can cause many negative environmental impacts.

Natural Communities: plant and animal diversity

Urban development can drastically alter the plant and animal diversity of an area. A common approach to development is to remove all of the plants and animals that were present in an area, build the development, and then strategically landscape the development with new plants. Many of the plants used in landscaping can become invasive. Invasive species are living organisms that are not native to an area but are brought in from somewhere else, often another country. Once established, invasive species cause

environmental or economic harm. Not all landscape plants are invasive, but the ones that are can quickly take over an area, out-competing native plants. Invasive plants can be a concern in the urban environment as well as nearby undeveloped areas that they may spread to. Whether native plants are removed for development or crowded out by invasive species, plant diversity is often lower in urban areas than in surrounding rural and undeveloped areas. A loss of plant diversity leads to a reduction in animal diversity because animals need plants for food and shelter.

Urban development alters the structure of animal and plant communities in many ways. Urban areas are often noisy, bright and full of traffic and hard surfaces. Some animals, especially nocturnal scavengers like raccoons, and small animals that can move around easily, such as birds, can adapt well to living in an urban environment, while others are unable to survive in urban conditions. Buildings, factories, roads, bridges, parks and green spaces are all part of the network that makes up urban development, and all of these alter plant and animal diversity in a variety of ways.



Land Use Legacy: Forestry

Forestry: Background

Forests are complex ecosystems that are managed by people for a variety of different reasons. Some of the most common concerns of forest managers include growing trees for harvest, providing wildlife habitat, use of forests for recreation and aesthetic value, and the provision of ecosystem services such as conservation and restoration of soil quality, air quality, and water quality. Because forestry is such a complex issue, we will mainly discuss the management of forests for the harvest of trees and tree products such as paper and timber, but it is important to understand that forests are often managed for a variety of associated products and services.

Topography: The Shape of the Land

When forests are managed for ecosystem services, recreation, aesthetics, and wildlife habitat, few if any changes occur in the topography of the land. Some movement of soil or gaps in the forest canopy due to tree falls is natural, and forest ecosystems are adapted to dealing with a certain level of disturbance.

Clear-cutting, on the other hand, can have a major effect on the topography of the land. Large machines used for

Hydrology: How water moves on and through the land

In the presence of sunlight, trees combine water and carbon dioxide to make food. Trees absorb water through their roots and transport it upward to the leaves and branches through the xylem. When sunlight heats the leaves of a tree, some water is lost through small holes in the leaf called stomata. This process is called transpiration. According to the USGS, a large oak tree can transpire 40,000 gallons of water a year.

The absorption and transpiration of water from the soil creates spaces in

Trees have been grown and harvested by people for a very long time. Wood has been one of the most common building materials and sources of fuel for as long as human civilization has existed. Today, trees are mainly harvested for use as building materials, paper, and firewood as fuel for cooking and heat.

When a single species of tree is planted for harvest in a large stand, that stand is called a tree plantation. Plantation trees can be planted at the same time so that all of the trees are the same age or planted in series so that there are at least three different ages of trees, but all trees are the same species. Often, trees are harvested from forests that were not planted as plantations but are instead mixed species forests.

clear cutting create compacted soil in some areas and ruts, gullies, and loosened soil in others.

Trees and shrubs have roots that anchor soil in place and a canopy of branches that slow rainfall. If all of the trees in an area are removed the protective canopy disappears. When rain falls on a bare patch of ground, the speed of the rain hitting the ground is much higher than under a forest canopy. Without the anchoring effect of tree roots, topsoil is much more likely to be washed away by rain.

the soil that do not have water in them. During a rain event, water is more likely to infiltrate the soil to fill the spaces in the soil than to stay on top of the soil. Canopies also slow rainfall, which increases infiltration.

Removing trees, especially through clear-cutting, changes this dynamic. Rainfall hits the ground harder and is less likely to infiltrate the soil. Evapotranspiration rates are much lower, and surface runoff is higher. Combined with compacted soil and increased erosion, the impact of tree removal on water bodies is an increase in surface runoff and a higher probability of flooding. When surface

There are many different ways of harvesting trees for wood, and each have different consequences. The first method of harvest is clear-cutting. When a forest is clear-cut, all of the trees in an area are removed at one time. As an alternative option to clear-cutting, forests can be harvested through a process called selective logging. When a forest is selectively logged, only a few trees are cut so that there are older trees available to produce seeds, and spaces for young trees to grow. Selective logging is often considered a more environmentally friendly alternative to clear-cutting, but it can be more labor intensive, time consuming, expensive, and yield less of an immediate profit.



Clear cut areas are prone to higher levels of erosion and increased frequency of landslides than areas that remain covered with forests. This may result in gullies and exposed areas of bedrock.

runoff occurs, eroded soil and nutrients will flow over land into water bodies. The lack of trees shading streams increases water temperature. Increased temperature, nutrients, and soil in the water reduce the amount of dissolved oxygen in the water, which in turn reduces water quality and the ability of a water body to support life. Finally, ground water infiltration is lower in areas that have been clear cut, which alters the underground flow of water as well as the above ground flow. Less ground water can cause a reduction in the base flow of rivers and streams.

Soil Composition: The Physical and Chemical makeup of the soil

When trees are removed from an area that was previously forested, the soil is exposed to sunlight and rainwater. The sunlight heats the soil and increases the breakdown of organic matter in the top layers of soil, and the rainwater traveling across the soil increases erosion. Topsoil, the layer of soil that is full of nutrients and organic matter is lost quickly, making the soil less healthy and harder for plants to grow in.

Heavy equipment used to cut and remove trees causes the soil to be compacted. Soil compaction can occur when machinery is driven over an area or over time by heavy foot traffic. Wet soils are more vulnerable to becoming

impacted than dry soils. Compaction occurs when soil is pressed, removing air pockets. Compaction makes it more difficult for plant roots to become established and for water to infiltrate the soil. Less plant cover and lower rates of water infiltration result in increased erosion, increased storm water runoff, and lower surface water quality in nearby bodies of water.

The chemical and biological structure of soil is also affected by logging. Trees use nutrients in the soil to grow. When trees are cut down and removed from an area, the nutrients in their tissues are also removed. If a tree falls naturally in a forest, it will decompose, returning nutrients from the tree to the soil which will be used by other plants and animals. Over time, removing trees

from a forest will deplete the nutrient content of the soil, making the forest less productive.

Selective logging causes less soil compaction and leaves some trees to shade the soil and continue contributing leaves and branches to the humus layer of the topsoil. Though some biomass is removed from the forest, much is retained, helping to protect the soil while still providing people with timber.

Natural Communities: plant and animal diversity

Forests are complex ecosystems that provide homes for many plants and animals. Altering the structure of a forest by removing trees can have a variety of impacts, both positive and negative.

Some forest species need sunlight in order to grow. Selective logging creates gaps in the forest canopy that can be colonized by species that need more sunlight than is available in mature forests. Like natural tree falls, this may increase species diversity of plants

which provide food and shelter for animals, thus increasing the diversity of the animal community.

Clear-cutting, on the other hand, removes all of the vegetation from an area and completely alters the ability of the land to support plants and animals. Plant species that need a lot of sunlight are the only ones that can grow and survive, creating a very different plant community than in a forest with gaps. Over time, the forest may grow back if the topsoil is not all lost to erosion, but it will take much longer than if the area is selectively logged.

When trees are cleared, the animals

that depend on them no longer have food and shelter. Some species of animals only make their homes in old hollow trees, or only eat the nuts or berries produced by trees that grow in mature forests. When an area is clear-cut, these species have to find new homes or they won't survive. Because of the interdependency and complex relationships between plants and animals in forest ecosystems, forest managers have a lot to consider when they determine the best way to harvest trees from a forest



Land Use Legacy: Mining

Mining: Background

Mining is defined as the extraction of materials from the land. Many of the raw materials that humans use on a daily basis come from mines. Though people often think of mines as holes in the ground where gold or other precious metals are found, there are many different types of mining operations, and the effects that mining operations have on the land vary widely depending on the way that the resource is extracted, and what resource is being mined in a particular area.

Mining operations are broken into two main categories, subsurface and surface mines. Surface mines include strip mines, pit mines, and mountain top removal. All of these extraction

methods involve first removing plants from an area, and then removing soil so that the materials that are being mined can be reached.

Subsurface mines are used for extracting materials that are very deep in the earth. In subsurface mining, a tunnel or a shaft is carved into the earth in order to reach the materials being extracted.

Many items are mined. Some of the materials extracted from mines include gold, copper, granite, sand, oil, coal, gemstones, clay, and even salt. Each type of mine has a different impact on the surrounding environment based on what method of extraction is used, what equipment is used, and what materials are being extracted. Some mining operations use hazardous

chemicals, others use large amounts of water and heavy machinery, while still others use large amounts of explosives. This summary of mining impacts should be considered to be a basic starting point, and not a complete overview.

Topography: The Shape of the Land

Mining has one of the largest impacts on topography of any type of land use. By definition, mining is the extraction, or removal, of resources from the land. Removing part of the land is essential to mining activities.

Surface mines have the most visible impact on topography. Most surface mines include large scale removal of soil and rock in order to reach the materials being mined. Pit mines, strip mines, and mountaintop removal involve large

equipment, heavy machinery, and often include controlled explosions in order to operate the mine. Soil near the mine may be compacted by the movement of heavy machinery, and the mine itself would undergo a wide variety of topographical changes such as the formation of pits or fissures, and the relocation of rocks and soil. In surface mining operations, the soil that is moved and relocated may have as large of an impact on the topography of the land as the mine does. A single mining operation may be the cause of

both a mountain top removal and a filled in valley.

Hydrology: How water moves on and through the land

The most obvious way that mining alters the hydrology of an ecosystem is in the way that surface water flows on the surface of the land due to the major shift in topography that a mining operation causes.

The flow of water over the surface of the land changes drastically in response to new land shapes caused by mining. Water may speed up, slow down, fill in new areas, create new water bodies, or infiltrate the soil at different points in response to changes in topography. Major alterations in hydrology can also

spread through a landscape, affecting a variety of downstream systems. For example, a new low point in the landscape may fill with water, diverting flow from a downstream wetland, causing that habitat to dry up.

The removal and disturbance of soil in a mining operation may also lead to an increase in soil erosion and increased deposition of sediments in rivers and streams. In turn, stream flow is impacted, as is habitat availability for aquatic organisms.

Mining operations often require large quantities of water to perform operations. Most water is used for processing minerals, but a large

increase in water use in an area can lead to depletion of groundwater sources. A decrease in the available water supply means that the amount of water required for recharging wetlands and other surface water bodies is also depleted, affecting organism that depend on those waters.

It is important to understand that the way that water moves through and over the land is impacted by many different factors, and that each pathway is a point in the larger system. One large alteration in land shape, such as a mine, will have many varied downstream effects on the hydrology of an area.

Soil Composition: The Physical and Chemical makeup of the soil

Mining can lead to a variety of changes in the physical and chemical makeup of the soil both on a mine site and in the surrounding area due to the transfer of soil and chemicals from mining sites due to erosion during rain events or due to accidents like spills of processing fluids or overflowing settling ponds.

One possible impact of mining is soil acidification. When soil materials that contain sulfur, such as pyrite, are exposed to air and rain water, the water and the sulfur creates sulfuric acid, lowering the pH of the soil. Soil acidification can negatively impact the biodiversity of soil bacteria and microbes and alters the availability of

nutrients and metals to plants. Some metals, such as aluminum, which is toxic to plant roots, become more mobile in acid soils, causing stunted root growth and harming plants. Acid mine drainage can also affect surface and ground water, harming fish and aquatic plants and thus damaging aquatic ecosystems.

Another possible chemical impact of mining is poisoning. Chemicals such as cyanide are used to separate the valuable minerals from unwanted minerals at mines. These chemicals can be released into the environment on mine sites, settling in the soil and poisoning plants and animals, making it difficult to reestablish a natural community on and near abandoned mining sites.

Natural Communities: plant and animal diversity

Due to how mining causes a wide variety of environmental changes including; land disturbances, altering the topography, hydrological cycles, and soil composition of the land, plant and animal environments are also disturbed. These large scale environmental changes can make it difficult for organisms to survive.

Different mining operations each yield different environmental impacts and vary according to location. Surface mining, for example destroys

landscapes, forests, and wildlife habitats when the ground is cleared in order to make room for mining operations. This means that many animals have to find a new home, ecosystem processes are disrupted, and plants are no longer there to anchor the soil, leading to soil erosion. Furthermore, the presence of mine tailings and chemicals makes it difficult for plants to regrow and alters the chemical composition of the soil.

When water mixes with many unearthed rocks and minerals due to mining, it can create a toxic water known as acid mine drainage. Acid mine drainage may contaminate

groundwater, streams, soil, plants, and animals. In turn, acid mine drainage can have a negative impact on human health and the health of the entire ecosystem.

Critical Thinking Questions for Land Use Legacy

Agricultural Land Use

- 1) Choose one of the four topics and summarize how agricultural land use affects either topography, soil composition, hydrology, or natural communities.
- 2) List three ways that farmers can reduce the impact of agriculture on soil composition. Choose one of the three and explain why you think doing this is beneficial to soil composition.
- 3) In your opinion, which of the four main ways that agricultural land use affects the land is the biggest concern? Why?
- 4) You are in a forest that was farmed 200 years ago but is now wooded again. Name three ways that you might be able to tell that the land was once used for farming.
- 5) How is stream water quality affected by agriculture, and why is water quality important?
- 6) Choose a negative impact of farming on the land and describe a way that you would minimize that impact.

Urban Development

- 1) Choose one of the four topics and summarize how urban development affects either topography, soil composition, hydrology, or natural communities.
- 2) List 4 aspects of urban development that you think are the same in any city.
- 3) In your opinion, which of the four main ways that urban development affects the land is the biggest concern? Why?
- 4) What is an invasive plant, and why are invasive plants an environmental concern?
- 5) Choose a negative impact of urban development on the land and describe a way that you would minimize that impact.

Forestry

- 1) Choose one of the four topics and summarize how forestry affects either topography, soil composition, hydrology, or natural communities.
- 2) Which has a greater environmental impact; selective logging or clear-cutting? Explain why and how.
- 3) What is soil compaction, how does it happen, and why is it a concern?
- 4) List 10 benefits that people receive from forests.
- 5) Choose a negative impact of forestry on the land and describe a way that you would minimize that impact.

Mining

- 1) Choose one of the four topics and summarize how mining affects either topography, soil composition, hydrology, or natural communities.
- 2) In your opinion, which of the four main ways that mining affects the land is the biggest concern? Why?
- 3) Which do you think has a greater environmental impact, surface mining or subsurface mining? Why?
- 4) You are in a forest that was a surface mine 200 years ago but is now wooded again. Name three ways that you might be able to tell that the land was once used for mining
- 5) Choose a negative impact of mining on the land and describe a way that you would minimize that impact.

Land Use Legacy Activities

Tour a farm, forest, and/or mine, and learn about the ways that these land uses impact the land and what is being done today to reduce these impacts.

OR

Invite a small farmer, forestry professional, or mining professional to visit your class and speak to the students about the impacts of land use on the environment and what is now being done in their industry to mitigate these impacts

Possible Resources:

- To find a local farm willing to do tours, check with your county extension office
- Search for a local farm
<http://www.certifiedscgrown.com/Certified/Members>
- Contact a forestry professional through the SC Forestry Commission
<http://www.state.sc.us/forest/>
- Contact a mining professional through the Mining Association of South Carolina
<http://www.scmines.com/>

Perform a soil comparison analysis.

One of the ways that land uses affect the environment is by altering the physical and chemical make up of the soil.

Collect multiple soil samples from different areas and perform simple soil analyses.

Students can work in groups to test the samples and determine if the soils are different in size of particles, color, pH, and any other parameters that you have the equipment to test.

More ideas and activities for studying soil

<http://www.brainpopjr.com/science/land/soil/grownups.weml>

Have students read the article “What is Biodiversity” from the National Wildlife Federation and discuss why biodiversity is important along with how land use by people may impact biodiversity.

One of the ways that land use affects the environment is by altering the species composition or diversity of plant and animal communities.

Perform simple vegetation surveys in order to determine if there is a difference in plant communities at a location based on variation in the way that the land is used.

**It is important to choose two sites very close together so that it is less likely that a difference in plant communities would be due to natural variation.*

Terminology:

species richness - the number of species found in an area

species diversity - a measure of variation of organisms found in a community that takes into account both the number of species in the habitat and the density of organisms of each species

Sampling procedure may be varied based on the age of the students and the instructor’s comfort level with plant identification.

Materials:

Meter sticks

Pencil and paper

Bean bag or sock filled with beans

Methods:

- Divide students into small groups. Each group should sample at least one plot in each land use type.
- Give each group 2 meter sticks and show them how to create and mark a square meter plot on the ground.
- In order to randomize the sample as much as possible, have the groups spread out along a transect line and ask one student in each group to close their eyes and throw the bean bag. The place where the bean bag lands should be the center of their plot.
- Students should count how many species (or different types) of plants are in their plot. Older or more experienced students can also note the life form of the plants (herbaceous, tree, shrub, grass, vine).

Once students have collected and recorded the total number of plants in their squares and the number of different species in their squares, compile the data.

For each plot, calculate

Density (species abundance) = # of plants per unit area

Species Richness = # of species per unit area

For each sampling area calculate

Relative Abundance of each species = $X/Y * 100$

X = # of individuals of species A

Y = total # of individuals

After compiling the data, interpret and discuss:

Which land use type had a greater species richness?

What does this imply?

Was there a difference between plots?

What does that tell us about species density and richness?

What conclusions can you draw from your survey?

Close your eyes and imagine that you are standing outside in the city. Then, imagine you are outside in the country. How is the ground different? Why?

What does permeate mean, and how does that term relate to the way that we use the land?

If cities are warmer than the surrounding countryside, how might that affect plants and animals that live there?

Research the term “Low Impact Development.” Why are impermeable surfaces an important part of this concept?

How do impermeable surfaces contribute to lower base flow of urban rivers and why is this a concern for people?

URBAN SURFACES PERMEABLE VS. IMPERMEABLE

Learning Objectives

Students will

- learn the difference between permeable and impermeable surfaces
- discuss ways that buildings, roads, and other impermeable surfaces impact the environment

Background Information

Urban areas are generally highly developed and populated by humans compared to other types of land use. One major way that people alter the land in urban areas is through the creation of buildings, roads, sidewalks, parking lots, and other covered surfaces. Surfaces that do not allow water to penetrate to reach the soil are called impermeable surfaces.

Impermeable surfaces affect the urban environment in a variety of ways.

- The dark color of roads, parking lots, and roofs absorbs heat, contributing to the urban heat island effect.

An urban heat island is a developed area that is hotter than the surrounding rural area. According to the US EPA, a city of 1 million people can be 1-5 degrees F hotter during the day and up to 22 degrees F hotter at night. This may not seem like much, but a few degrees can have a big impact on energy costs, increase air pollution, and even lead to increased mortality rates.

- Impermeable surfaces do not allow water to infiltrate into the soil leading to

An increase in the volume and speed of storm water runoff; water washing over the surface of the ground during and following precipitation events

Decrease in water quality of rivers, streams, ponds, and lakes due to pollutants such as litter, oil, gasoline, soap, pet waste, fertilizers, and sediment washed into water bodies by storm water runoff.

Slower recharge of underground aquifers and less flow of ground water. Since water cannot seep into the ground, water that is removed from aquifers through wells and pumps for irrigation is not replaced. This leads to less ground water. A loss of ground water can lead to other problems such as the formation of sinkholes or the infiltration of salt water into fresh water aquifers.

Lower base flow of urban streams and rivers due to lower levels of ground water. Lower base flows mean lower water levels in general which can contribute to lower levels of Dissolved Oxygen and thus lower water quality.

Increase in the temperature of water bodies due to stormwater absorbing heat from dark road surfaces prior to washing into streams and rivers.

Decrease in the level of Dissolved Oxygen that water can hold due to increased temperature. Dissolved Oxygen is essential for aquatic life to survive.

Urban Surfaces Activities:

Research the Urban Heat Island Effect using the Environmental Protection Agency's (EPA) website. Assign each student one of the following pages and ask them to read the page and then choose two important facts about heat islands to present to the class.

<http://www.epa.gov/hiri/about/index.htm>

<http://www.epa.gov/hiri/mitigation/trees.htm>

<http://www.epa.gov/hiri/mitigation/greenroofs.htm>

<http://www.epa.gov/hiri/mitigation/pavements.htm>

Impermeable surface survey

Demonstrate for the class:

Go to the City of Greenville's Historical Imagery Database.

<http://gis64.greenvillesc.gov/historicalimagery/>

Using only the most current aerial photos, zoom all the way in to the image somewhere within the city limits of Greenville. You may use the search address tool, represented by the binoculars icon at the top of the screen to find specific addresses, or choose at random.

(Google Earth or another mapping tool would also work for this exercise.)

Estimate the percent of the land covered by impermeable surfaces. Remind the students that buildings, roads, parking lots, and sidewalks are all examples of impermeable surfaces.

Estimate the percent of the land covered by permeable surfaces.

Estimate the percent of the land covered by water.

Either provide the class with the impermeable surface survey worksheet, or write the questions you will be using up on the board.

Depending on the age of your students, the EPA website may be a challenge to read. An option would be to turn this into a deductive reasoning activity to define unknown words.

IMPERMEABLE SURFACES SURVEY WORKSHEET

Directions:

Go to the City of Greenville's Historical Imagery Database.

<http://gis64.greenvillesc.gov/historicalimagery/>

Choose a point on the map and zoom in completely. Close out the address search window. Fill out the questions below for 5 different places in the City.

Using the scale bar at the bottom left corner of the screen, estimate the area of land shown in the picture. (This # should be the same for each measurement)

Estimate the percent of the photo covered by impermeable surfaces.

1) _____ 2) _____ 3) _____ 4) _____ 5) _____

Estimate the percent of the photo covered by permeable surfaces.

1) _____ 2) _____ 3) _____ 4) _____ 5) _____

Use the whole class' results to answer the following questions.

1) What is the average estimated % area covered by impermeable surfaces.

2) Do you think that this number is higher or lower than it would be outside of the City limits?

Why?

3) Name some of the surfaces that you saw in the pictures that are impermeable.

4) Name some of the surfaces that you saw that were permeable.

5) What are some of the negative consequences of a high percent of impermeable surface areas in the City?

6) What do you think could be done to reduce the percentage of impermeable surface in the City while still making it possible for people to live and work here comfortably?

Permeable VS. Impermeable Surfaces Experiment

Depending on the age of your students and the amount of class time that you have to dedicate to this experiment, you may want to perform it as a demonstration, or assign each group one or two earth materials to test.

Students will be creating their own experiment to test the permeability of the earth materials and how the speed of water (equivalent to speed of rain) effects the permeability. The final questions may be used as class discussion, or as journal prompts.

You may want to perform the set up for each group prior to the start of the experiment.

You will need:

Clear plastic bottles

Cheese cloth

Tape

Scissors

Earth materials (sand, gravel or rocks, soil)

Stop watch or clock

Modeling clay (make sure students fully cover the soil with the clay)

A metal pie tin

Basin

Make sure that students know to get a new layer of dry soil to use as a base for each of the earth materials that they are testing.

*The metal pie tin is for you to demonstrate the permeability of surfaces such as roofs and roads that are not permeable at all. Place the tin upside down over the bottle while the bottle is in the basin. Ask the students to predict what will happen when it “rains” on a roof or road. Pour the water over the pie tin.

Ask the students what they think this means in an urban environment? Where does all of the water from roofs, roads, parking lots, and other impermeable surfaces go?

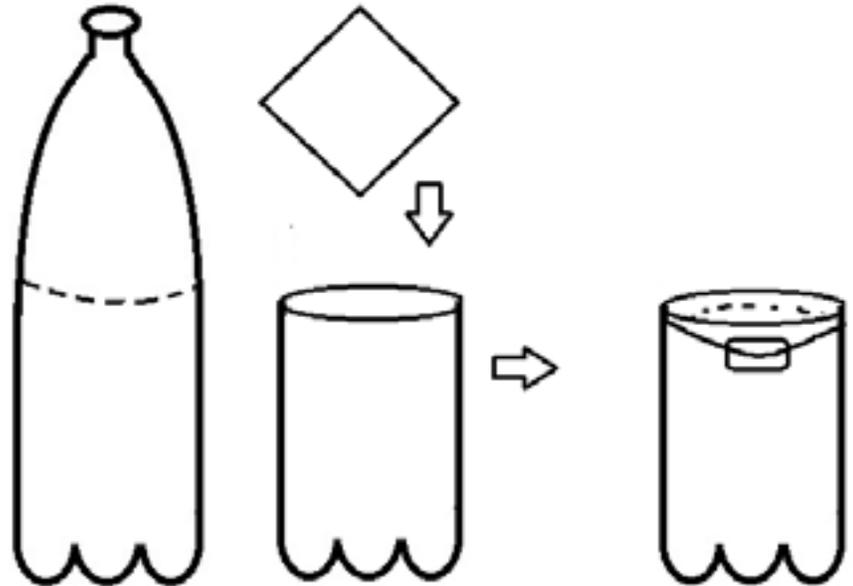


A model watershed is another tool that can be used to connect the concepts of land use, impermeable vs permeable surfaces, and water quality.

PERMEABLE SURFACES EXPERIMENT

Set up

1. Cut the top off of the plastic bottle, and punch a hole in the bottom of the bottle, near the top.
2. Using a graduated cylinder, pour 50 mL of water into the plastic bottle. Use a permanent marker to mark the level of the water on the bottle.
3. Repeat step 2, marking every 50 mL until you have reached the top.
4. Place the cloth over the top of the plastic bottle. Press the cloth down so that it is at least one inch below the top of the bottle.
5. Tape the overlapping cloth to the outside of the bottle.
6. Place the bottle in the plastic basin.



Observe and Predict

1. Measure out 500 mL of water into a pitcher, and pour the water over the cloth into the bottle.
 - a) What happens?
 - b) How much time does it take for all of the water to drain into the bottle?
 - c) Does the speed that you pour the water make a difference?
2. Touch each of the earth materials that you will test.
 - a) Which of the earth materials do you think will be the most permeable? Which will be the least?
 - b) Do you think the speed that you pour the water into the bottle will affect the permeability of the earth materials? How?
- 3) Generate a hypothesis

Design your experiment and Test your hypothesis

Control

- 1) Place a layer of soil in the bottle so that the cloth is covered.
- 2) Slowly pour 500 mL of water over the soil.
- 3) Use the stopwatch to record when the water in the bottle reaches each mark on the bottle.

Once you have the data from your control, you may test your hypothesis. Record your data below. (Depending on your hypothesis, you may not need to use every column)

Volume	Slow: soil	Fast: soil	Slow: sand	Fast: sand	Slow: rock	Fast: rock	Slow: clay	Fast: clay
50								
100								
150								
200								
250								
300								
350								
400								
450								
500								

Draw Conclusions: (answer these questions on a separate sheet of paper)

- 1) Which of the materials that you tested was the most permeable?
- 2) Which of the materials that you tested was the least permeable?
- 3) Did the speed that you poured the water make any difference in permeability?
- 4) Was your hypothesis correct?
- 5) What do your results suggest about permeable and impermeable materials in the real world? Based on your experiment, would you expect soil infiltration rates to vary based on the amount or speed of rainfall?

Brownfields Journal Prompts

What makes a property a brownfield and not just an abandoned building?

How does knowing the history of an area help us understand what challenges that area faces in the present?

What types of land use may result in a property becoming a brownfield? How can the creation of future brownfields be avoided?

List some of the positive things that can come from brownfield redevelopment. Which of these do you feel is most important, and why?

BROWNFIELDS

Learning Objectives:

Students will

- become familiar with the concept of brownfields, and understand that a brownfield is any property where reuse of the land is difficult due to contamination or the possibility of contamination.
- relate brownfields to land use and the consequences of land use as discussed in previous lessons
- learn about Greenville's efforts to redevelop brownfields

Background Information

Brownfields are a legacy of industrial and urban land use. A brownfield is a piece of property that is not currently being used, but the reuse or redevelopment of the land is complicated by the presence of (or the suspected presence of) contaminants such as pollutants or hazardous materials that could be a danger to people or the environment.

Brownfields are located in both rural and urban areas and are generally on land that was once used for industrial or commercial activities. Contamination does not have to be present in order for a piece of property to be considered a brownfield: for example, an old gas station used to be located on a lot, but is no longer there. There is a possibility that petroleum leaked from the underground gas tanks and contaminated the soil and/or the ground water in the area. It is also possible that no contamination took place, but until it is determined whether or not the soil and water is safe, the land won't be redeveloped due to the possible health concerns and expense of development. So, even though there may not be contamination in the old gas station site, the possibility of contamination is enough to make it a brownfield.

The Impact of Brownfield sites on a Community:

Brownfields are generally considered to be sites that impose limited to no direct health risks to a community, but there are other associated issues with brownfields that cause them to have a negative impact on a community.

Safety – brownfield properties often contain abandoned or derelict structures

Economic and social impact – abandoned properties can lead to increased vandalism, and either increased crime or the perception of the area being a “bad” place to live, leading to lost revenue and a negative economic impact

Environmental impact – the previous uses that occurred on brownfield sites may have caused contamination that could harm the environment. This is going to vary depending on the previous use of the site, but may include:

- Soil pollution or contamination
- Ground water pollution or contamination
- Impacts on surface water quality through storm water runoff

Brownfield facts

The EPA estimates that there are more than 450,000 brownfield sites in the US.

In Greenville, the decline of the textile industry in the mid-1900s caused many properties to be left abandoned or underutilized due to the uncertainty of whether or not the land they were on is contaminated

Challenges associated with Brownfields

The possibility of contamination makes it difficult to reuse or redevelop brownfield sites because of

- Liability or risk associated with contamination
- Contamination on a site makes that site a health risk and as such, it cannot be developed until it is cleaned up
- Even when there is no contamination, the possibility of a contaminated site could scare off investors or lenders and make development difficult.
- Cost of clean up
- When a brownfield is contaminated, the cost of remediation (clean up) can be very high. Clean-up cost may be more than the value of the property.

Benefits of redeveloping brownfield properties

Though challenging, the redevelopment of brownfield properties can provide many benefits to a community.

Environmental - redevelopment of a brownfield site requires that the site first be assessed for possible contamination. If it is determined that a site is contaminated, then often, that contamination is cleaned up, reducing the future environmental damage that would be related to the site.

A less obvious way that brownfield redevelopment helps the environment is by encouraging infill development. Infill development occurs when vacant or underutilized properties in an already developed area are redeveloped, or "filled-in." Infill development is often better for the environment than development in other areas because it discourages sprawl, utilizes already existing roads and infrastructure, and often provides amenities close to where people are already living, reducing the need for transportation.

Safety - The presence of dilapidated and abandoned structures can lead to an increase in crime rates. Broken down, unattractive buildings and vacant lots make people feel unsafe, and can give a neighborhood a poor reputation. By demolishing unsafe structures and cleaning up abandoned lots or buildings, brownfield redevelopment can help to reduce crime rates and make people feel safer.



Many brownfield sites in Greenville have been redeveloped with the help of EPA brownfield grants including Fluor Field (top), A J Whittenberg Elementary School (middle), and the Salvation Army Kroc Center (bottom)



Atlantic Station in Atlanta, GA is an example of a mixed use brownfield redevelopment. An old steel mill site has been turned into a mixed use development with retail shops, offices, homes, a movie theater, and a park.

Economic impact - every brownfield redevelopment project is different, but the general goal of brownfield redevelopment is to turn an underutilized, contaminated, or abandoned property into an asset to the community.

Some brownfield redevelopments provide housing for people that need it, some create parks and green spaces that bring in tourism and help protect environmental resources, while others create jobs for people in the community.

Brownfields in Greenville

The EPA estimates that there are more than 450,000 brownfield sites in the United States. Research conducted in 2000 revealed that Greenville is home to more than 50 brownfield sites, ranging in size from less than one acre to twenty acres. Most of Greenville's brownfields are located on Greenville's West side or Reedy River Corridor.

The rise of the textile industry once spurred development in West Greenville, yet the decline of industry contributed to environmental damage, hindering development as a consequence. Uncertainty of what properties were contaminated left many properties abandoned or underutilized, especially around the former textile mills. Known contamination of areas in West Greenville and along the Reedy River Corridor also aided in pushing development elsewhere to other parts of the city, resulting in further decline of the neighborhoods.

The EPA's brownfields grant program provides funds for communities, like Greenville, to perform environmental assessments on brownfield properties in order to determine whether or not the properties are contaminated, the type of and extent of contamination, and the cost of clean-up and redevelopment.

Brownfield Activities:

Discuss the characteristics of a brownfield property and the impacts of brownfield sites on a community.

Follow up with a discussion of how redevelopment of brownfields can provide many benefits for a community. For specific examples, the City of Greenville's Brownfields web page provides a short overview of brownfields projects in the City.

<http://www.ctcbrownfields.com/greenville/about.php>

Read and discuss brownfield redevelopment case studies from the EPA.

- Greenville, SC
- Improving Public Health through Brownfield Redevelopment
- Brownfields into Community Gardens and Farmers' Markets

Identifying Possible Brownfields

A brownfield can be any piece of property that is not being used to its full capacity. One of the challenges that cities, developers, and property owners face is that it isn't always clear whether a brownfield is contaminated or not.

In this exercise, students will visually analyze pictures of possible brownfield sites and identify possible risks. Students should assess each photo for possible safety, social and economic, and environmental impacts that relate to brownfields.

**It is important to note that this is a critical thinking exercise. There are no right or wrong answers for this exercise, as there is no way to know for certain whether a property is contaminated without analysis of the soil, water, and/or plant communities found on the site*

Possible Discussion Questions:

- What do you see?
- Does the site look abandoned/underutilized?
- How can you tell?
- What do you think the property used to be?
- If you lived next to this property, how would it make you feel?
- Would you feel safe here at night? Why or why not?
- Do you think that the soil or water at this site might be contaminated? Why or why not?
- How do you think this property might affect neighboring properties?

In addition to environmental concerns, brownfields also present a variety of social justice concerns. Depending on the age of your students and the focus of your lessons, researching and discussing brownfields as a social justice issue could be a connection to explore.

Example of a visual assessment:



*Old gas pumps = old gas station.
Possibility of underground storage
tanks for fuel and environmental
contamination from leaks*

*No windows, no trees, no cars =
this site is probably abandoned
and no longer being used. The
lack of people being here on a
regular basis would make me feel
uncomfortable if I lived next to
this building.*

*The lack of decoration or landscaping makes this
place unattractive. If a business opened up next
door, they might lose customers because this
place isn't very appealing.*

*I would classify this site as a brownfield because it used to
be a gas station, and that means that developers would be
unlikely to invest in this property because of the possibility of
contamination in the soil and groundwater.*

Brownfields Assessment Photographs



Brownfields Assessment Photographs



Brownfields Assessment Photographs



Chapter 3: Exploring Urban Water Issues

Water is essential to our continued healthy existence, both as individuals and as a society. As individuals and families, we use water for drinking, cooking, bathing, washing our clothes and dishes, and watering our lawns. As a society, we use water for industry, producing power, growing our food, and recreation, just to name a few.

A watershed is the entire land area that drains into a particular body of water. On a topographical map, watersheds can be picked out by finding a high area of land (rise, crest, hill, etc.) that forms a boundary between two bodies of water. Watersheds vary in size and in geography depending on the size of the water body, the topography of the land, and the land use patterns that occur in the watershed as well as surrounding watersheds.

As rain falls on the land, it can infiltrate the soil and be taken up by plants, infiltrate the soil further and become part of the ground water system, or flow across the surface of the land to join a water body such as a stream, river, lake, or wetland. In an urban ecosystem, the prevalence of impervious surfaces and compacted soil leads to a much lower rate of soil infiltration and a higher amount of over land flow, called storm water runoff. As this water flows over urban surfaces, it picks up trash, metals, oil, dirt, and chemicals on the ground and sweeps them into gutters and storm drains that lead directly to water bodies. Storm water runoff is a major source of water pollution in the US and has a negative impact on water quality, increasing the cost of water treatment and impacting freshwater and marine ecosystems downstream.

This set of lessons will focus on Greenville's watershed, storm water runoff, and ways to protect and conserve our water resources.

Word Bank

Water quality
Discharge
Clean Water Act
Nonpoint Source Pollution
Point Source Pollution
Storm Water Runoff
Pollution
Effluent
Contaminant
Hydrology
Ground water
Water table
Watershed
Dissolved Oxygen
Aquatic
Reservoir
Water cycle
Sediment
Impairment
Infiltration
Aquatic
Water Body
Filtration
Wetland
Ecosystem

Greenville is a Watershed Journal Prompts

In your own words, explain the concept of a watershed.

How is a watershed different from a reservoir?

Where do you think the water that you use comes from, and where does the water that goes down your drain go?

Describe the watershed that you live in. Use the concepts of land use that you have already discussed to hypothesize the differences between the watershed today and how it may have looked 100 years ago.

Choose a major river in South Carolina (Savannah, Broad, Saluda, Edisto, PeeDee, Santee, Catawba) and research its watershed. Where is it located? What are the major issues that the river faces?

GREENVILLE IS A WATERSHED

Learning Objectives

Students will

- understand the concept of a watershed
- understand that human activity and development within a watershed affects the quality of water in the water body
- find and research the watershed that their homes and school are located in.

Background Information

A watershed is the entire area of land that drains into a specific body of water. The City of Greenville belongs to the Saluda watershed. All of the precipitation that falls on the City of Greenville eventually flows into the Saluda River. Most of the City is part of the Reedy River watershed. The Reedy River drains into the Saluda River, making the Reedy River a part of the Saluda River's watershed.

The City of Greenville gets its water from three reservoirs, Table Rock, Poinsett, and Lake Keowee. Two water treatment plants treat all of the water that is piped through approximately 2,827 miles of pipeline (2011 Water Quality Report - <http://www.greenvillewater.com/waterquality.pdf>) to citizens of Greenville every day.

The land around the Table Rock and Poinsett reservoirs is owned by the Greenville Water Company, and through a cooperative agreement with the Nature Conservancy, is in conservation easement. This means that the land around the reservoirs cannot be developed. Lake Keowee is owned by Duke Power, and much of the area around the lake is developed. A 2011 source water assessment conducted by South Carolina Department of Health and Environmental Control (SCDHEC) found 145 possible contamination sources in the 337 square mile watershed surrounding Lake Keowee.

Land use within a watershed affects the water quality of a water body. Water travelling over the land picks up contaminants including soil, litter, and chemicals. Developed land with higher compacted soil or higher percentages of impervious surfaces than undeveloped land will have a higher rate of surface run off, resulting in higher levels of contaminants in the water and lower water quality. Spilled chemicals or breakdown products from industrial sites can leach into the soil and contaminate ground water aquifers which may eventually contaminate surface water bodies.

The City of Greenville gets its water from 2 reservoirs with watersheds that are mostly forested and protected with minimal development and human impact. As a result, the drinking water that Greenville has is very high in quality and was voted "Best of the Best" tasting water in North America at the American Water Works Association's 2011 conference in Washington, DC.

It is important to remember that Greenville is also part of a watershed, and that the rain water that falls in Greenville makes its way to the Saluda River and eventually, becomes drinking water for people living downstream.

Greenville is a Watershed activities:

Model a watershed.

Have students create a model watershed in order to visualize how water moves over the land.

Follow this link to a full lesson plan on modeling a water shed:

http://www.therez.ms/students/documents/watersheds_wetlandsmodel.pdf

Ask the students to use what they know about the water cycle to **discuss** how water moves through their watershed.

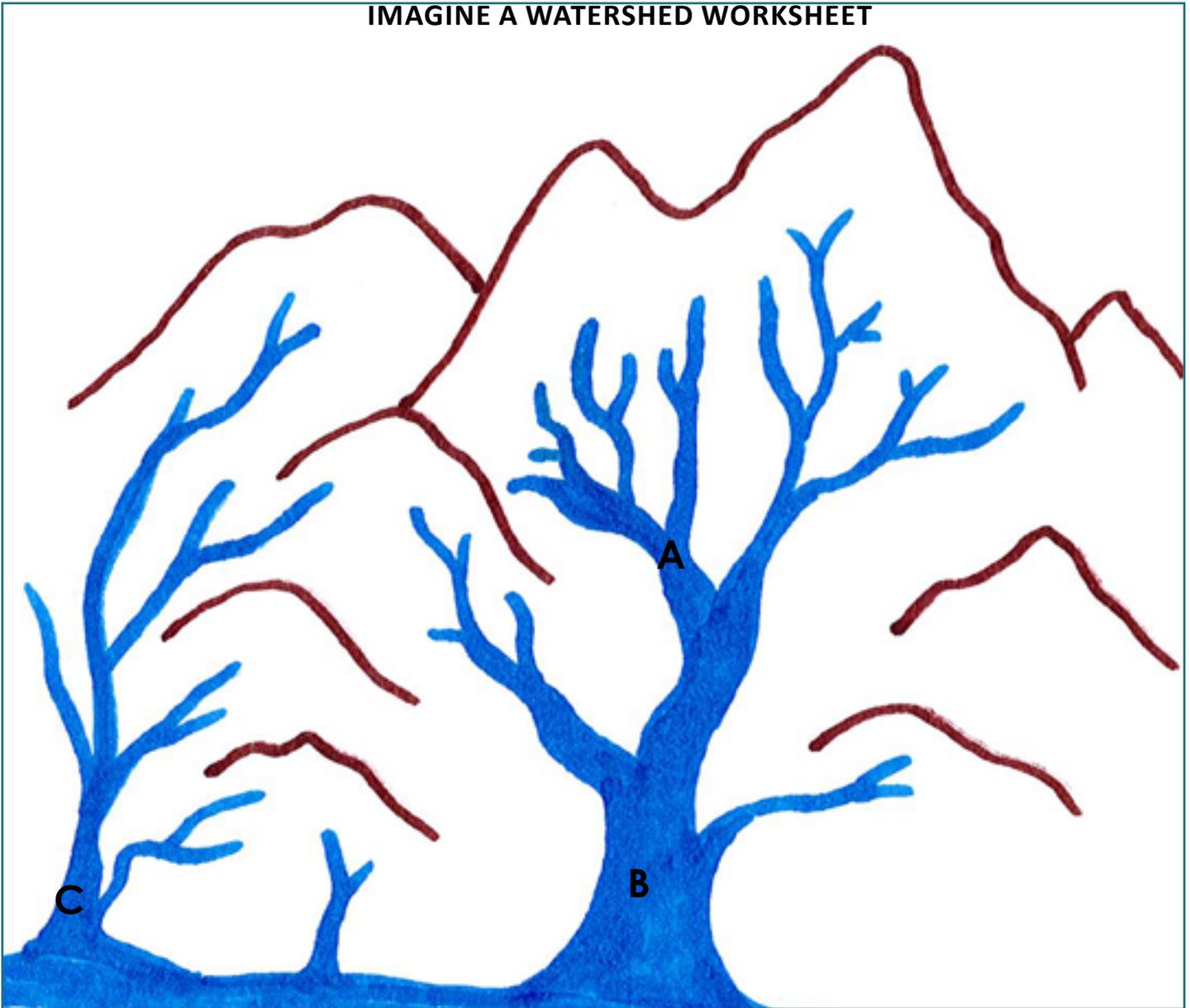
Creating a model watershed can be a time consuming activity. If you don't have the class time to devote to this activity, instead consider inviting a speaker to bring an enviroscape or other model in to speak to your class about watersheds and the impact of land use on the water.

Possible resources:

Environmental Education in South Carolina

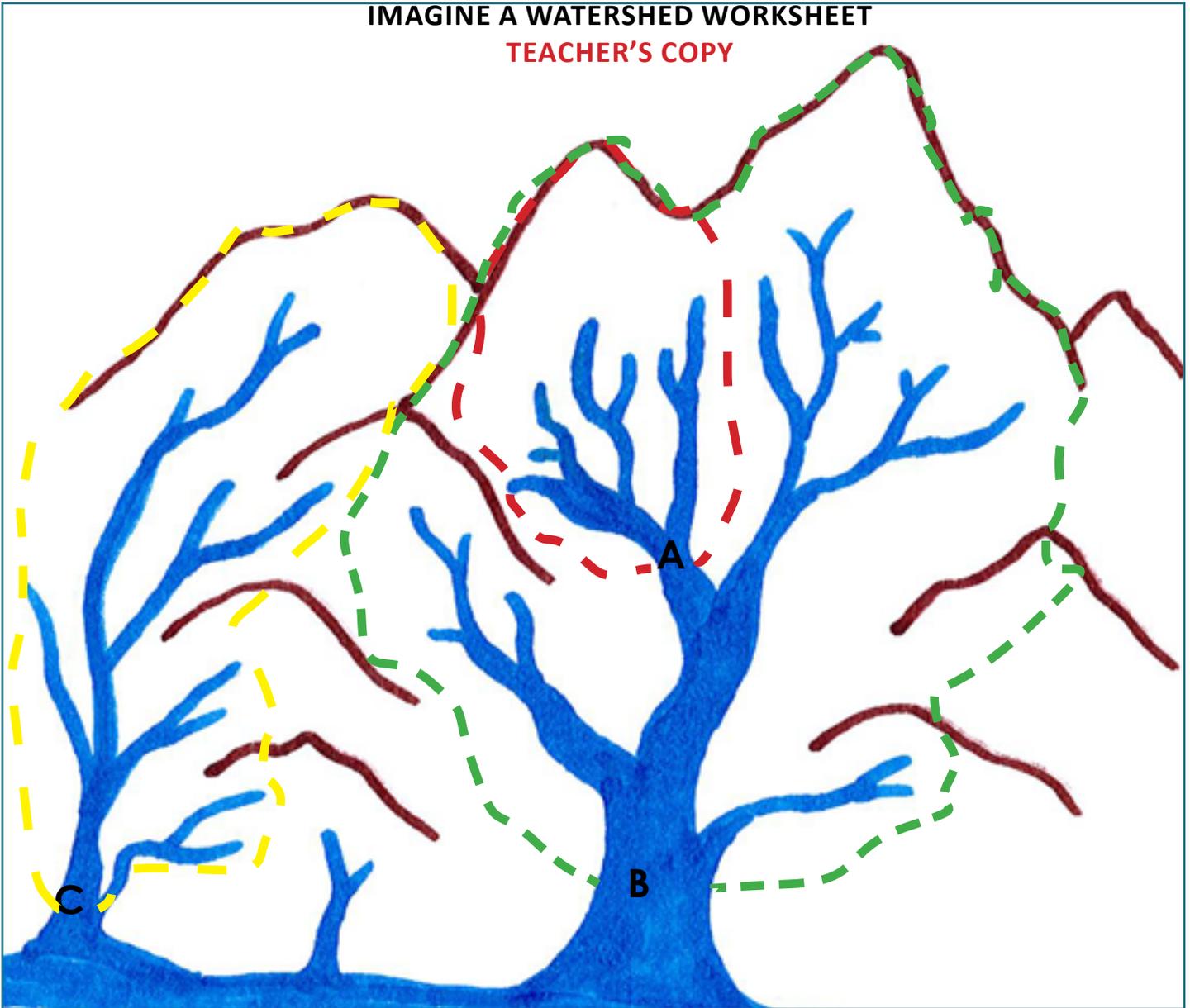
More lesson plans on watersheds are available from PBS: http://www.pbs.org/pov/borders/2004/educators/edu_water1.html

IMAGINE A WATERSHED WORKSHEET



1. Using three different colored pencils, circle the watersheds for the rivers at point A, point B, and Point C on the map.
2. Do any of the watersheds overlap? If so, which ones, and why?
3. Close your eyes and use a fourth colored pencil to place three random dots on the watershed. Draw arrows to trace the path that those three water drops might take to get to the ocean.

IMAGINE A WATERSHED WORKSHEET
TEACHER'S COPY



1. Using three different colored pencils, circle the watersheds for the rivers at point A, point B, and Point C on the map.

answers are approximate: the important point is that the watershed for each point is all of the land where precipitation on the land would eventually flow to that water body

2. Do any of the watersheds overlap? If so, which ones, and why?

Yes: A and B overlap because the river A is also part of the watershed for the river B.

3. Close your eyes and use a fourth colored pencil to place three random dots on the watershed. Draw arrows to trace the path that those three water drops might take to get to the ocean.

answers will vary

The Urban Water Cycle Journal Prompts

Trace the steps that your water goes through after water the lawn. Does it matter if you spill any water on your driveway? Why or why not?

List 3 differences between the urban environment and the natural environment that affects our water and explain why these differences are important.

Would you rather drink water from a river in the mountains or the City. Explain why.

Research the waste water treatment process at rewaonline.org. Does any part of the process surprise or interest you? Explain.

Is it important that water used in agriculture and manufacturing is clean? Why or why not?

THE URBAN WATER CYCLE

Learning Objectives

Students will

- explore the ways in which urban development impacts water quality in urban streams and other surface waters
- understand the water cycle and how the concepts of the water cycle can be applied further to animals, plants, and structures in an urban setting in order to model how water travels through the urban environment

Background Information

The hydrologic cycle, also known as the water cycle, is the process by which water is transferred from oceans to the atmosphere, the land, and finally back to the ocean through evaporation, transpiration, precipitation, and runoff. This lesson modifies the hydrologic cycle to model the movement of water within and through an urban environment.

Greenville's water source is mostly protected, but all water bodies are an important resource, not just our reservoirs.

Everyone lives downstream. The water that runs over and through the City of Greenville eventually enters the Saluda River and flows to the Atlantic Ocean. People and animals downstream depend on that water.

Less than 1% of the water on Earth is freshwater that is available for human use and consumption.

Oceans hold approximately 97.2% of the water on Earth, 2.15% is locked in ice caps and glaciers. That leaves less than 1% to make up the water in lakes, streams, rivers, wetlands, and groundwater.

Contamination and destruction of freshwater resources is a very serious problem for both the environment and human health.

Aquatic freshwater ecosystems are extremely important. More background on the importance of wetlands and freshwater ecosystems can be found in the next section, sustainable water.

The Urban Water Cycle

The following information can be used independently to foster discussion of the movement of water through an urban environment, or as part of the urban water cycle game.

In order to understand how the urban environment impacts water quality, we will consider a simplified model of the water cycle to study the places that water may travel in the urban environment. You can either play the water cycle game following a discussion about how water moves in the urban environment, or you can use the game as a starting point and follow with an in depth discussion about how water moves. Though the urban water cycle game does not show every possible path that water can take to cycle through the urban environment, it is a good starting point to begin thought provoking discussion.

Note that the sources and sinks in the urban water cycle game are not equal in volume or in impact.

Urban Water Cycle Model Information

The River –

Water enters rivers

- From snow melt in the mountains
- From precipitation directly on the rivers
- From surface runoff following precipitation events
- From drainage pipes
- From areas where the ground water discharges into rivers and streams

Water leaves rivers

- Is drawn through pipes by people for a variety of reasons
 - Drinking water and water used in homes and businesses.
 - Irrigation of crops
 - Industry – for the creation of goods, cooling of equipment, and other uses
- Evaporation
- Animals drink directly from the river
- Plants alongside the river or aquatic plants in the river may take up water through their root systems

The atmosphere (represented by the cloud)

Water enters the atmosphere

- Evaporation from the surface of water bodies
- Evaporation through sweat from people and animals
- Transpiration from the leaves of plants
- Evaporation from puddles and standing water on streets, parking lots, buildings, fountains, and other impermeable surfaces

Water leaves the atmosphere

- In the form of precipitation (rain, fog, snow, sleet, hail)

The building

Water enters the building

Water is piped into buildings. For the urban water cycle game, water is piped into the building from the river. This is not entirely realistic. In most cities in the U.S., water is treated at water treatment plants (usually different from waste water treatment plants) before being piped to buildings. In Greenville, the drinking water comes from reservoirs, and is treated at a water treatment plant before being piped to residents. In some areas, the water that is piped to buildings comes from underground aquifers, from rivers, or other sources

The Urban Water Cycle Model information as listed is the reasoning behind the possible pathways that water can take in the urban water cycle game.

This information may be useful to foster discussion following the game. For example, ask the students where their water droplet travelled to from the road, and then discuss whether or not this seems realistic. Many students may not be aware of the fact that stormwater is not treated or filtered and that anything on our road ways goes directly into rivers when it rains.



The urban water cycle lesson and activities tie in well with previous lessons, including land use, and Greenville is a watershed. Above, community center students use a model watershed and the urban water cycle game to learn about water and the connections between our water and the way we use land.

Water leaves the building

Water is used by people for drinking or cooking

Water is used by people for inside uses such as washing dishes, clothes, or themselves, and it goes down the drain

Any water that goes down the drain in a building in Greenville goes to the wastewater treatment plant

Water that goes down the drain in some rural areas goes to septic tanks

Some water conservation systems, called grey water systems, reuse water that goes down the drain to flush the toilet, water plants, or be filtered for other uses.

Water is flushed down the toilet and goes to the waste water treatment plant

Water is used for outside uses

Watering the lawn or plants

The water would go into the plants or the soil

If sprinklers are used, some water would evaporate and enter the atmosphere

Washing the car, the house, etc.

Water that lands on an impermeable surface such as a driveway would make its way to storm drains and eventually to the river, picking up contaminants along the way

Plant

Water enters the plant

Water is taken up by the plant through the plant's roots

From a source of groundwater

Following a precipitation event

From a river or other water body

Irrigation

Water leaves the plant

The plant takes up some water and assimilates it as part of the plants tissues

The water would remain inside the plant until the plant dies and then be released into the soil, into a decomposer, or into the atmosphere.

An animal or person may eat the plant and take its water in through ingestion.

The plant transpires extra water through the stomata in its leaves and releases it into the atmosphere

Person

Water enters the person

People drink water from the faucet in buildings

People also ingest water through food

Though the first thing that we often think of are soups or foods that are boiled in water, plants and animals all contain water, and when people ingest them, they are ingesting water

Water leaves the person

People take up some of the water that they drink and eat and assimilate it as part of their tissues.

Like the water inside the plant, the water would remain inside the person until they die and then be released into the soil, into a decomposer, or into the atmosphere.

People use the toilet inside buildings. Once the toilet is flushed, that water goes to the waste water treatment plant.

Some water evaporates from people as sweat and enters the atmosphere.

Road

Water enters the road

Through precipitation directly onto the road

Surface runoff onto roads

From driveways and yards where people water plants or wash cars

From rain events on the land surrounding the roads

Surface runoff is a major contributor to nonpoint source pollution and is considered a major threat to water quality in the U.S. Due to the high percentage of impervious surface and compacted soils and the relatively low rate of vegetation found in urban areas, surface runoff is generally much higher than in rural areas.

Water leaves the road

Evaporation into the atmosphere

Storm drains

Many people believe that the water from storm drains is treated before being released into rivers and streams, but that is rarely the case.

Water from roads, along with all of the trash, chemicals, soil, and other contaminants that have been washed into the storm drain, drains directly into rivers and streams.

Download extra copies of the Urban Water Cycle Game Cards from the Connections website.

Waste Water Treatment Plant

Water enters the waste water treatment plant

Any water that is flushed or goes down a drain in any building in the city ends up at the waste water treatment plant

Any plants that are placed in garbage disposals also end up at the waste water treatment plant

Water leaves the waste water treatment plant

Evaporation from settling ponds

Following treatment, most of the water from the waste water treatment plant is returned directly to the river

Urban Water Cycle Activities:

Play the Urban Water Cycle Game (appendix I)

Cut out the water cycle game cards and dice provided. Fold the dice and secure tabs with tape.

Set up:

Create 7 stations, and place a Water Cycle Game card, corresponding die, and a colored marker in the same color at each station.

Explain to the students that they are playing the part of a single water droplet in an urban setting. Provide students with a note card and have them mark each time they go to a station on the card. If they roll the die and it tells them to remain at a station, they should go to the back of the line and mark their card again when they reach the die.

Play for an allotted amount of time or a set number of turns and then follow the game up with a discussion.

Take a **field trip** to the waste water treatment plant to learn more about where water goes when we are finished using it.

<http://www.rewaonline.org/tours.php>

Brainstorm a list of all of the things that you can think of that people use water for in an urban environment. You may want to challenge the students by saying something like “the last class I taught came up with 20 different things we use water for. Can you think of more than 20?”

Urban water uses guessing game: use either the list that your class created or the list below. Divide the class into two teams. Introduce the game as charades about water uses in an urban environment. The teams will take turns sending one student up to mime a way that water is used in the urban environment. No speaking is allowed, and a time limit such as 1 minute or 30 seconds should be in place. If the team whose member is presenting can not guess the water use in the allotted time, the other team has a single opportunity to steal their points, but they must make a team decision. The first answer given will be the one that counts.

Some possible water uses for the urban water use guessing game:

Shower	Wash the car
Wash the dog	Clean the dishes
Drinking water	Watering plants
Flushing the toilet	Washing clothes
Brushing teeth	Putting out fires
Decorative fountains	
For pets to drink	Hydroelectric power

Research water quality in your neighborhood:

A water body that is impaired is one that has poor water quality that negatively affects that water body's ability to support life or its use as a recreational or drinking water source.

The following source provides good background information on many different sources for impairment to water bodies.

http://scorecard.goodguide.com/env-releases/def/cwa_cause_class_def.html

Have students research a common impairment, and check scorecard to see if any nearby water bodies are impaired.

Questions for consideration:

- 1) What are the possible sources of water contamination?
- 2) What are the possible negative effects the contaminant may have on people or the environment?
- 3) Can you see the contaminant?
- 4) What can be done to prevent or clean water that has been contaminated by that substance?

Water Quality and Conservation Journal Prompts

Why do you think it is important to conserve and protect water resources?

Describe the difference between conservation and protection.

What are two things that you or your family does that wastes water at home? How can you change those habits to keep from wasting water?

Describe the connections between water resource protection and land use.

Use the information that you have learned to write a letter about the importance of water conservation and/or protection to a community leader. Make your letter as specific as possible.

WATER QUALITY AND CONSERVATION

Learning Objectives

Students will

- research a water quality issue
- brainstorm ways that they can conserve and protect water quality in an urban environment
- perform a water conservation audit of their own habits

Background Information

The Clean Water Act, CWA, is the set of laws and regulations put into place by the federal government in 1972 that regulates the discharge of pollutants into water bodies and sets standards for water quality in U.S. surface waters. It is illegal to discharge any pollutant from a point source into a water body in the U.S. without a permit.

Point source discharge occurs when a pipe, ditch, or other man-made system allows any substance to drain directly into a water body. Nonpoint source pollution is any pollution that enters a water body through any other method, such as through storm water runoff from agricultural fields or urban streets. Prior to the CWA, point source pollution was a major concern in the U.S., as many industries pumped pollutants directly into water bodies. Though point source pollution still occurs, nonpoint source pollution is a larger concern today, partially because it is very difficult to track and regulate.

Due to the relatively rainy climate in the Southeast, water is often not seen as a limited resource, but conservation and protection of water quality is a very real concern. Human activities have a huge impact on water quality and quantity available for use by people as well as natural systems.

Water quality

Water quality refers to the suitability of water for a specific use based on physical, chemical, and biological characteristics. Often, when discussing water quality, human health is a major concern, but the ability of a water body to support life is also an important measure. Water that is contaminated in some way is considered to be poor in quality. When contamination occurs on the scale of a body of water (stream, river, lake, etc.) that water body is said to be "impaired."

It is important to note that a contaminant does not have to be a chemical pollutant in order to cause impairment of a water body. Soil from erosion and hot water from impervious surfaces can both cause poor water quality, making it difficult for a water body to sustain aquatic life.

As has been discussed in previous lessons, storm water runoff is a major contributor to poor water quality in the US. When water flows over urban surfaces, it picks up soil, trash, oil from vehicles, chemicals and pesticides from urban lawns, pet waste, and more and sweeps it into storm drains which flow directly to the river.

Water conservation – the amount of water we use is important

Water everywhere is connected through the water cycle. Water flows. The water that you use will eventually end up in the ocean, but if we use too much water, we can disrupt downstream processes. Aquatic organisms need certain levels of water in streams and rivers in order to survive. Without the right amount of

water coming in from upstream, swamps, marshes, and other wetlands can dry up. Many ocean animals use estuaries and marshes as nurseries, and without enough water, these animals won't be able to reproduce. Using too much water could have far reaching consequences.

There are many ways that we can conserve and protect water quality. One is through regulation. Laws and regulations such as the Clean Water Act are important in that they set standards for behavior and consequences for breaking the law. Yet, laws can only do so much. Day to day behavior of individual citizens can have a large effect on water quality.

Water Quality and Conservation Activities:

Brainstorming: impairment source and human behavior

List an impairment, and then ask the students to brainstorm where that impairment may originate on land, what human behaviors could cause it, and finally, what could be done to help reduce that type of pollution.

EXAMPLE:

Impairment - high levels of nutrients

Source - animal waste, fertilizer

Human behaviors that might lead to excessive nutrient levels in water - allowing pet waste to remain on the ground near rivers, placing excessive fertilizer on lawns near water, putting fertilizer out right before it rains

Ways to reduce the problem - pick up or bury pet waste so that it doesn't wash into rivers; only use the amount of fertilizer you need, and make sure you check the weather before applying fertilizer and don't apply it right before a rain event.

Some examples of impairments to list:

- Plastic trash
- Sediment
- Pesticides
- Toxic Chemicals
- Oil
- Nutrients
- Debris

Perform a Water use Audit

*Individual water use audit worksheet available on the next page.

As a class, list the ways that you use water throughout the day. Remind the students that drinking water is necessary and one of the reasons that we are doing this audit is to conserve and protect water for drinking, so drinking water is exempt from the water use audit.

Brainstorm ways that water is wasted in everyday use, and then brainstorm solutions for each waste. After brainstorming multiple solutions for each waste, vote as a class to find the “best” solution.

EXAMPLE:

Water Use	How water is wasted	Possible Solutions
Washing hands	while waiting for water to warm up, some goes down the drain	install a tankless water heater wash hands with cold water collect water as it is heating up and use it to water plants
Washing hands	while soaping hands, extra water runs down the drain	don't use soap turn the water off while soaping hands

**note that not all solutions to conserving water when washing hands are feasible. While not using soap to wash your hands may save water, it isn't good for personal health. Water conservation must strike a balance where water is still used when needed yet saved when possible.*

Provide students with copies of the water use audit to perform at home, preferably on a weekend. Once the audits have been performed, have a class discussion about home water use. Use the questions shown left as a starting point for discussion. Compile the data taken by the class to extrapolate water use to your community.

During what activity did you use the most water?

Do you feel like you wasted water? Why or why not?

How do you think you could alter your activities to use less water?

Were you surprised by how much water you used in a day?

Home Water Use Audit

Instructions: Place a bowl beneath the faucet in your sink. Turn the water on the way you normally would to wash your hands or brush your teeth and leave it on for 5 seconds. Measure the amount of water in the bowl. Use the water for watering plants, pets, or drinking and repeat until you have 3 sets of measurements. Find the average amount of water that you use in 5 seconds. Divide by 5 in order to find the amount of water that you use every second. Repeat for your shower. Fill in the data table provided with your measurements.

Use a stop watch or clock to time your water use and fill in the data table provided. Ask your parents for help answering the rest of the water audit questions.

Questions:

How many sinks are in your home?

How many people live in your home?

How many toilets are in your home?

Do you have a dishwasher?

Is it an ENERGY STAR dishwasher?

How many times a week does your family run the dishwasher?

Do you pre-rinse your dishes?

Do you have a washing machine?

Is it an ENERGY STAR washing machine?

How many times a week does your family run the washing machine?

How many times did you flush the toilet in a day?

Do you have an irrigation system for your lawn?

Bathroom Sink

Trial 1: 5 seconds running = _____

Trial 2: 5 seconds running = _____

Trial 3: 5 seconds running = _____

Average vol in 5sec = _____

Volume/sec = _____

Use 1: _____ sec

Use 2: _____ sec

Use 3: _____ sec

Use 4: _____ sec

Use 5: _____ sec

Use 6: _____ sec

Use 7: _____ sec

Use 8: _____ sec

Use 9: _____ sec

if you need more space, continue on a separate sheet of paper

Shower/Bath

Trial 1: 5 seconds running = _____

Trial 2: 5 seconds running = _____

Trial 3: 5 seconds running = _____

Average vol in 5sec = _____

Volume/sec = _____

Time in shower = _____ sec OR

Time water runs to fill bath = _____ sec

List any other ways that you use water, other than drinking/cooking:

Class Home Water Audit Data Collection

Have each student total the amount of time that they ran the water in their bathroom in a day and compile those numbers in a table on the board, or in a separate document. Add a tally of all of the answers collected from the home water audit.

Use the data collected to do some math, either as a group or individually. Some ideas for water audit math are below:

A (# of students in class) = _____

Find the average volume of water/second for the class's bathroom sink (Class total/A) = _____

Find the total volume of water used from the bathroom sink (Class total time in seconds x ave volume/sec) = _____

Find the average volume of water used from the bathroom sink by one person in a day (class total vol/A) = _____

Extrapolate the volume of water used from the bathroom sink by a person in a day to the entire population of Greenville County, then the population of South Carolina (use the data on the useful water facts and figures data sheet).

Extrapolate the volume of water used from the bathroom sink for one person in one week, all of Greenville County in a week, and all of South Carolina in a week.

Find the total amount of water used in the class' washing machines in one week. Divide that amount by the number of students in the class for an average amount of water used in washing machines per person. Repeat for dishwashers.

Find the average # of flushes per person each day, and the average volume of toilet water used daily.

Add all of the averages per person together and extrapolate to Greenville County and South Carolina to see how much water we use in a day.

Discuss the results of the water audit as a class.

Make sure to remind your class that the results that you have didn't take into account every water use in their homes.

Ask students to brainstorm ways that they could conserve water while still using what they need.

Common ideas may include (but are not limited to):

- turn the water off while brushing your teeth
- scrape food off plates instead of pre-rinsing
- only wash a full load of clothes
- take shorter showers
- water plants with a drip irrigation hose instead of a spray irrigation that loses water to evaporation

Extend the Class Water Audit:

If you would like to put your water conservation knowledge to the test, repeat the class home water audit and ask the students to put all of their water saving tips to use.

Have students spend a second weekend tracking their water use time, but with all of their water conservation habits in place.

Compile the new data and see how much water they saved.

If every person in Greenville County or South Carolina did the same simple water conservation steps, how much water would they save in a day, a week, or a year?

Rain barrels make a great class or group project to encourage water conservation and draw connections between storm water runoff, land use, and water quality.

For more information, check out Clemson University's rainwater harvesting guide.



Useful facts and figures: Water Audit Data

2010 population Greenville Co	451, 222
2010 population South Carolina	4,625,364
Ave water used per load ENERGY STAR dishwasher	5 gal
Ave water used per load non ENERGY STAR dishwasher	6 gal
Ave water used per load ENERGY STAR washing machine	15 gal
Ave water used per load non ENERGY STAR washing machine	23 gal
Ave water used per flush in a standard toilet	3.5 gal
Amount of water in an Olympic sized swimming	2,500,000 L
1 Gallon	3.78514 L
16 Cup	1 gal

The TUNZA magazine is unique because many of the articles are written by young people. You could start a class publication as part of Community Quest. Students could research different topics of interest to their community, relate them to what they have learned in class, and put the articles together as a magazine for their friends or family.

Read and discuss pages 16 and 17 of the TUNZA, UNEP magazine for youth. The article explains some ancient and innovative methods for harvesting water in dry climates. Ask the students to imagine that they needed water but were unable to find a water source. How would they go about harvesting and collecting water?

<http://www.unep.org/pdf/Tunza/TunzaV4N1-DesertsDrylands.pdf>

Test out your knowledge

Let students play the EPA's WaterSense game.

<http://www.epa.gov/watersense/kids/games.html>

Perform an Experiment:

http://water.epa.gov/learn/kids/drinkingwater/upload/2005_03_10_kids_activity_grades_4-8_plantsinwaterfiltration.pdf

Use the experiment above to show how plants can help filter pollutants from the soil.

To further illustrate the filtration properties of plants, double the number of cups that you use, and for each “pollutant” that is poured into a plant, also pour the same pollutant into a cup with just soil and rocks.

Make an aquatic animal sun catcher as a reminder of the importance of conserving and protecting water resources.

Materials:

Plastic 2 Liter bottles (clean, with labels removed)

Scissors

Permanent markers

Tape

Drawing or picture of a fish or aquatic animal

1. Cut the top and bottom off of the 2 Liter bottle and cut 2 slits straight down the sides of the bottle. You should now have 2 curved pieces of plastic.
2. Tape the picture of a fish or other aquatic animal to the desk and tape the piece of plastic over the top.
3. Use the permanent markers to color in and trace the picture.
4. Remove the tape from the plastic and use the scissors to cut out the animal.

If you would like, punch holes in the sun catchers and let the students hang them. They can be sent home or used to decorate the classroom as reminders to conserve water.

Recycle the leftover plastic bottle pieces.



Recycled fish suncatchers make a fun and simple project to remind students that we aren't the only ones who need clean water.

Read the short essay, “Water through the ages” as a class, in small groups, or individually.

You may utilize the discussion questions below or create your own.

Discussion Questions for “Water through the ages”

Who is John Snow, and how has his discovery influenced our present day society?

What are some of the different ways people have depended on water in history, and how do we depend on water today?

What happens if a community's water source becomes contaminated?

What are some things that you can do to help protect Greenville's water supply?

We know how important our water supply is, but chemicals, waste, trash, and other contaminants are still dumped into water sources every day. How does that make you feel? Do you think that we protect our water sources enough?

Water through the ages

By Emily Hays, Furman University

Let's flash back to the year 1854. In a London neighborhood, 127 people living on Broad Street died within three days of each other. Almost every family in the neighborhood experienced the death of at least one family member. People started packing up and moving out for fear of catching the disease. After a single month had passed, the death toll reached 500 people. Something was very wrong; a cholera outbreak had occurred. Cholera is an intestinal disease that can cause death within a few hours of symptoms, such as vomiting and diarrhea. The problem was that no one knew where cholera came from, and many believed that it was spread through "bad air."

A British doctor, John Snow, did not think cholera was spread through the air, so he started investigating the situation. He made a map of the city including the city water pumps, and homes of those who died. He noticed that people that lived close to the Broad Street water pump were dying in greater numbers than those living elsewhere in the city. He contacted local officials, had the Broad Street water pump handle removed, and the outbreak stopped. Doctor Snow had discovered that water was the connection. It turned out that raw sewage, or human waste, was dumped into the Thames River in London, just above the location where the Broad Street pump drew in its water. People had noticed that their water smelled bad and looked cloudy, but they drank it anyway. Today, John Snow is famous for his discovery about the spread of cholera, and the importance of having clean drinking water.

All throughout history, people and ecosystems have depended on water for life. Cities and towns develop near water sources, because we all need fresh water. Rivers, lakes, and oceans are used for transportation, which is important for trade between countries. People catch fish and find other food in water. When European cities developed, water was a crucial source of power and energy, fueling industry. By building dams and canals, people are able to direct water flow in such a way that it helps get jobs done. Water was, and still is, crucial to jobs, transportation, food supply, and health.

John Snow showed us that water impacts our health. The people in London lived in very crowded, dirty conditions, which also helped diseases like cholera spread quickly. The English did not know that their water needed

to be taken care of, and it made them sick. The ancient Romans, on the other hand, were famous for their clean city and water. They constructed tall downward sloping tunnels, called aqueducts, to bring water from the mountains into the city. The water from the mountains was coming from a clean and protected source. They even had separate areas to put human waste and bath houses, unlike London. Romans were ahead of their time; no one had ever done that before.

Greenville has worked to protect our water, and as a result, we have one of the most protected and cleanest sources of drinking water around! Just like the Romans had aqueducts bringing their water into the city, Greenville pipes its drinking water in from reservoirs surrounded by forests located in the mountains. The drinking water here is some of the best in the country, and that is good for both the people and the environment. No matter the time period, and no matter if you are coming from London, Rome, or Greenville, water has always been extremely important. Water impacts our health, and our environment, helps us grow food, and even provides us with sources of transportation and relaxation. As we have seen, when people do not take care of their water source, it can negatively impact their health. A healthy community is dependent on healthy, clean water.

Chapter 4: Housing

Shelter is a basic human need. The way that we build homes, the materials that we use to build homes, and the structure and shape of our homes has changed over time. Many factors affect the design and construction of shelter. The background information and activities in this chapter will explore different housing types, the reasons for building the way that we build, and some of the challenges that communities will face in the future regarding housing.

TYPES OF HOUSES

Learning Objectives

Students will

- understand that houses come in many different shapes and sizes
- be introduced to a variety of different types of houses from places around the world and learn that the environment and needs of the people who live in these houses affect the materials and shape of the structure
- compare and contrast different houses from around the world with their house

Background Information

Shelter is a basic human necessity. Houses protect people from weather and the environment, and provide a safe place to sleep, eat, and live.

Since houses are built in order to protect people from their environment, it follows that the way a house is built and the way it looks will change depending on where it is located.

Traditionally, houses were built out of readily available materials to protect people against the unique challenges of the area in which they lived. The geography of the land, the natural communities and natural resources available and the climate all affect the materials, shape, and placement of houses built in those places.

We will discuss some of the traditional houses found in three very different biomes; desert homes, tropical homes, and arctic homes; in order to demonstrate that the environment where a home is located impacts how it is used and built.

Word Bank

Mixed Use
Development
Density
Nomadic
Earthship
Urban
Suburban
Rural
Biome
Design
Construction
C&D Waste
Architecture
Climate
Reclaimed
Recycled
Certification
Green Building
Infill
Efficiency
LEED

Housing Journal Prompts

Describe the materials used to build the house that you live in. Imagine that your house was built 200 years ago. Would the materials your house is made of be different? Why?

Compare an igloo with a traditional desert house. How are they similar, and how are they different?

Describe 3 environmental factors that have to be taken into consideration when building a house. How would each affect the materials used or site chosen?

Why do people build apartment buildings? What environmental conditions are needed to make an apartment building a good idea?

Why is mixed use development something that is might be considered more sustainable than traditional subdivisions?

Desert homes

Desert biomes are very dry with little vegetation. People who live in deserts face challenges related to sun, heat, and finding water. Traditionally, wood was difficult to come by, so people who lived in deserts would not have access to wood as a building material. Some desert people were nomadic, following traditional routes to find food and water for themselves and their animals.

Without access to wood as a building material, desert peoples had to make use of what was available to them.

- Some, like the Pueblo of the American Southwest, carved homes in natural caves along cliff faces. (http://teacher.scholastic.com/researchtools/researchstarters/native_am/)
- Some desert people made use of the abundant sand and clay to create homes made primarily from a mud brick called adobe or rammed earth.
- Nomadic desert people often made portable homes from animal skins, felt, or fabric woven from animal hair such as the Mongolian Ger (also pronounced Yurt).
- Deserts can be cold or hot, but they are always dry.
- One feature that many traditional desert homes share is a lack of windows, or a low number of windows.
- Photographs of adobe, mud brick, and earthen homes <http://www.touropia.com/amazing-mud-brick-buildings/>

Tropical homes

A tropical rainforest is a forest filled with plant and animal life with tall trees in the tropics, near the Earth's equator. The temperature is generally warm, between 68 and 93°F, and there is a lot of rain, often more than 100 inches in a year. The large amount of rain in tropical rainforests leads to very high levels of humidity, especially on the forest floor where there is little light or breeze due to the shading canopy of tall trees. There is no cold season. The timing of rainfall may vary with a wetter and drier season.

- Rainforests are filled with plant life. Unlike desert homes, there is an abundance of wood and other plant based building materials available.
- Rainforest homes must protect people from rain and heat.
- Rainforest canopies are often dense, making the floor of the rainforest much darker than open land.
- Bricks or adobe style homes would be uncommon in a tropical rainforest environment because the humid, wet air would make it difficult to make bricks.
- Rainforest homes may have to take into account seasonal flooding. The design aspects that may be used include homes on rafts, homes on stilts, or even homes in trees.
- More information about tropical rainforests <http://www.britannica.com/EBchecked/topic/606576/tropical-rainforest>

Arctic homes

The arctic is primarily in the Northern Hemisphere. The arctic is very cold. The growing season is only around 60 days each year. During the summer, the sun stays up for weeks at a time, and during the winter, there is no sun for weeks at a time. There is little precipitation in the arctic. It is often windy, and the ground is frozen in a layer called permafrost.

- Traditional snow homes in the arctic, commonly called igloos, were made in dome shapes with blocks of snow that turn to ice.
- Many native arctic peoples were nomadic, building snow houses in winter and living in tents made from skins during the summer.
- Today, due to trade and modernization, many arctic people have homes similar to those found in other parts of the world, made of wood. These homes are often built raised on stilts above the ground. If they were built directly onto the ground, the heat from the home may melt the permafrost and cause the house to sink.
- Information about the Arctic biome and the traditions and habits of the people that traditionally lived there http://www.mnh.si.edu/arctic/html/resources_faq.html
- <http://www.aitc.sk.ca/saskschools/arctic/Apeople.html>

In contrast to traditional housing, modern housing often looks very similar, no matter what climate it is built in. Yet, modern housing is often still built to respond to the environment it is in. Apartment buildings are built in order to allow many people to live in a small space, so they are most often found in cities, where there is a high population density. We will consider four types of modern homes, apartments, mixed use housing, single family homes, and earthships.

Apartments

Apartments are buildings with many different homes separated inside so that many people can live in a single building.

- Apartments are common in cities.
- Apartment homes allow more people to live on a smaller space by building upwards instead of out.
- Apartment buildings make sense in cities. The demand for land and space is higher in a city, and thus the cost of land is higher. Apartments allow for affordable living space in a high demand area.
- Apartments come in all shapes and sizes. Some apartments are small, some could be as large as an entire floor or more of an apartment building.

Mixed Use Housing

Mixed use developments are developments that make use of an area to include a variety of uses such as residential, commercial, shopping, and even industrial. Mixed use developments may be apartment style, offering multiple units in one building. Since mixed use development combines a variety of functions, they are common to towns and cities, especially in central areas where people want to live very close to where they work, shop, and eat.

- Often, mixed use housing today is a combination of apartment style homes above retail or commercial spaces.
- Mixed use housing makes it possible for people to live within walking distance of places where they can work or purchase goods and services, saving money and time on transportation.

Single Family Detached Homes

Single family detached homes are what we tend to think of as “normal” houses. Most common in suburban and rural areas, single family homes are homes that hold one family or small group of people and usually sit on a parcel of land, known as a lot.

- Single family homes are less common in downtown areas of cities due to the population density and the cost of land in cities. Since there is a high demand for property in downtown areas, it is very expensive. Usually, apartments, town homes, or mixed use developments, where many people can live on a small amount of land, are more affordable in cities.

Earthships

An earthship is a modern home that is built to be energy efficient and environmentally friendly using a variety of green building techniques including passive solar, rammed earth tire foundations, water collections, and grey water systems.

- Like the traditional houses, an earthship makes use of materials that are common in their environments. Since earthships are built in developed countries, we have a surplus of used tires. Tires filled with soil make up the foundation of earthships.
- A major goal of earthship homes is to build a home that is environmentally friendly and self sustaining as possible. Many earthships are built to be completely “off grid,” meaning that they are not hooked up to electrical systems or water systems and must generate their own electricity, capture their own water, and stay cool in summer and warm in winter with minimal outside inputs. In order to do this, earthship builders use many green building techniques that will be discussed in the green building section later in this chapter.
- Earthships are built primarily from reclaimed and recycled materials. Because of the range and uniqueness of the building materials and the fact that earthships are built to work with the climate that they are in, similar to traditional houses, earthships are often very unique in design.

*Learn more about earthships
and the theories behind them
through earthship.com*

Types of Houses Activities:

Where in the world? Using visual clues.

Provide students with photographs showing a variety of traditional and non-traditional homes, including examples from the background information in this section, and have them guess where in the world the houses are located based on the materials that they are built with and their shapes.

This could be a small group activity, an individual activity, or a journal entry. Ask the students to explain why they made the choices that they did.

Similarities and differences

Using the photos from “where in the world,” ask students to compare and contrast pairs of houses. How are they alike? How are they different? Why?

Drawing a home

Discuss the difference between the word house and the word home.

Provide the students with a piece of recycled cardboard and markers or crayons. Have the students draw a representation of their home, including at least two windows.

In the windows, have the students draw a picture of something that is very important to them. Once everyone has finished their drawing, have each student present their home to the class, including why it is special.

Have a housing photohunt. List and discuss some different types of houses that you might see in and around Greenville, SC. Have students take photographs of as many different types of houses as they can find and put together a photo collage.

Are any of these houses built the way they are because of the environment?



Community center students view photographs of traditional houses from different parts of the world.



Community center students draw representations of their homes on recycled cardboard.

Green Building Journal Prompts

What does it mean to be a “green” person? Describe three things that you could do to be green.

How can a building be green? (not the color)

Do you think that the landscape around a building is important? How does the landscape relate to the building?

Why are sustainability professionals interested in green building?

If you could change one thing about your home to make it greener, what would it be?

Why is site placement (where a building is located) an important thing to consider when creating a green building?

GREEN BUILDING

Learning Objectives

Students will

- be introduced to the environmental impacts of buildings
- understand why a green building approach is beneficial economically, environmentally, and for human health
- learn what LEED stands
- research an aspect of green building

Background Information

Buildings are everywhere, and the construction, operation, and demolition of buildings has a large impact on environmental and human health. Some statistics related to why a sustainable approach to building is needed include:

Buildings are responsible for 38.9% of total U.S. energy consumption and 72% of electricity consumption (2005 EPA)

Buildings contribute 38.9% of the U.S. Carbon Dioxide emissions (2008 DOE)

Americans spend about 90% of our time indoors where air quality can be 2 – 5 (and occasionally >100) times worse than outdoor air quality (EPA)

The amount of waste generated by construction and demolition of buildings is approximately 160 million tons/year

The average U.S. family moves every 10 years.

For more statistics about buildings: <http://www.epa.gov/greenbuilding/pubs/gbstats.pdf>

A “green building” is any structure that is designed, planned, constructed, and operated in a way that minimizes its impact on the environment, increases efficiency, and protects human health. Green buildings are sustainable structures. Many people seem to think that expensive technology such as energy star appliances, solar panels, and green roofs are necessary for green building, but sustainable constructions have been around for years. One major part of a green building that is often overlooked is the price. In order to truly be sustainable, a structure also needs to be economically accessible to build and inexpensive to operate.

Green buildings take into account the impact of the structure throughout its life cycle. A green building is one that is sustainable and has a low environmental impact in every part, from the design and planning of the building to the site selection, maintenance, energy use, construction, and even the landscaping.

Green building is a holistic approach to design and construction that considers the building’s impact and connections to the surrounding area and environment. Increased efficiency in green building also leads to lower operating costs, making green buildings more economically sustainable over time.

There are many considerations that go into the design and development of a green building. The following list can be considered a starting point for exploring

some of the elements of a green building, but should not be considered a comprehensive list:

Design

Materials

Site placement

Landscaping

Building efficiency

Technology

Design

The design of a building is the planning stage. During this stage, the architect takes into account all of the aspects of creating the building. A green design plan will effect a lot of different decisions, including what the building is made of, where it is located, and the electrical, water, air ventilation systems that will be a part of the finished structure.

The design plan will also take into consideration the future uses of the building. A building that is going to be used as a grocery store would have different needs than one that would be used as an office building or home.

Materials

Many different types of materials go into building construction (bricks, wood, tiles, wires, windows, door knobs, pipes, roofs, etc.). Green builders make an effort to use materials that are environmentally friendly, sustainable, and safe as often as possible.

Some options for green building materials include:

Recycled – recycled materials are anything that is broken down and made into something new. Many parts of buildings, from floor tiles to siding, can be made from recycled materials. Using recycled materials for building instead of newly harvested (virgin) materials, saves energy, protects natural resources, and is often less expensive.

Reclaimed – reclaimed materials are anything that is reused as it is, without making it into something new. According to the US EPA's green building statistics report, the US throws away an average of 160 million tons of debris of C&D (construction and demolition) waste each year. 54% of that is from demolition, and 44% is from renovation. Reclaiming materials from buildings that are about to be demolished or renovated can save a significant amount of waste from being thrown into landfills, and can be much cheaper than using new materials.

Environmentally grown and harvested - another option for green building materials is to purchase items that are virgin, but that are grown or harvested in an environmentally friendly way. Many factors contribute to whether or not a virgin building material is environmentally friendly, including where it comes from, how much fossil fuel is used to grow and harvest it, how far it is shipped, how much water is used to grow or harvest it, how much a harvesting operation affects air quality, whether or not the workers are paid a fair wage, and much more. Since it is very difficult to research every aspect



The A J Whittenberg greenhouse is also a green building because it is made of plastic bottles, utilizes passive solar energy, and collects rain water.

of a material, many green builders rely on third party certifications, such as the FSC (Forest Stewardship Council) to certify whether or not a material is grown and harvested in an environmentally friendly way.

Healthy and safe – and important aspect of green building is making sure that the final structure will be long lasting, healthy, and safe for the people that are using it. An important part of material selection for green builders is making sure that they are using non-toxic, safe materials.

Site Placement

Where a structure is built and the orientation of the structure on the site are all part of site placement. Many aspects of site placement affect how sustainable a building is.

Region or climate – when planning a green building, one of the first things that an architect or builder will consider is the regional climate, soils, and other physical factors of the site. As discussed in “Types of Houses,” climate has a huge effect on what type of building is suited to an area. In the Southeastern United States, for example, we have hot summers and generally mild winters, so it is less important for a builder to consider the effects of snow on a building and more important to consider energy efficient cooling systems.

Other general regional issues that contribute to whether or not a potential structure is green include whether or not (and how intensely) the construction would impact wildlife or threatened or endangered plants and whether the area is in a flood zone.

Infill – Infill occurs when a structure is built on a vacant lot in an otherwise developed area, such as a city. Infill construction can be more expensive due to the difficulty of getting construction equipment into areas that are already urban. Yet, infill can be more sustainable than building in an unoccupied, rural area, because the infrastructure (water, electricity, roads, transportation systems, etc.) that people need is already in place. Also, infill construction makes use of vacant and underutilized properties (such as brownfield properties) instead of building in a less developed area, and that can protect populations of plants, animals, and their natural habitats as well as natural resources in rural areas.

Orientation – once the correct site has been matched with the correct structure, the orientation of the building on the site must be considered. One example of the importance of site orientation are the Charleston “single houses” which were built with long and open floor plans designed to catch the breeze off the coast and long shaded porches which helped keep the inner rooms of the home cool in the hot summer. Examples of orienting a building to help keep it cool or warm have been found even as far back as ancient Roman ruins.

Constructing a building so that the orientation, structure, and materials of the building help keep it warm in winter and cool in summer is considered “passive solar” technology. Earthships and other buildings that make use of passive solar energy have a long layout with most of their windows on the Southern facing side of the building so that the sun shines inside in winter. Other features of passive solar include using landscape trees to shade the house and

block wind on the East and West; overhangs that block the sun during the summer; and large areas of earth or water that act as thermal mass, absorbing heat during the day and releasing it during the evening, helping to regulate the temperature of the building.

Landscaping

Green building is a holistic approach to building and design that takes the whole site into account, including the area around the building and how it is landscaped. There are many ways that landscaping can help to make a building more sustainable: reducing the amount of water used, or collecting water, reducing pesticide and herbicide use

Materials: The same concepts that apply to materials used inside the building apply to the materials used in the landscape. Local, reclaimed, and reused materials are often used in green building landscapes to reduce the impact of transport and production of materials and to reduce the price.

Permeable surfaces, such as brick pavers in place of concrete walkways, help water infiltrate into the ground, reducing storm water runoff. Native plants often need less water and chemical fertilizers or pesticides, since they are adapted to the environment that the building is located in. Using native plants in the landscape also provides habitat for native animals and helps protect and conserve local ecosystems.

Xeriscaping, using plants and other items that require little or no water (such as rock gardens and cactus) is one option for conserving water in the landscape. Other landscaping practices, such as *rain gardens, rain barrels, and green roofs,* contribute to water conservation and protect water quality. Green roofs and plants in the landscape can also lead to improved air quality, especially in urban areas where green roofs may be able to help reduce the urban heat island effect.

Edible landscaping, growing plants that are both attractive and edible, is a concept that is currently growing in popularity. Reducing the need for trips to the grocery store and providing healthy food on site is another way that landscaping can contribute to a green building.

Building Efficiency

As both a part of the environmental and economic sustainability aspect of a structure, energy efficiency is a key part of the design, maintenance, and operations of a green building. Energy efficiency results in less energy use in general, which leads to less pollution from the source of the energy. There are many ways that a building can be designed to be more energy efficient, from insulation to orientation for passive solar.

Energy sources: Where the building gets its energy from contributes to its sustainability. Traditional energy sources like coal, oil, and natural gas, are fossil fuels, and thus unsustainable. Alternative energy sources such as wind turbines, solar panels, methane digesters, and geothermal systems, are often used to power or help power green buildings.

Efficiency of the systems: The efficiency of heating, cooling, and ventilation systems in a green building are maximized in many ways. Each building is different, so this means different things in

Green Building Topic List:

Bioswales
Composting Toilets
Cool Roofs
Energy Star Appliances
FSC (Forest Stewardship Council) certified lumber
Geothermal Heat
Green Roofs
Insulation
LED lights
Living Walls
Low or No VOC paint
Native Plants
Permeable Pavers
Radiant Heat Floor
Rain Barrels
Rain Gardens
Reclaimed Building Materials
Recycled Materials
Renewable Materials
Solar Panels
Tankless Water Heaters
Thermal Mass
Timers
Wind Turbines
Xeriscaping

each building. In general, high insulation, proper design, regular maintenance, energy efficient fixtures and appliances, and energy saving precautions are incorporated into green building systems and maintenance.

The human factor: Education is key to helping green buildings stay green. It doesn't do much good to use energy efficient light bulbs and low flow faucets if the people in the building leave the lights on all the time and let the water run constantly. Unplugging "energy vampires" like cellphone chargers and video game consoles, turning off the lights when you leave the room, keeping the thermostat low in winter and higher in summer, and other simple energy saving habits can be a big part of a green building.

Technology

Technology can be a useful tool in designing and creating structures, but it is not an essential part of a green building. Solar panels, motion sensors for lights, green roofs, wind turbines, energy efficient appliances, living walls, low flush toilets, and more are all examples of technology that have already been discussed that can be incorporated into a structure to make it more sustainable. Yet, simple, hand built cob houses with very little technology are also green buildings. In green building, the end result of a sustainable, energy efficient, healthy structure is more important than the technology that goes into it.

Green Building Activities:

Research an aspect of green building.

In small groups or individually, assign students a topic related to green building from the list on the left. Students should research their topic and make a short presentation to the class. Use the following statements and questions as research prompts, or add your own:

- Define your topic
- How does your topic relate to green building?
- What aspect of green building; efficiency, environmental health, or human health and safety, does your topic contribute to? How?
- Show an example photograph of your topic.
- Is there anything else that they class should know about your topic?

Watch a movie about Earthships

For a very young audience:

Bob the Builder builds an Earthship

For an older audience:

Garbage Warrior

Visit a green building:

The South Carolina chapter of the USGBC web page has a map showing all of the LEED projects located in South Carolina.

http://www.usgbcsc.org/site/?page_id=12

Have students read the “What is LEED” page.

Take a field trip to visit a LEED certified building.

Does the building look different from other buildings?

How?

If students have access to a computer, have them take the **Green Building Web Quest** and follow up with a class discussion.

Provide students with the critical reading pieces “What is LEED?” and “Sustainability and Housing.”

Some possible questions for discussion, journals, or other assignments are provided following the articles.

Green Building Web Quest

Instructions: visit the websites listed below to help answer questions about Green Building. Answers must be in complete sentences.

<http://climatekids.nasa.gov/career-contractor/>

http://greenliving.about.com/od/architecturedesign/tp/green_building_advantages.htm

<http://www.scholastic.com/browse/article.jsp?id=3754018>

<http://www.epa.gov/greenbuilding/pubs/whybuild.htm>

<http://greenliving.nationalgeographic.com/green-homebuilding-techniques-3157.html>

Where do materials for Green buildings come from?

What is the purpose of Green building?

List one specific thing that Michael Gubbins says green buildings do.

How does green building impact human health?

Why is energy efficiency an important part of green building?

What is something new that you have learned about green building?

Green Building Web Quest: Teacher's Copy

Instructions: visit the websites listed below to help answer questions about Green Building. Answers must be in complete sentences.

<http://climatekids.nasa.gov/career-contractor/>

http://greenliving.about.com/od/architecture/design/tp/green_building_advantages.htm

<http://www.scholastic.com/browse/article.jsp?id=3754018>

<http://www.epa.gov/greenbuilding/pubs/whybuild.htm>

<http://greenliving.nationalgeographic.com/green-homebuilding-techniques-3157.html>

Where do materials for Green buildings come from?

- *Local sources (mentioned specifically in the climate kids contractor interview)*
- *Reclaimed materials*
- *Recycled materials*

What is the purpose of Green building?

- *Green buildings decrease the impact of development on the environment, reduce operating costs over time, and improve overall quality of life*

List one specific thing that Michael Gubbins says green buildings do.

- *Recycle water, generate power, make it easy to recycle garbage (all three are mentioned in the scholastic article as specific things that Michael Gubbins mentions)*

How does green building impact human health?

- *Green buildings reduce indoor air pollution, which leads to healthier occupants. Specifically, lower rates of asthma due to reduction in VOC through low and no VOC carpets and paints, increased ventilation and air circulation*

Why is energy efficiency an important part of green building?

- *Energy efficient buildings use less energy, which leads to less pollution at the energy source. Energy efficiency also leads to lower operating costs over time.*

What is something new that you have learned about green building?

- *Answers will vary*

What is LEED?

LEED stands for Leadership in Energy and Environmental Design, and it is a certification program run by the US Green Building Council. This program provides graded certifications for green buildings on a point scale, similar to receiving a grade on a report card. There are multiple categories in which a project or building can be certified, and there are many ways that buildings can earn points. Categories and rating systems are reviewed and may change every few years in order to keep the LEED rating system up to date with new science and technology.

The category system in LEED is designed to take the needs and challenges of specific types of construction into consideration. Basically, the category system is in place because it would be unfair to judge a small house by the same criteria as a hospital or a large retail store. The categories currently available for certification are: new construction, existing buildings, core and shell, commercial interiors, retail, homes, neighborhoods, schools, and healthcare. The first step in applying for LEED credit for a building or project is choosing the category that the project falls into.

Within the project category system, there are many ways that a project can earn LEED credits. These are broken into five main credit categories, with three extra credit categories that apply specifically to neighborhood development projects and two extra credit categories that apply to homes. General credit categories are:

- Sustainable sites: These credits are awarded for buildings and projects that use design and technology to minimize the impact of the building on ecosystems and water resources.
- Water efficiency: These credits are awarded for buildings and projects that apply systems and technology that reduce the use of water and that encourage water conservation.
- Energy and atmosphere: These credits are awarded to projects that reduce energy use through technology and design.
- Materials and resources: These credits are awarded to buildings and projects that use sustainable building materials and utilize design and technology to reduce waste.
- Indoor environmental quality: These credits are awarded to buildings that promote indoor air quality and improve indoor quality through the use of windows and natural lighting.

Why LEED? A building can be a green building and not have LEED certification. LEED certification is entirely voluntary. There are many reasons that someone may choose to certify their building or project through LEED. Think of LEED as an award that you have won. That award shows the world that you are good at something. LEED does the same thing, but for environmentally friendly buildings. The highest level of LEED certification available is LEED Platinum, followed by gold, silver, and certified.

Sustainability and Housing

By Emily Hays, Furman University

Sustainability is an important concept that is part of every piece of our lives, including where we live. At the core of sustainability is longevity; if something is considered sustainable, it is expected to last a long time and be self-sufficient. How can we continue to use earth's resources today in a way that does not take advantage of them and does not limit the ability of future generations? When it comes to housing, this question becomes: how can we maximize housing availability as earth's population continues to rise without over exploiting earth's resources or destroying virgin landscapes? The answer may lie in existing infrastructure.

Instead of developing new properties from virgin landscapes, consider the alternative: renovating existing properties. By using existing foundations and redeveloping properties, the impacts extend beyond just conserving forests or property. Think about it: If a new house is built on untouched land, trees must be cleared, the ground must be leveled, and the materials transported to the building site. In order to transport materials, there must also be a road of some sort to make that property accessible. Roads typically mean more development. The process of developing untouched landscapes leads to the development of more land, and could very easily lead to an urban sprawl development, with more roads, homes, schools, and shopping centers popping up farther and farther away from the urban center.



Mixed use redevelopment: River Place in downtown Greenville



Mixed use redevelopment in Atlanta , GA

However, one way to reduce this ripple effect of development is to simply take advantage of existing properties. Purchasing an existing lot can sometimes be more expensive to redevelop, but alternately to urban sprawl, let's consider the ripple effect. Roads, schools, shopping centers, and neighborhoods are already in place. Therefore, the property is accessible. Redevelopment helps improve the aesthetics of a neighborhood, encourages other homeowners to renovate rather than move away, and consequently can help further boost the economic development of a neighborhood. It becomes a place where people want to live rather than a place someone seeks to move away from.

One emerging innovative solution to redeveloping properties is the placement of mixed-use housing in an

area. This type of housing links residences with businesses, transforming an area where people live into a lively space where people can live, shop, work, and play without needing to go far to get to the things that they need. An example would be a building that has shops on the ground level, convenient for the passerby on the street and those that live in the building, with apartments or condominiums on the upper floors of the building. In some cases, mixed-use housing includes shops, office space, residential space, and even parks and open space. This is often also more affordable than owning a single family home and maintaining the property.

Creating places where people want to dwell can be a challenging task, but when transportation opportunities are linked with economic development and recreational areas, people find that area much more attractive. This is why the location of housing is such an important piece of sustainability. Where homes are situated impacts where and how people live, work, and play. In addition, in areas where jobs, transportation, mixed-use housing, housing opportunities, schools, and recreational facilities are linked, communities are safer and healthier.

What is LEED? Questions for Discussion

- 1) What type of writing is this piece?
- 2) In your own words, explain what a LEED building is.
- 3) What is the difference between a building being a LEED building and a green building?
- 4) Do you think that there is a downside to LEED certification? What is it?

Sustainability and Housing Questions for Discussion:

- 1) What is the author's main point? Do you agree or disagree with her, and why or why not?
- 2) What is mixed use development, and how does mixed use development relate to sustainability?
- 3) What is infill development, and how does infill development relate to sustainability? Do you think the author of this piece would approve of infill development? Why or why not?
- 4) Describe a type of development that you think may be unsustainable according to the author. What about the development you have described makes it unsustainable?
- 5) Would you like to live in a mixed use development? Why or why not?

*Compare and contrast the two articles.

My Greener House Journal Prompts

What aspects of your home do you think are good for the environment or bad for the environment?

Overall, would you consider yourself a “green” person? Why or why not?

Write a paragraph about the connections between the environment and human health.

Why is human health an important aspect of sustainability?

What does the term “resource use” mean to you? How can we as a society reduce resource use while still providing a high quality of life for our citizens?

Do you think that the government has a responsibility to be “greener?” Why or why not? If so, provide an example of something you think the government should do.

MY GREENER HOUSE

Learning Objective

Students will:

- learn about and discuss aspects of housing, other than the building itself, that relate to sustainability.
- analyze their personal habits in order to determine ways in which they could live a more sustainable lifestyle
- use prior knowledge of green building concepts to explore ways that they can make their own homes more energy efficient or environmentally friendly.

Background Information

Something that is sustainable is long lasting, affordable, and easy to maintain with minimal external input and minimal environmental impact. Sustainability can be thought of as a large puzzle. Many different pieces work together in order to make up the whole. We can't feasibly cover every aspect of housing that contributes to whether or not a housing system is considered sustainable, but we can make a start.

Some of the issues that contribute to the sustainability of housing include:

Affordability

By definition, something that is sustainable is something that can last a very long time. So, in order to be sustainable, housing must be affordable. Since affordability means something different to every person, depending on their circumstances, this is can be a complex issue.

Many factors affect the affordability of housing:

Where it is located

- How close it is to a person's work, food source, and other needs. For example: the further away an individual's house is from the place that they work, the more money they will have to spend in transportation costs.

Physical aspects: the size of the house, how new it is, and the materials it is made of will all affect affordability.

Maintenance and operation costs: many of the energy efficiency measures discussed in the Green Building lesson can be applied to a house in order to reduce the amount of money that a person has to spend in electricity and other bills. The lower the operation cost, the more affordable the house will be, but some of these measures cost a lot to implement.

For more information on the importance of affordable housing:

<http://www.nhc.org/media/files/Housing-and-Economic-Development-Report-2011.pdf>

Location

The location of housing is an important aspect of its sustainability. If the housing is located in a place where it is necessary to drive a long way in order to get food, go to school or the doctor, it may be considered less sustainable for some people than a home that is located in a neighborhood along with all of the things a person needs to survive.

On the other hand, an off grid home like the earthship that we learned about in the green building section, would not necessarily be less sustainable without access to a grocery store or water pipes because it is built to grow food and collect rain water.

Location also takes transportation systems into account. Especially for individuals who do not own cars, transportation systems (including alternative transportation systems such as bike lanes, trails, and sidewalks) are an essential factor in choosing housing. Housing is more sustainable if a variety of transportation options are available.

Safety and health

Social issues are very important when discussing sustainability. Something that a person can live in for a long time should be a safe and healthy environment. Many things contribute to whether or not a home is safe and healthy, including the materials that it is built with and where it is built.

Environmentally friendly

We have already learned about green buildings, but what about a house that has already been built? A building doesn't have to be specially designed to be more efficient and environmentally friendly. A great way to make a home more environmentally friendly is to change your habits. Being "green" is all about reducing waste and saving resources. Through some simple changes, we can save money and protect the environment, and make our homes "greener."

A home can be more environmentally friendly, or "greener," through any of the following

- Conserve water
- Conserve energy
- Reduce resource use

My Greener House Activities:

A Greener Me:

On the board, list the following topics

Electricity

Water

Food

Waste/Trash

Have students brainstorm things that they do that is wasteful. In order to start the brainstorming, some examples may include:

- Leaving the TV on when not in the room
- Taking very long (or very hot) showers
- Opening a drink and only having a few sips and then throwing it out
- Not recycling

After brainstorming habits that are wasteful, have students come up with ways to fix these habits.

Next, introduce either the “My Greener Home” quest, or the “A Greener Classroom” group project.

A Greener Classroom:

Ask the class: are any of these habits things that we do here at school?

Some examples may include

- Leaving the light on when you leave the classroom
- Using multiple paper towels when drying hands
- Throwing paper in the trash instead of the recycling bin

Propose a “Greener Classroom” week where students are asked to be mindful of their wasteful habits and try to change. Create a “Greener Classroom” chart and list the habits that the class is trying to break. Every time that a student does a green thing (recycles, turns the lights off, turns off the water while soaping their hands, etc.), draw a star on the chart next to that habit. You may want to provide incentives, such as an extra 5 minutes of recess when the group reaches a certain number of stars.

MY GREENER HOME

Directions: Become a **green detective**. Use the questionnaire below to discover some of the ways that you could make your home greener.



Energy

1) Energy Vampires:

___ The number of appliances or electronics that are plugged in at your house.

___ How many electronic devices are on chargers?

___ Are any chargers still plugged in when the electronic is not connected?

___ How many appliances or electronics have a clock or a light that is always on?

2) Wasted Energy:

Make a tally every time that -

___ A light is left on in a room and no one is there.

___ An electronic device (TV, video game, computer, etc.) is on and no one is using it.

Do you (or anyone else in your family) ever:

___ Leave the door open longer than you need to while the heat or AC is on?

___ Leave the refrigerator door open?

3) What temperature is your thermostat set to?

BE A DRAFT DETECTIVE:

Make a draft detector by taping a piece of toilet paper, cut in a long strip, to the end of a pencil. Hold your draft detector about an inch away from the cracks at the bottom and sides of doors and windows. If it flutters, there is a draft.

___ Total # windows ___ # with drafts

___ Total # doors ___ # with drafts

Water

1) Leaks

___ The number of faucets in your home

___ The number of faucets that leak or drip

Check Y or N if you have the following at home:

Dishwasher Y/N

Washing machine Y/N

Outside spigot Y/N

A sprinkler system Y/N

A pool Y/N

___ The number of times you flush the toilet in a day

Food

___ Do you ever have left over food at the end of a meal?

___ Does your family compost?

___ Do you eat your left overs?

___ Does your family ever throw out food that has gone bad because you didn't eat it?

___ Do you ever have meals that don't include meat?

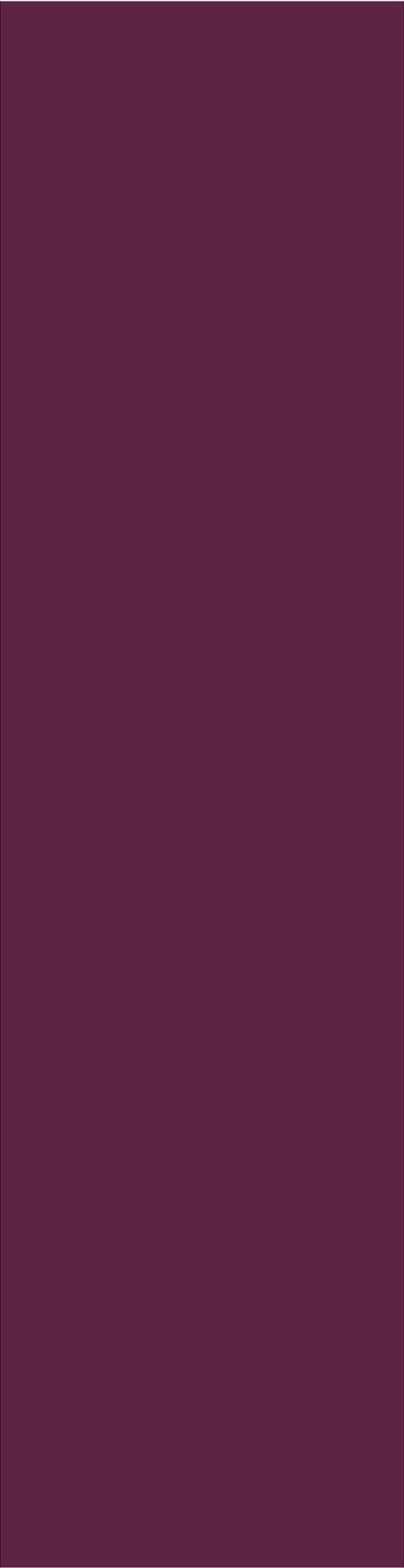
___ Does leftover food go in the trash can?

Waste

___ Do you recycle?

___ Do you every throw away anything that you could reuse?

___ Do you donate used items to thrift stores or hold garage sales instead of throwing things away?



Break the class into small groups and assign each group one of the topics below. Ask the students to **brainstorm** what these topics mean in relation to housing and what they have to do with sustainability and being green as a society.

Ask each group to **report** their decisions to the class and then have a group **discussion**.

Affordability

Safety and health

Location

Environmentally friendly

Chapter 5: Transportation

People need transportation to get from one place to another. Whether or not reliable transportation is available to an individual affects that person's quality of life. Transportation can also be expensive.

Most U.S. cities are built with the car in mind as the main form of transportation that people will use to get from one place to another, but the car is not the only form of transportation, and the expense both economic and environmental of owning a car makes it difficult for some residents to afford.

Sustainability and Transportation— a sustainable transportation system is one that will last and be effective for a long time while remaining affordable and causing minimal environmental damage. The current trend in transportation, one car per person, is not sustainable. Automobiles are expensive, use large amounts of fossil fuel energy, and pollute the air.

TYPES OF TRANSPORTATION

Learning Objectives

Students will

- understand that transportation is necessary in our daily lives: to get from one place to another, a person has to use some form of transportation
- become familiar with many forms of transportation, including some of the most commonly used for daily life in Greenville SC (commuting, running errands)
 - driving a car
 - riding a bike
 - bus
 - walking

Background Information

Transportation allows people to get from one place to another.

People use some form of transportation almost every day to get to work, school, run errands, and perform other activities.

Transportation occurs any time a person moves from one place to another, and transportation systems include any vehicle or combination of vehicles that can be involved in transporting a person, a group of people, or goods.

Word Bank

Transportation
Public Transportation
System
Multi-modal
Walkability
Trail
Green Way
Road Diet
Automobile
Bus Rapid Transit (BRT)
Vehicle
Alternative
Fuel
Hybrid Car
Pollution
Emission
Commute
Light Rail

Transportation Journal Prompts

Would you consider a playground slide a form of transportation? Please explain your answer.

How many different types of transportation have you used this year? List as many as you can remember and discuss your favorite and least favorite.

Do you think that buses are a sustainable form of transportation in Greenville right now? Explain your answer.

In this section we will focus on the most common types of local transportation that may be used to run an errand or on a daily commute to and from work, but it is important to note that there are many other types of transportation and transportation systems such as planes, boats, helicopters, trains, etc.

Each type of transportation system has benefits and drawbacks.

Bus

While there are many types of public transportation, the most common public transportation system used in Greenville, SC is the bus. Bus systems allow many people to be transported at one time.

One major benefit of public transportation is that it comes at a comparatively low cost to the rider.

- More than just the price of a ticket, using public transportation also means reduced upkeep on cars and less money spent on gasoline.
- Public transportation helps reduce emissions from cars into the atmosphere because it allows many people to be on one vehicle at the same time.

The main drawback of public transportation is that it may not be convenient because of a lack of stops or convenient stop times. Few public transportation systems run 24/7, so individuals that need transportation late at night would not be able to use the bus.

Greenville's Greenlink bus system has 11 fixed routes that run from as early as 5:30 AM until as late as 7:30 PM. For more information about Greenlink visit <http://www.greenvilleesc.gov/RideGreenlink/default.aspx>

Car

Cars are normally owned by individual people or families and are used to transport a small number of people.

One of the main benefits of using a car as a means of transportation is that it allows the individual to decide when and where they would like to go without other concerns.

- Cars allow for longer trips than may be feasible for bicycles or walking, and unexpected stops as well as transit at any time of the day or night, something that cannot be achieved with the current bus system in Greenville, SC.

A drawback of cars is that they are an expensive form of transportation.

- Gas prices are rising and it costs money to keep cars well maintained.
- The costs of insurance, parking, and other driving related expenses also contribute to the high expense of car ownership.

Another major drawback of individual car ownership is that a high number of cars on the road cause emissions into the atmosphere to increase.

There are other options to the traditional, fossil fuel car. One option is a hybrid car, which uses both fuel and electricity. Another is an electric car, which uses electricity as its main form of fuel.

Both hybrid and electric cars are a more environmentally friendly option to driving traditional fossil fuel cars, but these options and the infrastructure to support them are not yet available to all individuals.

There are also ways to make using an individual car for transportation more cost effective and environmentally friendly.

- Carpool (and split the cost of gas)
- Plan out errands and take a single trip to run multiple errands instead of going out multiple times.
- Make sure that your car is well maintained with proper air pressure in the tires and regularly changed filters and oil to get the most gas mileage and the least pollution.

Bicycle

This form of transportation is great for one person who is not going a long distance.

Bikes do not harm the environment with emissions.

People using bikes, walking, or buses as a form of transportation will result in a lower number of cars on the road. A lower number of cars on the road will reduce congestion, emissions, and the overall time of commutes.

Biking is a form of active transportation, meaning that the individual is actively working in order to move from place to place. This makes it good exercise. People who exercise regularly tend to be healthier than those who do not.

The built environment plays a major role in whether or not people choose to use bicycle transportation as a regular alternative to the automobile. Bike paths, trails, and dedicated bike lanes on roads make it much easier and safer for bike commuters. Large roads with high speed limits and no set aside bike lanes can be unsafe for cyclists.

Bike transportation, for the average person, is typically only feasible for distances shorter than 3 miles.

Safety is of great concern when using bikes as a form of transportation.

- Cyclists should always use designated bike lanes (when available), be cautious of fellow cyclists as well as cars, be sure to clearly indicate which direction they are turning, and wear a helmet.
- When riding a bike in the early morning or the evening, bikes should have lights and reflectors to increase their visibility.



Trails like the Swamp Rabbit Trail in Greenville, SC, offer residents a safe and healthy alternative to automobile transportation, but in order to use the Swamp Rabbit on a regular basis, people need to be able to access the trail.



B-cycle stations allow people to rent bikes on a temporary basis in order to get around town.

The City of Greenville completed development of a bicycle master plan in 2011. Efforts by the City and its partners to increase quality of life in Greenville, reduce congestion and air pollution, and provide affordable transportation options are driving the creation of more a multi-modal transportation system where bike and pedestrian friendly paths are connected to bus hubs. Bike lockers are being installed across the city, and bike racks are on each Greenlink bus.

Bike share programs, like the B-cycle program started in Greenville in early 2013, allow individuals to purchase memberships and rent bikes from B-cycle stations.

Walking

Walking is a great way to stay fit and get from place to place in an environmentally friendly way.

Walking helps keep you healthy. It allows you to exercise while moving from one place to another without harming the environment.

Walking, like biking, is normally only appropriate for short to medium distances when you don't have a lot of baggage to transport.

It is also important to remember safety concerns when walking.

- Always remember to walk on sidewalks when they are available.
- When sidewalks are not available, walk on the side of the street against oncoming traffic so that you can see what is coming.
- When crossing streets, make sure to use cross walks and to be very cautious of oncoming and turning traffic.

Every transportation system has benefits and drawbacks. Knowing the benefits and drawbacks of the different types of transportation allows an individual to make an informed decision about which form of transportation they would like to use in any given situation.

Types of Transportation Activities:

Discuss transportation options:

Ask students about the most amazing place that they have ever been.

Ask where it was and how they got there.

Then ask them where they would like to go after school and how they would get there.

Are the transportation options that they use on a daily basis the same as the ones that they used to go to the most amazing place they have ever been?

If not, why are they different?

Play “Transportation 20 Questions”

Cut out the pictorial transportation (Appendix II) cards and pass them out to the students, telling them not to show their cards to anyone else.

Pair the students and have them try and guess their partner’s form of transportation by asking only “Yes” or “No” questions.

When students are finished, either switch pairs or give them new cards.

For a variation on the game, place the cards on yarn necklaces and hang them around the students’ necks with the photo in the back so that others can see the card. Each student must then find his or her match (do this by duplicating the cards). In this variation, the game will begin by each student asking their peers yes or no questions regarding their type of transportation. When the student thinks he or she knows what type he or she has, then they will try to find their pair. The goal of the game is for each student to figure out what form of transportation they represent. Once everyone has figured it out, the game is over.



A quick game of “red light, green light” is a great activity to get students ready to talk about transportation.



Community center students play “Transportation 20 Questions” followed by a discussion of the pros and cons of each of the major systems used in Greenville.



The Greenville transit center is a node in the City's multi-modal transportation network.

Finding positives and negatives:

Remove the cards for "walking, bicycle, bus, and car" from the deck and hand out the remaining cards to the class.

Individually or in pairs, ask the students to brainstorm 3 positive and 3 negative characteristics (pros and cons) of their form of transportation and present their conclusions to the class.

More pros and cons:

As a large group, ask the students to brainstorm positives and negatives for the 4 main types of transportation.

Compile the answers on the board and continue the discussion.

Some possible questions for discussion:

Which transportation system that we discussed is your favorite, and why?

Which transportation system do you think is safest? Do you think some of the transportation systems we discussed are not feasible for Greenville, Why not?

Can you think of any transportation systems that we have not discussed?

*Remind the students that any time we move from one place to another, we are experiencing a form of transportation and that in other parts of the world, people may not have access to the forms of transportation we use.

Some examples to get started may include:

- Pogo stick
- Elephant
- Rickshaw
- Jet ski
- Escalator
- Camel
- Hang glider
- Zip line
- Swimming

Map out a route:

Have students open the Greenlink bus route pdf <http://www.greenvillesc.gov/RideGreenlink/Routes.aspx>

Either singly or in groups, ask the students to choose 5 places on the map that they would like to go (include their home and school) and plan out a route.
Remind them that they can use streets and bike paths.

Divide the students into groups and ask them to **come up with five destinations** for each form of transportation: bus, car, bike, and walking. These destinations can be local, state wide, or national.

Take a field trip to a local bike shop or a local bus station to learn how different forms of transportation work.

Watch a **video** and follow up with a class discussion

About **bike shares**

About **bus rapid transit (BRT)**

Challenge students to count the # of types of transportation they see in the BRT video.

Can they find at least 9?

Research one of the transportation topics listed below and write a persuasive article intended to convince someone why they should or should not invest money in the transportation technology.

- Compressed Natural Gas (CNG) Bus Systems
- PRT (Personal Rapid Transit)
- Gasoline Hybrid Cars
- Cellulosic Biofuels
- Electric Cars
- Bike Share Systems
- Light Rail
- Greenways
- Biodiesel
- Self Driving Vehicles

EXPLORING THE SUSTAINABILITY OF TRANSPORTATION

Learning Objectives

Students will

- discuss how sustainability is related to transportation systems
- participate in a debate related to sustainability and transportation systems

Background Information

This set of information and activities is intended to allow students to further explore the advantages and disadvantages of alternatives to the car as a primary form of transportation and to provide background information into some of the factors that can determine the sustainability of a transportation system.

Walkability – walkability is a term that can be used to describe a place. The walkability of a neighborhood or area is based on how easy and safe it is to walk in order to get most of the things that a person needs in order to survive. A very walkable neighborhood would include safe sidewalks and pedestrian friendly paths with places to work, play, shop, eat, and live all within a short distance.

Safe sidewalks

Distance is not the only thing that determines walkability. A grocery store could be a block away, but if that block contains a six lane highway and no safe crossings, then the grocery store may as well be a mile away.

Safe sidewalks:

Are wide

- Wider sidewalks make it possible for people to walk side by side, but also to stay far enough away from cars to be safe. For example, if a person were to trip and fall on a wider sidewalk, they would be less likely to fall into a road than on a narrow sidewalk.

Are clear of debris and in good condition

- Sidewalks in disrepair, with cracks and gaps, are more hazardous for pedestrians and cyclists than sidewalks in good condition, because the poor condition of the sidewalk could cause an accident.
- Debris on the sidewalk is also likely to cause someone to trip and fall, so a clean sidewalk is safer.

Exploring the Sustainability of Transportation Journal Prompts

List some characteristics that would make a type of transportation sustainable.

Which do you think is more sustainable, adding bike lanes to roads or increasing the number of bus routes? Explain your answer.

Why do you think safety is mentioned as an important factor when discussing the sustainability of a transportation system?

Do you think electric vehicles are a sustainable transportation option? Why or why not?

In your own words, explain the term “active transportation” and why it is important to a more sustainable society.

Are clear of encroaching vegetation, trash cans, and other obstructions

- Keeping the trees and shrubs near sidewalks trimmed back not only prevents accidents and falls, but it also helps create a clear sight line so that people in cars are more likely to see the people on the sidewalk.

Are separated from the road by a buffer

- A buffer of space, whether it is on-street parking, a rail, a bike lane, or a landscaped curb, between the sidewalk and traffic, helps prevent car and pedestrian accidents.

Sustainability of alternative transportation systems (other than a gas powered automobile)

Public transportation (bus, train, trolley, subway, etc.):

- Public transportation systems are often considered to be more sustainable than automobiles because many people can be transported at one time, so even though a bus uses more gasoline than a car, the amount of energy it takes per person is less.
- More than the number of people to be transported must be considered when determining whether a transportation system is sustainable. In order to be sustainable, people need to be able to use it, which means that the system needs to go places that people want to go and run at times that people want to use it. It also must be accessible and inexpensive and it must make enough money to cover the expense of running and repairing the system.

Multi modal transportation:

- Multi modal transportation systems provide a variety of options for people to get from one place to another. An example of a multi modal system would be a place that has a bus station where a bike sharing system was also located at a trail head so that people could walk or ride the bikes.

Active Transportation (bicycles, walking, skate boards, and more)

An active mode of transportation is a way to get from one place to another under your own power.

- Active transportation, like biking or walking, uses less fossil fuels and produces less air pollution than traveling by automobile or bus. Active transportation is a form of exercise, so active transportation systems promote healthy living and reduced health care costs.
- Promoting active transportation can be done by increasing the safety of pedestrians, cyclists, and other forms of active transportation as well as providing access. Bike shares, bike lanes, road diets, sidewalks, and other similar alterations to urban infrastructure can help promote active transportation.

Types of Transportation Activities:

Revisit the discussion of what sustainability is (something that can last a long time with a minimal input of energy and minimal impact on the environment; that is also safe, affordable, and desirable) and ask the students to discuss how these ideas can be applied to transportation systems. Why is our current transportation system, where most people own one or multiple cars, not considered sustainable?

Have each student use the walk score website to **calculate their walk score:**
<http://www.walkscore.com/live-more/>

The walk score website compiles information gathered from a variety of websites including Google maps to measure the distance of a location from basic amenities such as food and retail shops and awards points based on how many of these items are within walking distance (under a mile).

Calculate the walk score of your address.
What is your walk score?
What does that mean?
Do you ever walk to any of the places listed?
Why or why not?
Do you think the website got it right? Is your neighborhood walkable, or is it not?

Create a model of the ideal, sustainable type of transportation.
Give the students scrap materials, like egg cartons, cardboard, or other recycled materials. Ask them to use their imagination to create their own ideal transportation vehicle. Tell them to keep the idea of being sustainable in mind.

Provide the students with paint and markers and after the allotted time for the craft is over, have them present their vehicles to the class.

**If you have already done Chapter 2: Land Use, then your students are familiar with the concept of a road diet from the web quest using the historic Greenville photos. Main Street in Greenville was put on a road diet in 1979.*

The City changed the large four lane main street into a street with two travel lanes, put in street trees, angled on-street parking, and large side walks.

Discuss this with the class. How different would main street be without the trees, parking spots, and large sidewalks? Would it be as safe with four lanes of traffic? Would people walk, shop, and use the streets the way that they do today if the road diet hadn't been put in?

Debate: Sustainable transportation – road diets.

Divide the students into two groups for the debate. Provide each group with the debate topic and the short summary for their side, and allow time for each group to research their topic further and discuss their arguments for or against the road diet. Then, host a debate.

Some basic resources (students will have to do their own research to back up their group's position):

Photographs showing a variety of "before and after" road diet scenarios.

http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/design_nonmotor/highway/index2.cfm#s13

Blog article discussing some pro and con opinions of a road diet test in California

http://montrose.patch.com/blog_posts/blog-honolulu-road-diet-why-or-why-not

US Department of Transportation

http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_013.htm

Debate topic:

A motion has come before City Council to put a major roadway in the city on a road diet. The proposed plan would change the four lane street to a two lane street with a dedicated turn lane in the center and bike lanes on either side. Initially, proponents of the project argue that the road diet will make the street safer and provide opportunities for more individuals to bike instead of driving while opponents of the project argue that the plan will increase the commute time for people using this road for work and cause an increase in accidents. City Council has decided to hold an open session where representatives from the two groups will be allowed to present their arguments for and against the road diet.

Chapter 6: Green Space

Green spaces are an important part of the urban environment. Green spaces include any area in a city that is not developed, but is set aside as a park, garden, forest, or conservation area. Green spaces can be any shape or size, and vary widely to fill different rolls within the urban environment.

Whatever their primary purpose, green space provides us with a variety of social and environmental benefits that are essential to our quality of life.

THE BASICS OF GREEN SPACE

Learning Objectives

Students will

- discuss and define the concept of an urban green space
- learn about the benefits of green space in an urban environment
- use the knowledge that they have developed throughout this program to explore the connections between land use, water quality, air quality, and green space

Background Information

What is Green Space?

Green space is any area in an urban environment that is not developed.

Most commonly, green spaces are thought of as parks, gardens, and other landscaped or planned areas where plants grow.

Green space can include small areas, such as planted islands in the middle of roads up to very large spaces such as parks.

Green space in a city can be natural, landscaped, or a combination of both.

Some green spaces include trails and pathways that act as connections for people to get from one place to another.

Word Bank

Green Space
Park
Garden
Landscaping
Riparian Buffer
Photosynthesis
Conservation
Aesthetic
Buffer Zone
Urban Heat Island
Arboretum
Heritage Preserve
Air Quality
Water Quality
Greenway
Biodiversity
Passive
Open Space
National Park
Natural
Commons
Native

Green Space Journal Prompts

Explain what Green Space is in your own words.

Why do people and cities need green space?

Is it important for a city to make its green space pretty? Why or why not?

Describe three different green spaces that you have visited. Which was your favorite, and why?

Do you think that green spaces in cities contribute to safety and human health? Explain your answer.

Green spaces alongside rivers are known as riparian buffers, undeveloped areas that help to reduce the impact of storm water runoff on urban rivers and streams, keep the water shaded, stabilize the bank, and protect water quality.

Benefits of Green Space in a City

Environmental Benefits of Green Space

Plants absorb carbon dioxide from the air and through the process of photosynthesis convert the carbon dioxide to sugar that is used by the plant and stored in the form of cellulose in the plant's tissues.

During photosynthesis, plants give off oxygen, which is essential for animals, including people, to breathe.

Trees help shade buildings and pavement. Summer temperatures can be reduced drastically by shade trees.

- Cooler temperatures inside buildings means less energy is expended running air conditioning systems to keep buildings cool.
- Shaded parking lots, roofs, and other surfaces may help reduce the urban heat island effect.
- When rain water falls on pavements, roofs, and other impervious surfaces, that water absorbs some of the heat from the surfaces and transports it into rivers and streams through storm water runoff. Increased water temperatures leads to reduced levels of dissolved oxygen in urban water bodies. Shaded surfaces don't absorb as much heat, so through shade urban trees can passively help protect water quality.

Plant roots stabilize soil

- Without plants, soil is exposed to sun, wind, and rain. When soil is exposed, it is more likely to be carried away by wind and rain, leading to a loss of topsoil and reduced soil quality.
- Soil that is eroded is deposited in rivers and streams.
 - When soil enters rivers and streams, nutrients in the soil are introduced into the water body and the soil itself causes the water to become cloudy.
 - Nutrients in the soil increase the productivity of aquatic plants, causing more plants to grow.
 - Cloudy water reduces the ability for light to penetrate the water, meaning that underwater plants can't use light for photosynthesis. These plants die, and bacteria break them down, using up the oxygen in the water. Reduced oxygen levels lead to reduced water quality and a reduced ability for the water body to support life.
- Soil deposited in rivers and streams can lead to blocked water ways and flooding. Energy and money must be spent to dredge and clear water bodies.

Trees and plants in urban areas help reduce water pollution and protect water quality. Planted areas alongside rivers and streams, known as riparian buffers, have been shown to protect and increase water quality in urban environments.

- Plant roots absorb water, which reduces the amount of above ground runoff during rain events.
- Along with water, roots absorb nutrients and some pollutants that would otherwise enter water bodies.

Leaves and branches intercept water as it is falling during rain events. The canopy of trees slows the rain, and the roots, stems, and organic matter on the ground slows the speed of over ground flow. Reduced speed allows nutrients, metals, and soil to settle out of runoff before it reaches water bodies.

Green spaces provide habitats for native plants and animals. Depending on the size, green spaces can provide important refuges that allow animals and plants to survive in an urban environment.

Many green spaces include trails and paths that create connections for people using active transportation to get from one place to another. Increased use of active transportation helps reduce the use of automobiles, leading to reduced air pollution.

Aesthetic/Societal benefits

Green spaces are aesthetically pleasing. Studies show that people are more productive in environments that they find pleasant.

Green spaces provide places for recreation, relaxation, and social interaction.

- Spaces for recreation, as provided by parks and other green spaces, lead to reduced obesity and other health benefits for urban residents.

Green spaces encourage people to spend time outside. More individuals spending time outside leads to more people watching the area, which discourages criminal activity, leading to safer neighborhoods.

Some individuals cannot afford to own a car. For those individuals, the connections that green spaces and trails help create can help them reach jobs, grocery stores, and other essential services.

Basics of Green Space Activities:

3 in 3 minutes: Web research and short presentation.

In small groups, assign or allow students to choose one of the covered research themes from the Green Cities: Good Health website that presents research findings compiled by the University of Washington and the United States Forest Service on the benefits of green space in the urban environment: http://depts.washington.edu/hhwb/Top_Introduction.html

Each group should read the information provided about their theme and decide amongst themselves how they will present their information to the class. Their presentation must be 3 powerpoint slides long. Each slide should take only 1 minute to present, have one photograph, and no more than 3 bullet points.

Follow the presentations with questions and discussion.

Green spaces photo quest:

*If students don't have access to a camera, this activity could be done as a web photo quest using your school's photo database.



Digital cameras are a great option for integrating technology and art into the classroom through photo scavenger hunts.

Photo Quest Instructions: Take (or find) a photograph of each of the following

- An urban green space where people relax
- An urban green space with water
- An animal in an urban green space
- An urban green space where people are active
- An urban green space with lots of plants
- An urban green space with art
- Kids doing something fun in a green space
- A small green space
- A very large urban green space
- A green space that is not a park

Have each student **write a list** of the green spaces that they have seen in the City.

Make a master list on the board and then ask the students to **compare and contrast** the types of green space that they have listed. Are they all the same size? Are they similar in shape, in the plants that they contain, or in their function? If not, how are they different?

Jump start the brain storming with a few examples:

community gardens

back yards

trees alongside the river

lawns

parks

planted medians



It is important to note that urban green space comes in all shapes, sizes, and functions.

*Top: A J Whittenberg School Garden
Middle: Falls Park on the Reedy River
Bottom: Linky Stone children's garden*

Urban Trees Journal Prompts

Why are trees important to have in a city?

Can grass and flowers provide us with the same benefits as trees do? Why or why not?

Describe your favorite tree. What makes your tree special?

Write a haiku about trees.

Use what you have learned about urban trees to discuss their importance as related to sustainability.

Without looking it up, what do you think the term “urban forestry” means? Is urban forestry important? Explain your answer.

URBAN TREES

Learning Objectives

Students will

- learn about the benefits that trees provide in an urban area
- research a tree species native to Greenville, SC and report on the specific benefits that tree provides to people and the natural environment
- relate what they have already learned about land use, green space, and more specifically to trees

Background Information

The benefits of trees in an urban setting have been mentioned throughout this program as parts of the sections on land use, water quality, and green space.

Trees are plants that have a single woody trunk.

Like most other plants, trees are able to make their own food from sunlight, carbon dioxide, and water through a process called photosynthesis. Trees in urban areas perform a variety of functions that are beneficial to people and the environment.

Trees absorb carbon dioxide and release oxygen

Photosynthesis takes place in the leaves of the tree.

Trees absorb CO₂ and other gaseous compounds in the air through small openings called stomata located mainly on the bottom side of the leaf.

The chemical equation for photosynthesis is $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$. What this equation means is that 6 molecules of carbon dioxide, 6 molecules of water, and light energy are used by the plant to create a single molecule of sugar (food) and 6 oxygen molecules are the by-product.

Carbon dioxide is the main greenhouse gas emitted due to human activities, primarily the burning of fossil fuels such as coal, oil, and natural gas for energy and transportation.

<http://www.epa.gov/climatechange/ghgemissions/gases/co2.html>

Trees absorb some airborne pollutants, reducing air pollution

When the stomata are open and air is taken into the leaf, gaseous pollutants (including and in addition to CO₂) are absorbed. Once inside the leaf, these compounds diffuse into the intercellular space.

Other airborne compounds “stick” to the outer surface of the tree leaves. Since these compounds do not get absorbed into the leaves,

the tree is only a temporary holding place for these compounds. These compounds can be returned to the air by wind, washed off when it rains, or dropped to the ground when the leaves fall.

Trees stabilize soil and help prevent erosion

Tree roots physically stabilize soil by growing into the ground, but there are other ways that trees prevent erosion. When water runs over the surface of the ground, it picks up pieces of soil and organic matter as it moves. When water infiltrates the ground, soil and organic matter is deposited and erosion rates are reduced.

Trees aid in water infiltration in many ways. When rain drops hit the tree canopy, they are slowed down. By slowing the rain before it reaches the ground, trees give water more time to infiltrate the soil and help reduce the buildup of sheets of storm water runoff.

Also, by absorbing water from the soil, tree roots essentially create small empty spaces in the soil, allowing for greater infiltration of water into the ground.

Trees help reduce water pollution in streams by absorbing storm water runoff through the roots and slowing runoff

The roots of trees absorb water. Especially during a rainstorm, this is important in an urban environment because it reduces the buildup of storm water runoff, a major source of non-point source pollution in water bodies.

When absorbing water, trees also take up nutrients and other compounds that are present in the water. This helps prevent those compounds from being washed into water bodies.

Wooded areas alongside streams are called riparian buffers, and are essential for maintaining good water quality in urban streams.

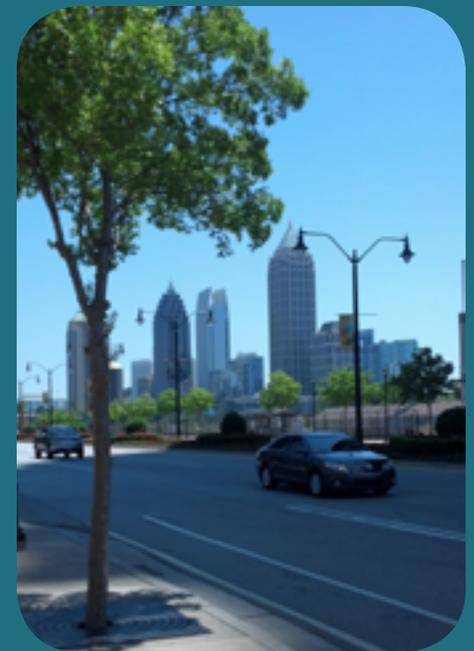
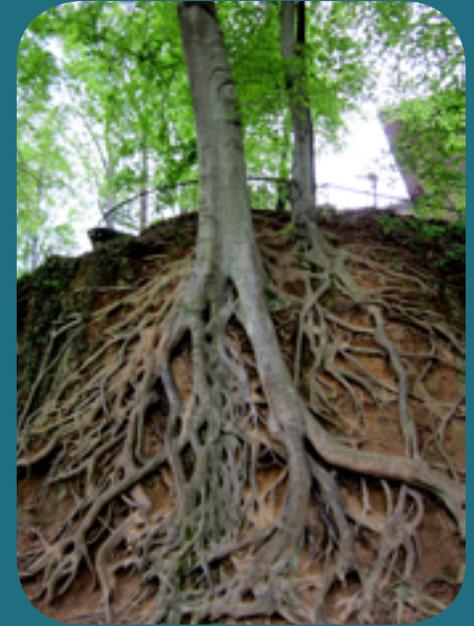
Trees provide shade

According to the United States Environmental Protection Agency (USEPA), surfaces in the shade can be 20 - 45°F cooler at peak temperature than the same surface without shade.

Shade can significantly reduce electricity bills and energy needs during summer months, especially in the South.

Through shade and evapotranspiration, trees help mitigate the Urban Heat Island Effect

Through the process of transpiration, plants take up water through their roots and release it back into the atmosphere through the stomata in the leaves. The increased rate of evaporation of water helps cool the air. Shading and transpiration together lead to an overall decrease in air temperature during the summer, mitigating the urban heat island effect and reducing the amount of energy and resources need to cool buildings through air conditioning.



Trees provide homes for animals

Trees offer shelter and food to a variety of animals including birds, lizards, small mammals, and insects. Increased biodiversity helps keep ecosystems intact, and the presence of carnivores such as hawks, insectivores, and carnivorous insects help reduce pest populations and control disease vectors. Urban trees can act as small habitat “islands” and can reduce the impact of habitat fragmentation and destruction for some animal species.

People use a lot of products that come from trees. Some examples include

- Oranges, apples, bananas, berries, maple syrup etc. as food
- Rubber and fibers for ropes
- Medicines
- Dyes
- Wood for building
- Fire wood and charcoal as fuel for heating and cooking
- Paper

Urban Trees Activities:

Ask students to close their eyes and picture a tree in the city.

Think about that tree for awhile. What does the tree look like? Where is it? What does it do? Do any animals live on or near the tree?

Have the students open their eyes and then ask them to list the benefits that their tree provides the city. Create a big list and then briefly discuss the benefits of trees in the urban environment.



Students utilize a simple dichotomous key available in the Urban Naturalist Program to identify trees on the Swamp Rabbit Trail near downtown Greenville, SC.

Provide students with the list of trees of Greenville
<http://www.clemson.edu/extfor/publications/bul117/list.htm>.

Either allow them to choose or assign each student or small groups of students a type of tree to **research**.

Allow students to research trees for 10-15 minutes and then report on their tree to the class.

Some guided questions for research:

- 1) Is the tree native to Greenville County?
- 2) What does the tree look like?
- 3) In what habitats is that tree commonly found (requirements for growth)?
- 4) Is the tree used in landscaping?
- 5) Do people use parts of this tree for anything, and if so, what?

Websites for research:

<http://www.duke.edu/~cwcook/trees/#trees>

<http://www.clemson.edu/extfor/publications/bul117/list.htm>

<http://www.fs.fed.us/database/feis/plants/tree/>

Make a leaf rubbing collage.

Have students gather leaves (or bring in some leaves from different common trees).

Use crayons and white paper to create rubbings of tree leaves. (if you do this craft outside, students can also create rubbings of bark and other items that they find)

Cut out the leaf impressions and glue them onto a sheet of cardboard, foam board, or heavy construction paper to form a collage.

Gather twigs and use clippers (an adult should use the clippers) to trim them so that they are just a little bit larger than the collage.

Use twine or yarn to bind the corners of the sticks or bundles of sticks together.

Punch a hole in the top center and bottom of the collage and tie the pictures to the stick frame.

You can also expand this craft and have students use a leaf key to identify their leaves.



Example leaf rubbing collage with twig frame

Perform an experiment to determine how shade trees affect temperature.

Materials

Clear plastic cups (pre marked with a line at 2 inches from the bottom of the cup)

Water

Thermometers

Procedure:

Each group gets four cups filled with water to the line.

Label your cups A, B, C, and D

Measure and record the temperature of the water in each cup. This is your baseline temperature.

Take the cups outside.

- Place cup A in the shade in a grassy area.
- Place cup B in the shade on a paved area.
- Place cup C in the sun on a grassy area.
- Place cup D in the sun on a paved area.

Create a hypothesis

Measure the temperature of the water in the cups throughout the day at regularly timed intervals.

Create a line graph of the results.

Questions for discussion or reflection

1. Does your data support your hypothesis?
2. Which cup of water got the hottest?
3. What had a greater effect on temperature of the water, the shade or the surface that the cup was sitting on? Why do you think that is so?
4. What do your results tell you about the importance of shade in urban areas?
5. Did the rate at which the temperature of the water changed vary between cups? How much, and what conclusions can you draw?

Print out the poem below, and cut into strips with each line on a strip. Give each student one strip of paper and ask them to come up with a movement or mime to communicate what is written on their strip of paper without using words.

Have the group stand in a circle and say the numbers in order. The students should step into the center of the circle and perform their movement when you call out their number.

Once the last person has finished, ask if anyone has figured out what the poem is talking about. Read it out loud and discuss all of the things that trees provide.

1. I stand tall
2. I give
3. Air that's clean to breath
4. Water where fish can swim
5. I bend
6. I give
7. Food for people and animals
8. Shelter where many live
9. I fall
10. I give
11. Healthy soil where plants can grow
12. Materials for building homes
13. Fire for cooking and staying warm
14. I grow
15. I give
16. Shade in the heat of summer
17. Beauty all year round

Parks Journal Prompts

Is there a difference between a green space and a park? Explain your answer.

Think of a park near your home. How is this park different from a natural area?

Compare and contrast 2 different parks that you have visited.

What is the difference between an amusement park and a state park? What benefits do each of these types of parks provide to their community?

If the city were going to build a new park in your neighborhood, what kind of park do you think it should be?

Are parks important? Why or why not?

PARKS

Learning Objectives

Students will

- use their previous knowledge of green spaces to discuss the benefits that parks provide the City of Greenville
- analyze a park as part of the built environment and determine some differences between a planned and a natural green space
- learn about the history and significance of Falls Park, one of Greenville's most prominent parks

Background Information

As we have already learned, green space is defined as any natural area with plants in an urban environment.

Parks are a special type of green space, designed and set aside for people to use. There are many different types of parks including:

Heritage preserves are areas of land meant to preserve either the natural or cultural history of a specific location.

- Bald Rock Heritage Preserve

National parks are areas of land set aside by federal laws for conservation of land and resource and are often utilized for passive recreation.

- Yellowstone National Park
- The closest National Park is the Smokey Mountains National Park

State parks are areas of land owned by the state and preserved.

- Paris Mountain, Table Rock, Caesar's Head, and Jones Gap are state parks that are close to the City of Greenville.

Gardens parks are parks that are dedicated to growing plants.

- The Linky Stone Children's Garden in downtown Greenville
- Arboretums are garden parks dedicated specifically to trees
- Botanical Gardens

Recreational parks are areas of land designated for sport or recreational use.

- Baseball or soccer parks are examples of these and can be found all over the country.

Marine parks are areas of water that are set aside to conserve the special variety of aquatic life.

Amusement parks, theme, and destination parks are usually privately owned parks dedicated to fun activities.

**Recreational parks, marine parks, amusement parks, theme parks may include green spaces, but not necessarily. This is one of the reasons that we consider green space separate from parks.*

One of Downtown Greenville’s most prominent and widely used parks is Falls Park on the Reedy River, but Falls Park didn’t always look like it does today.

The History of Falls Park (excerpt from the City of Greenville’s website)

Most of modern day Greenville was hunting land used by the Cherokee Indians, whose main villages were located in what is now Oconee County. A part of the Iroquoian Nation, the Cherokees may have set up temporary summer camps along the banks of the Reedy River. In the 19th and early 20th centuries, Indian artifacts were found along the north bank of the river.

European settlers were forbidden to live here until 1777, when the Cherokee were forced to cede their land to the new state. Referred to as “the cradle of Greenville,” it was the magnificent, life-giving falls of the Reedy River that led the first settlers to this region.

In 1768, Richard Pearis, who was married to a Cherokee Indian, established a trading post and grist mill at the base of the falls. In 1774, Pearis bought 50,000 acres – including the falls - from his son, who was considered a member of the Cherokee Nation. At the time, it was unlawful for a white man to purchase land from the Indians, so this allowed Pearis to get around the system. Pearis eventually sided with the British during the American Revolution. When he returned to Greenville, his business and family were gone.

Following Pearis, Lemuel Alston built a small tub mill on the site of Pearis’ mill. In 1815, Vardry McBee bought more than 11,000 acres from Alston, including most of present-day Greenville, and built two flour mills – one in 1817 and one in 1829. McBee was a philanthropist and gave the land for the town’s first schools, colleges and churches.

A variety of industries eventually clustered along the Reedy River. Those industries included an ironworks, the Gower, Cox, and Markley Coach Factory, a sawmill, a paper factory, an armory, as well as grist and corn mills.

In 1876, McBee’s heirs worked with three Massachusetts mill owners to open the water-powered Camperdown Mill, which produced yarn and gingham until 1956. The falls provided a power source for industry in the early 19th century. A variety of industries eventually clustered along the Reedy River, including an ironworks; the Gower, Cox and Markley Coach Factory; a sawmill; a paper factory and an armory, as well as grist and corn mills. A 27-acre mill village grew up on the hills surrounding the falls, complete with churches, mill store and recreation grounds. Whole families, often including children as young as 9 or 10, worked at the mills. They rented the mill houses for 50 cents a week per room; water and lights were supplied by the mill. The extension of Church Street in the late 1950s destroyed much of the once-extensive mill village.

In 1852, Furman Institution (now Furman University) bought the land. Three textile mills and a cotton warehouse operated in the early 1900s, all contributing to the pollution of the Reedy River.

In 1967, the Carolina Foothills Garden Club reclaimed 26 acres for the current park, with the support of the City of Greenville, Furman University and the Planning Commission. Over the next 40 years, the Garden Club and the City



Ruins and remnants of historic structures can be found throughout Falls Park



of Greenville have worked with individuals, corporations and state and federal agencies to further develop the park, clean up the river and restore the historic Falls Cottage. In 1990, landscape architect Andrea Mains introduced the concept of transforming the park into a regional attraction, with beautiful public gardens and a pedestrian bridge.

Recent History

In the mid-1980s, the Carolina Foothills Garden Club and the City of Greenville adopted a master plan for the park that was designed to restore the beauty of the area and provide a safe and welcoming gathering spot for individuals and groups.

The vision for a dramatic public garden was finally realized when the Camperdown Bridge was removed in 2003. Using funds generated through a local hospitality tax, and building on the master plan designed in 1999 by landscape architect Andrea Mains, Falls Park was developed to include 20 acres of gardens showcasing Reedy River Falls. In August 2002, Mayor Knox White announced “In Full Bloom in 2003,” a \$13 million initiative to transform the park into a public garden and oasis. Included in the project was construction of a 355-foot-long, 12-foot-wide, curved suspension bridge that was designed by world-renowned architect Miguel Rosales to provide dramatic views of the upper falls and the gardens below. Additional designs called for a new park building with two levels of plazas, a private restaurant, public restrooms and the garden’s maintenance facility to be located on the South Main Street end of the bridge.

Greenville's Parks Activities:

Park exploration and design element survey:

Have students either visit a park or take a virtual tour of a park and answer the following questions:

- What design elements do you see? (ex: benches, paved paths, gardens, lights, playground)
- What natural elements do you see?
- Are there any parts of the park that are both natural and designed?
- How does the park make you feel compared to the rest of the city?

Design the Perfect Park

As a class, brainstorm a list of items that you would like to see in a park in your neighborhood. Remind students to include some of the design elements from the park exploration survey.

Divide the class into small groups and provide each group with a large sheet of paper and colored pencils, markers, or crayons. Each group should then choose at least 10 items from the list that the class created and work together to draw a park plan.

The plans can be simple schematic drawings, and don't have to be artistic, but should be a representation of how the park would look from above with at least 10 of the important elements included.

Ask one student from each group to present their plan to the class.



Ask students to **perform a visual comparison** using the photographs on the next page in order to discuss how does design and planning contribute to the way that people feel.

Each of the photographs were taken near one another, in a similar environment with varying degrees of design. Ask the students to comment on the way that design alters their perceptions of the environment.

Which of the photos do they prefer, and why?

Which photo seems safer?

How does each photo make them feel?

Provide students with a copy of (or a few pages from) the Falls Park guide and take a class **field trip** to learn about one of Greenville's most prominent parks.

Download extra copies on the Livability Educator's Page at <http://connections.greenvillesc.gov>





Chapter 7: Social Sustainability

Social sustainability means creating a good quality of life for all people. It is essential that social sustainability be addressed and understood as an important component of sustainable development. Social sustainability can be thought of as one of the core, or end goals of sustainable development. So in a way, everything that has been addressed so far in this program relates to social sustainability. Some topics related to social sustainability; such as safety, affordability, quality of life, and health, have been addressed throughout this program. Here, though, we will offer some ideas for addressing three social sustainability concepts that are broad and could fit in with any of the other chapters in this program; philanthropy, economics, and service learning.

Though presented as a stand-alone chapter, the activities related to philanthropy, economics, and service learning may be most useful if combined with other lessons.

PHILANTHROPY

Learning Objectives

Students will

- explore the concept of philanthropy as an aspect of social sustainability
- research a famous philanthropist and present their research to the class
- discuss how philanthropy relates to sustainability

Background Information

Philanthropy means doing something or giving something that will benefit someone else or a community without any expectation of reward.

As a working definition for students, philanthropy is giving **time**, **talent**, or **treasure** for the common good.

Word Bank

Philanthropy
Economy
Success
Budget
Service
Social
Affordability
Expense
Service Learning
Non Profit
Market
Wealth
Charity
Altruism
Income
Expenditure
Excess

Philanthropy Journal Prompts

Have you ever performed an act of philanthropy? What was it? How did it make you feel?

In your own words, explain the term “social sustainability.”

Who is responsible for an individual’s quality of life? Explain your answer.

In your own words, explain what philanthropy is. Do you think that philanthropy is an important part of developing a more sustainable society? Why or why not?

Take a moment to imagine that you live in “Greed Town.” Imagine living in a society where everyone acted only in their own best interest with the goal of personal gain. People would rapidly use up earth’s resources for profit, destroying natural habitats and ecosystems. Greed and deceit would become prevalent as people strive to get ahead with no regard for the well-being of others. Furthermore, in Greed Town, citizens would not care for those in poverty, assist people with mental or physical disabilities, reach out to animals that have been neglected or abused, and more. In Greed Town, where everyone acts in their own best interest, the life and vitality of the community would dim.

Society needs people to reach out and care for others. Philanthropy benefits communities, and it can benefit the giver just as much, if not more so, than the receiver. A large part of living in a community is feeling a sense of place and belonging, and service helps create that as well as foster a level of trust between people.

Contributing to the community also makes the region a place where people want to be. No one knows the needs of a community better than the individuals living within it. Taking responsibility for our own growth and development through philanthropic acts that benefit ourselves and those around us is an important part of helping our society develop in the way that we want it to. It is important that we use our own talents and skills to help improve our own portion of the world.

Philanthropic actions and gifts have been important components in the development of the society that we live in. Acts of philanthropy do not require money, and do not have to be grand in scale. Anything that is done or given in order to help someone else or a community without an expectation of reward can be considered philanthropic. All people can be philanthropic because there are many different ways to give, no matter one’s interests.

There have been many famous philanthropists in our nation’s history that have been instrumental in the development of our society. Three very different examples of philanthropists are:

Andrew Carnegie was an industrialist who helped shape our country’s history. He founded Carnegie Steel Company in the 1870s. The wealth he gained from this company was not all kept for himself or his family. Instead, he used his wealth to help further the development of the education system in that time. He built Carnegie Hall to help increase education in the arts. He also founded Carnegie Mellon University. His acts of philanthropy benefited the education system in this country.

Audrey Hepburn, the famous actress, also helped the world at large with her philanthropic acts. After starring in many films, she quit the world of Hollywood to become an ambassador for UNICEF advocating for children’s rights. After her death, a foundation benefiting international human rights was established.

Emerson Fullwood’s story of philanthropy shows that it does not take a lot of money to do something charitable. Fullwood grew up in an underdeveloped African American community. His family was built on a legacy of giving; his grandfather had helped build one of the first African American churches after slavery. Fullwood transformed

his weekly golf game with friends into a fund-raising event, helping to raise money for local schools.

Philanthropy is still an important part of our society today. Many groups, such as non-profit organizations, rely on community members to donate their time and skills and work together in order to make a difference. Coming together as a community toward a common goal allows people to combine their time and talents in a way that one individual might not be able to do on their own. Other people practice philanthropy by doing small, but influential things such as: dropping off old blankets at the humane society, participating in a road or stream clean up, making seasonal decorations for hospitals, writing cards to soldiers, or volunteering at a soup kitchen. Philanthropy is all around us, in large-scale community efforts, in small group organizations, and even in individual acts of kindness.

Philanthropists to Research

Oprah Winfrey

Bill Gates

Andrew Carnegie

Henry Ford

Ted Turner

Mary Kennedy Shriver

William Colgate

Johns Hopkins

Walt Disney

Christopher Reeve

Warren Buffett

Mother Teresa

Michelle Obama

Jacqueline Kennedy Onassis

Lady Bird Johnson

Cornelius Vanderbilt

William Henry Vanderbilt

Jane Addams

Clara Barton

Florence Nightingale

Vardy McBee

Al Gore

Theodore Roosevelt

John Muir

C. Thomas Wyche

Philanthropy Activities:

Have students **research a famous philanthropist**. Either assign students a philanthropist from the list provided or allow them to choose their own. Ask students to fill out a profile of their philanthropist including:

- Year born
- Year died
- Where they lived
- What they did that was philanthropic
- An interesting fact about them
- At least one photograph of the philanthropist

Have the students present their philanthropist to the class.

*You may wish to use this list as part of a living history project or a dress up like your philanthropist day.

Become philanthropists by creating dog or cat toys out of old T-shirts and donating them to a local animal shelter.

- Every community has animal shelters and organizations dedicated to helping cats and dogs that don't have homes.
- Often, these organizations are run by volunteers and don't have a lot of resources to provide the animals that they save with things like beds and toys. Without spending any money, you can create dog and cat toys to gift to a local animal shelter.

For complete instructions, see pg 14 of the Green Craft Challenge.

Break the classroom into small groups and assign each group a focus area where they could perform acts of philanthropy. For some ideas, see the list below. You can assign students a particular focus area or allow them to choose.

Ask students to **brainstorm** in a group to come up with a list of the needs that their focus group may have. Once the groups have a list, each student should make up a project idea that they could do to benefit or meet the needs of their focus area.

Then as a class, ask each group to present their focus group and philanthropic ideas, explaining how and why their projects would make a difference.

Possible focus areas may include: Senior living facilities, homeless people, children with asthma, a park, hospitals, schools, mentally impaired, animal shelter, medical clinic, a deserted/trashed field, hospice patients, community garden, community center, blind children, and more.

Reading and discussion

Have the students brainstorm a list of things that they think are beautiful, steering the conversation to beautiful things in the natural and built environment in their own community.

Then read aloud *Something Beautiful* by Sharon Wyeth. Follow the book with a discussion. Possible starting points include:

- Why did the girl clean up the neighborhood?
- Did the girl perform an act of philanthropy?
- Did the girl receive any benefit from her actions?
- Have you ever done anything philanthropic like the girl in the story?

Next, discuss ways the students can help make their neighborhood, school, house, or town more beautiful.



Community center students create recycled T-shirt dog toys following a lesson about philanthropy and making a difference.

Affordability Journal Prompts

In your own words, explain what the economy is.

How does the idea of philanthropy connect with the ideas of “needs” versus “wants?”

Does volunteering help meet needs, wants, or both?

If something is affordable, does that mean that people will buy it? Why or why not?

What factors, other than cost, influence people to purchase a product?

Write a paragraph discussing affordability as it relates to housing or transportation.

AFFORDABILITY

Learning Objectives

Students will

- discuss the idea of affordability and what factors influence affordability
- use what they have learned in previous lessons to relate the concepts of affordability and sustainability
- understand the difference between things we *need* and things we *want*

Background Information

Economics is a social science that is concerned with the production, consumption, distribution, and transfer of wealth. When discussing economics, it is important to note that personal economics is very different from the economy at a large scale. For this lesson, we will focus on a few general concepts of personal (micro) economics and how money and the distribution of money relate to sustainability.

When making a decision on what to purchase, an individual or family weighs multiple factors, such as:

- 1) Do I **NEED** the thing that I am buying?
- 2) Can I afford the thing that I am buying?
- 3) Will the thing that I am buying make me happy?

Generally, an affirmative answer to these three questions will result in a purchase. Yet, anytime we purchase one thing, no matter how large or small the purchase, it diminishes our ability to purchase something else. Also, the interaction between the three major questions will alter whether or not an individual purchases something.

As an example, we can plot need, affordability, and happiness on a bar graph to discuss the way that these three factors can influence one another:

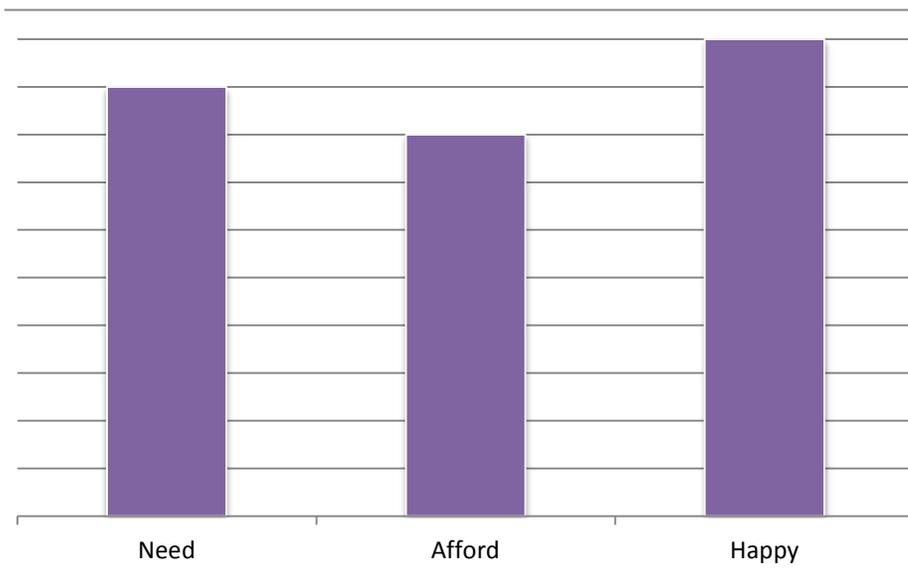


Figure A: This bar graph represents something that a person needs, can afford, and it makes them happy. Maybe this is a favorite healthy food or healthy activity that doesn't cost too much. When all three of these bars are high, it is likely that an individual will purchase something.

Yet, affordability can change easily due to external circumstances. The amount of money available to be spent by the individual or family may change. If someone loses a job, suffers an injury, or has an unexpected expense such as the need to replace a car or repair the roof on their house, the affordability of other items, even ones that we need and make us happy will go down.

In this instance where the item is highly needed and makes the person happy, an individual may still make the purchase, but would then have to sacrifice something else.

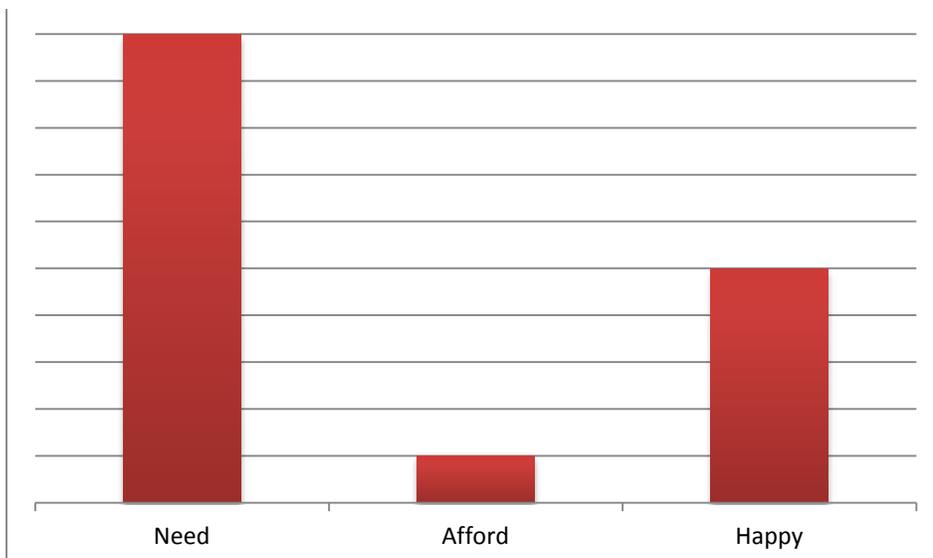


Figure B: This bar graph represents something that someone needs very much, and it will make them happy, but they cannot afford it. Maybe this is a new car for someone who has to commute to their job and doesn't have access to public transportation. Maybe it is a surgery that the individual needs to survive or day care for a child of a single mother who has a low paying job.

In this example, the need is so high that the person will have to find a way to make the purchase even though it isn't affordable. Expenses like these are reasons why some people have to borrow money on credit and why programs like insurance exist. Sometimes people need things that we can't afford. These situations can lead to debt, and are one of the reasons that financial planning is an important aspect of a sustainable lifestyle. Saving money for a rainy day can help when unexpected financial burdens arise.

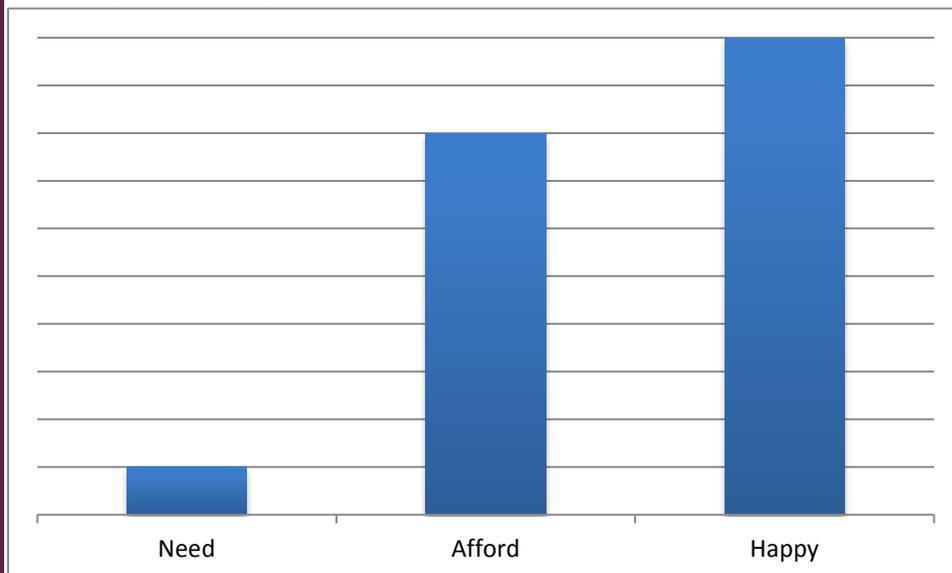


Figure C: This bar graph represents something that a person doesn't need, but they can afford it and it makes them very happy. Maybe this is an inexpensive snack that they really like, a new video game, or a pretty dress.

Whether or not a person buys this item would depend on a lot of factors, including whether or not they were concerned with their future finances, how happy the item would make them, the opinion of other members of their household, and more. If they were concerned about saving for retirement or a big purchase such as a house, they may not buy the item that they don't need even though they could afford it. Sometimes people treat themselves to items that make them happy just to make themselves happy. This type of spending can be OK as long as it is kept to a minimum.

Much like the concepts of Sustainability, Green Building, and Community, the concept of Affordability is more complicated than it seems. Affordability is not the same thing as "cheap." The activities in this section are intended to help begin introducing students to the factors that influence affordability and personal economic decisions.

Affordability Activities:

Discuss affordability. Is affordable the same thing as cheap? How is affordability related to sustainability?

Use the instructions, worksheets, and cards in Appendix III to **run an affordability simulation** in the classroom. Have students pretend that they are adults with a home and jobs of their own. This exercise is designed to simulate some of the choices that they will one day be expected to make in regards to spending and income.

To get the most out of the game, play it multiple times, having students start with different scenario/income cards and follow up with a class discussion.

Service Learning Journal Prompts

Why did you chose the service learning project that you chose?

What is the most memorable moment from your service learning experience and why?

Do you think that service learning is beneficial? Why or why not?

If you could change one thing about your service learning project, what would it be?

SERVICE LEARNING

Learning Objectives

Students will

- integrate a service learning project into their Community Quest studies
- give a report about their service learning project to the class

Background Information

Defined by the National Commission on Service-Learning, service-learning is “a teaching and learning approach that integrates community service with academic study to enrich learning, teach civic responsibility, and strengthen communities.” Service-learning is an integrative learning approach, linking the classroom with the community. The distinctive element of service-learning is that while it provides a service to a community, it concurrently has profound learning impacts on the student, paving the way for career interests, developing critical thinking skills, and class collaboration.

Service-learning is also one way that people learn civic responsibility, quite literally “the responsibilities of a citizen” to their community. It helps students define the relationship between community members and place. Actions of civic responsibility include advocacy, participation in volunteering, churches, community meetings, etc. Service-learning helps answer the questions, “why do I need to learn this, and why is this relevant?” It also helps students recognize the importance and power of their actions on others, while teaching responsibility, leadership, critical thinking, and problem-solving skills, giving students a broader perspective and more avenues to apply classroom experiences to real-world examples.

Service-learning also helps students create memories and experiences in their physical environment. Developing this attachment and knowledge of what happens in a community also garners a sense of place and identity within the area. What makes a place profound and impactful is the people, shared experiences, and the memories created. Urban planners want to create places that help facilitate a strong sense of place where people can enjoy spending time with each other, making memories. Service-learning and volunteering is a great way for students to learn and develop a sense of responsibility as members of their community and it provides them with meaningful experiences that will help shape how they view and interact with their community.

Project possibilities and tie-ins:

“I am from...”

This is an activity geared towards helping students realize their “sense of place” (SOP). Students will write an 8-10 line poem about where they are from. Students will then go around and read their SOP poems to each other. To facilitate the creation process; ask them to think about what makes their home unique. Include memories, smells, sights, experiences, and everything ranging from a physical house to an entire community. They should start with the words, “I am from...” and go from there. Even though everyone may be in the same community, there are differences in one's sense of place.

Example:

I am from cotton fields in urban spaces.

I am from summer family bike rides, QT, hot days,
and sticky fingers.

I am from laughter, excitement, and refreshment.

I am from a place where zip codes and money
did not matter because thankfulness and service
mattered more.

Sitting in my grandpa's lap, reading a book to my
sister, and singing at church were fleeting moments
but treasured memories.

I am from chocolate chip cookies and breakfast
in bed on the best of days, and adventures through
the city with my grandma.

I am from fireside chats, jumping in leaf piles, and
pumpkin carving.

I am from dust and to the dust I will return.

Introduce a service learning project at any time during community quest.

To help you and your students choose appropriate or interesting projects that tie into the program, possible project ideas have been listed that relate to each of the Chapters in the Community Quest program.

*This list is meant as a starting point for exploration and not as a comprehensive guide.



Some examples of service learning projects

Top: Running a recycling program at school

Middle: Volunteering in a community garden

Bottom: Participating in water quality monitoring in local streams

Service Learning Project Ideas

Chapter 1 What is a community:

- Attend City Council meetings and write short newsletter reporting on important city news for your class and community
- Meet with your neighborhood association president to discuss the current important issues in your community and create a service project that will help address an issue
- Volunteer at a local soup kitchen or food bank
- Participate in the Great Backyard Bird Count <http://www.birdsource.org/gbbc/>
- Become a citizen scientist and perform a frog count <http://www.greenvillezoo.com/forms/Frogz2013.pdf>
- Get a group together and have a neighborhood clean up

Chapter 2: Urban Surfaces and Land Use

- Organize a litter clean up or adopt a highway
- Volunteer at a community garden, local small farm, or CSA
Examples: Gardening for Good, Mill Village Farms, Generous Garden Project
- Sponsor or participate in an invasive species plant removal <http://scnps.org/>
- Perform soil testing in your community and report your findings to the local garden club or an interested community organization. Clemson University Extension provides soil testing http://www.clemson.edu/public/regulatory/ag_svc_lab/index.html
- Soil restoration and composting: start a composting program at school or in your community

Chapter 3: The Urban Water Cycle

- Participate in a river sweep or clean up
- Perform a water quality survey and/or macroinvertebrate bioassessment <http://www.iwla.org/index.php?ht=d/sp/i/1977/pid/1977>
- Visit a senior citizen group and give a presentation on Greenville as a watershed and the importance of water conservation

Chapter 4: Housing

- Give a report on the importance of energy conservation at your neighborhood association meeting.
- Partner with a local organization to help weatherize homes for families.
- Volunteer with a group that builds houses for those in need. Such as Habit for Humanity

Chapter 5: Transportation

- Conduct a transportation survey to determine how students get to and from school <http://scsaferoutes.org/resources/evaluation>
- Start a bike group to promote safe, healthy activity
- Run a charity 5K and raise money for a local nonprofit

Chapter 6: Green Space

- Volunteer with Trees Greenville to plant trees
- Park clean up
- Organize a “tactical urbanism” event

Chapter 7: Social Sustainability

- Volunteer at a local non-profit organization. Find opportunities at www.handsongreenville.org/

Chapter 8: Planning

- Go to a public meeting and participate in the planning process.



Some examples of service learning projects

Top: Painting toilet paper roll flowers as gifts for seniors

Middle: Starting a composting program at school

Bottom: Creating an educational display at school to educate your peers about an environmental issue

Chapter 8: Planning

A plan is something that is developed prior to taking action in order to guide future decision making. Whenever you are considering going on vacation or taking a trip, planning out your route and activities ahead of time can help you make the best use of your time and resources.

Like anything else, the City changes over time and grows. So, just like you make a plan for your vacation, City planners develop plans for the City. The City's plans are there to help guide the growth and development of the City over time so that the City can make the best use of its resources and grow and change in a direction that provides benefits for City residents.

As we have discovered throughout community quest, a City is more than a collection of buildings. Everything within a City is connected. City planners need to understand these connections: from the way that transportation availability affects housing to the way that development affects water quality, in order to create useful and meaningful plans for the City's future.

WHAT A PLANNER DOES

Learning Objectives

Students will

- understand what a City Planner does
- become familiar with some of the tools that planners use to create plans
- connect the concepts from land use legacy, brownfields, water quality, sustainable transportation, and green spaces to understand why planning for development is important
- develop a plan for an imaginary neighborhood that incorporates feedback from various "stakeholders"

Word Bank

Stakeholder
Plan
Development
Planner
Livability
Zoning
Population
Infrastructure
Census
Urban
Region
Map
GIS
Projection
Residential
Multi-Family
Single-Family
Commercial
Industrial
Public Use
Green Space
Mixed Use
Ethnicity
Charrette

What a Planner Does Journal Prompts

How does having a plan help with getting work done?

Imagine that you are a city planner tasked with designing a new community. What buildings and design elements would be essential to include in a new community?

Why do planners need to understand hydrology (the way that water moves through and over land) in order to plan development in a city?

Do you think that zoning is a positive or a negative thing? Please explain your reasoning.

Why is the census important to planners?

Background Information

A city planner helps to guide the growth and development of a City. Cities are complicated. When designing a City, a planner has to think about things like how people will get from one place to another safely, what type of buildings belong in different areas of the city, and where the best spot is to put a new factory or a parking garage. Planners have to take a lot of different viewpoints into account and weigh environmental, economic, and social needs in order to create plans for the City's development.

There are many tools that planners rely on in order to guide growth and development. Some of the key tools used by planners to create plans include:

Maps and Geographical Information Systems (GIS)

Maps are tools that provide information about a place. Planners use maps to study the current and past layout of a place and to plan for future changes. Geographic Information Systems (GIS) is a technology that stores, uses, compiles, and displays data visually, using maps. Combining maps and GIS allows planners to visualize data.

In order to accurately plan for the future, GIS maps that graphically display large amounts of information about a place are an extremely useful tool. Some of the data that maps and GIS allow planners to visualize include: topography, geography, current land use, roads, utilities, hydrology, and more.

Zoning for Land Use

Zoning is the tool that defines what type of land use subcategories can be placed in what location. The original purpose of zoning is to help protect people and the environment so that incompatible land uses (such as a pig farm, an apartment complex, and a factory) can't be placed next to each other. As our understanding of development and the needs of people in developed areas changes and grows, so do zoning laws and regulations.

Zoning maps use a common color key to stand for different types of land use categories:

- Residential (yellow)
 - Multi-family (orange)
 - Single Family (yellow)
- Commercial (red)
- Industrial (grey)
- Public Use (blue)
- Green Space (green)
- Mixed-Use (purple)

Mixed-use is a type of development where buildings are designed accommodate a variety of different uses. For example, a mixed-use development may include buildings with retail shops on a ground floor and residential or office spaces on the upper floors.

Census

A census is a collection of data that surveys every individual in a population. The U.S. Census collects data about all of the people living in the United States. Planners use census data, often combined with GIS, in many ways.

Census data allows planners to make projections about the needs of a community in the future. For example, if the census data of an area shows that there are a high number of families with babies and small children in an area, planners know that there will be a need for more or larger schools in the future. Similarly, if the census data shows a high percentage of older people in an area, there may be a need for senior centers or hospitals.

Accurate baseline data is essential for planners to determine the needs of a community in the future.

Public Input

Public input is where planners gather opinions and information from various stakeholder groups and individuals in the community in order to determine what the people of the community need and want for the future. Public input is an essential part of the planning process. In order to plan how a community will look in the future, planners must understand the needs and wants of the people that live, work, and spend time in that community.

Public input can be gathered in a variety of ways. In order to develop a plan that is meaningful, realistic, and useful, planners need to incorporate and understand many different points of view. Surveys, online polls, phone calls, small focus group meetings, large public meetings, workshops, individual interviews, and more are all ways that planners reach out to the people in a community in order to determine what the community needs.

Planners face a difficult task, and they must consider many different strategies, factors, opinions, needs, and desires in order to create a vision for the future that meets the needs of as many people as possible while still protecting resources and keeping people safe and healthy.

What a Planner Does Activities:

Engage students in a **mock public hearing** designed to facilitate an understanding of the various types of stakeholders that planners work with in order to create a plan.

Pass out a description card (blank cards are available for you to add stakeholders if you wish) of various possible stakeholders to each student. Tell the students that they are all living in AwesomeVille and planners from the city government are working on a new comprehensive plan to help guide the growth and change of the city in the future. Ask them to imagine that the description on their card is their job or position in the community and that they have been invited to a public meeting to discuss AwesomeVille's future. Choose as many or as few of the proposals as you have the time for. Have students think about how they would feel about each of the proposals that are raised at the meeting.

*Depending on the age of students, there are multiple ways to stage the mock hearing.

- You may wish to set up a group of 5 students to be the decision makers, and assign the other students stakeholder cards. Read a situation card and then open the floor for "public comment" where any of the stakeholders may have 1 minute to make their argument for or against the proposal and then the 5 students on the board vote to approve or deny the proposal based on the stakeholder arguments.
- Or, you may assign all students with a stakeholder card and read the proposal. Then, ask the students to vote either Yes, No, or Doesn't matter based on the position that they believe their stakeholder would take. Once the voting is done, ask for a volunteer from each of the three decisions to explain to the class what stakeholder they are and why they would vote for, against, or neither on the proposal.

Stakeholder Cards

<p>Small business owner</p> <p>You own a small business in the main shopping district of AwesomeVille. Your major concerns are making sure that plenty of people continue to visit the shopping district, improving the character of the community, and making sure that your business grows.</p>	<p>Older Resident</p> <p>You live in a retirement community in a small neighborhood near downtown AwesomeVille. You have lived in the City most of your life and you would like your neighborhood to stay the way that it is. You live on a fixed income, and don't have access to a car. You get places that you need to go by walking or taking public transportation.</p>
<p>Young Resident</p> <p>You live in a townhouse in a mixed use neighborhood near downtown AwesomeVille. You have a young child, and are mainly concerned about raising your family in a safe, healthy place. You are interested in riding your bike to work.</p>	<p>Factory owner</p> <p>You own a large factory on the outskirts of AwesomeVille. Your factory employs a lot of residents from the city, and is a major part of the local economy. You are mainly interested in making money and keeping your taxes low.</p>
<p>City council member</p> <p>You are one of 7 people that make up the governing body of AwesomeVille. You were elected by the citizens, and it is your job and responsibility to make sure that the City of AwesomeVille has everything it needs to have a healthy, safe, economically, and environmentally sustainable future.</p>	<p>School principal</p> <p>You are the principal of AwesomeVille Elementary School. Your major concern is to make sure that you have the ability to provide a good education to all of the children of Awesomeville.</p>
<p>Church pastor</p> <p>You are a pastor at AwesomeVille Church. You are concerned with keeping your community safe and healthy.</p>	<p>Environmental activist</p> <p>You are an environmental scientist who lives and works in AwesomeVille. You are interested in making sure that the natural resources near the City are protected, that the Awesome River is kept clean, and that the City conserves resources whenever possible.</p>

Stakeholder Cards

Developer

You are a real estate developer. You have built and sold many of the large buildings in downtown AwesomeVille. Your major concern is selling the properties that you have developed and being able to develop more.

Local small farmer

You own a small farm on the outskirts of AwesomeVille and grow food crops that you sell to local businesses and at Farmers Markets. Your major concern is keeping your property taxes low, growing healthy food, and being able to see your food for a profit.

Doctor

You are a Doctor at AwesomeVille General Hospital. You are mainly concerned about the health of the community.

Police Officer

You are a member of the AwesomeVille Police. You are mainly concerned with keeping the citizens of AwesomeVille safe, making sure that crime rates are low, and living in a quiet neighborhood where your children can play outside.

Optional Mock Public Hearing Proposals

- 1) The electric company has proposed that they build a dam on the Awesome River. The dam would provide hydroelectric power for the City as it grows as opposed to the current coal powered plant, but in order to pay for the dam to be built, electricity rates will go up 10%.
- 2) The state highway department has proposed that the highway through AwesomeVille be widened from 4 lanes to 6 and the speed limit be raised by 5 mph.
- 3) An out of town real estate developer has submitted a proposal to build a large shopping mall on the outskirts of AwesomeVille.
- 4) The AwesomeVille county landfill is filling up too fast. The City has proposed a recycling center that will be built near downtown. All residents will receive recycling bins for free, but the cost of their trash service will go up by 10% in order to pay for the new facility.
- 5) There is a four lane road that runs through downtown AwesomeVille. The road has a high volume of traffic and is unsafe for pedestrians to cross, making it difficult for people in the North side of town to get to the stores in downtown. The City has proposed putting the road on a road diet; changing the road from 4 travel lanes to two with a center turning lane, bike lanes on either side, and street trees. The road diet also calls for a reduced speed limit.
- 6) AwesomeVille is expecting to have a population explosion in the next 5 years, because living there is awesome. City planners project that there will be 2,500 new jobs in the area and that 2,000 new housing units will be built. In order to accommodate fast growth within the city boundary, rather than in subdivisions farther and farther out, planners are hoping to encourage walkable communities and the use of bus service by proposing to increase the allowable height of buildings at certain major street intersections from 4 stories to 10 stories.
- 7) A developer has bought the vacant, overgrown property behind a residential neighborhood and wants to build a convenience store and gas station with 10 fuel pumps. He is required to put a fence and some trees behind the store as a buffer for the neighborhood. The City's regulations do not prevent the store from operating until midnight or from leaving bright lights and signs on all night long, but the Board of Zoning Appeals may restrict these types of things if they cause negative impacts to the existing neighborhood. A permit for this type of development next to a neighborhood requires a public meeting.

Have students **read** the “Introduction to the Census” page and **hold a mock census** of your grade (or the whole school).

Each class is a census tract.

Once the data has been collected, have students analyze the data for differences between tracts. Depending on the age range of your students and the number of classes that participate in the census, you may wish to provide students with already compiled data and just have them compare and contrast census tracts. Keep the census anonymous. Note that most of the questions are not actual US census questions. Please add any questions that you feel are appropriate.

Possible mock census data to collect:

- Age
- Gender
- Grade
- Race and Ethnicity
- # of people that live in your home
- # of pets that you have
- Color shirt that you are wearing today
- Do you have a bicycle



A small group works to create a plan for a park during a charrette

You may also wish to utilize the stakeholder cards from the mock public hearing as characters that students can play for the design charrette.

Learn about zoning in Greenville. Have students visit the City's Planning Department webpage and search for information on zoning.

Ask each student to find three interesting facts on the City's website. After the allotted amount of research time is complete, have each student pick one fact about zoning to share with the class.

Design a city mock charrette. Print an aerial photograph from Google maps or another program. Break the class into small groups and chose a scenario to have your students create a plan. Tape the base map to a table with masking tape and cover it with tracing paper. Students should use markers to draw their ideas on the tracing paper.

The Census: An Introduction

By Emily Hays, Furman University

The U.S. Census Bureau, a group overseen by Congress, is responsible for planning, conducting, and reporting the census. A census is a collection of data intended for every individual in a population. The census is important because it informs us of the number of people that live in the United States, and it is conducted because it is required under the U.S. Constitution. The U.S. Census Bureau conducts the main census every ten years, but also conducts many other different surveys in between. All people that live in the United States are expected to take the census, even if they are not a U.S. citizen. It is conducted by place of usual residence, be it a house, apartment, RV, college dormitory, etc. The census asks basic questions such as how many people are living in your home, age, gender, and race.

The U.S. Census Bureau sends out questionnaires and surveys in the mail and include a pre-addressed and stamped envelope to mail it back in. The results from the census are important for a number of reasons. First, the answers help give us an idea of how many people live in the United States, helping determine the number of seats each state has in the House of Representatives. Secondly, the results are used to help make decisions about what community services to provide and how to distribute \$400 billion in federal funds to local, state, and tribal governments each year.

Many people, especially non-U.S. citizens, do not want to participate in the census for fear of being reported. However, all information is confidential by law, and the U.S. Census Bureau is prohibited from sharing that information with any other organization. Therefore, the Bureau spends a lot of time and money making the census short as well as easy to fill out and send in. If people do not fill out the census, it makes it harder to anticipate what communities will need in addition to making it more difficult for communities to receive federal funding.

The census helps planners make our communities a better place. For example, if results suggest that in a particular neighborhood, 20% of the children are under the age of five, the government will be able to anticipate the need to build a new school in that area. Federal funding received from census results also help improve college grant and loan programs, public transportation, public health services and hospitals, neighborhood improvements, senior services, and more. Even when the U.S. Census Bureau is not conducting the decennial census, it conducts surveys related to economics, populations, governments, and communities.

Design Charrette Worksheet

Planners get information from the public in many different ways such as:

- conducting surveys
- having conversations with community leaders and other stakeholders
- hosting public meetings
- attending other meetings within the community (neighborhood and business associations and others)
- holding a **charrette**

A charrette is a public meeting held by planners where design professionals and the public work together to **draw pictorial representations** of their ideas.

Charrettes often include multiple small groups of residents and other stakeholders from a community working together to draw a plan on a map of the area. The people in the group may have varying opinions of what the plan should look like, and it is important that they all work together to create a design that reflects the opinions of everyone in the group.

INSTRUCTIONS:

Use the space below to brainstorm some ideas that you feel should be included in your group's plan. Work with the other members of your group to create a plan that everyone likes.

Optional Design Charrette Scenarios:

- 1) The City of Awesomeville is planning to create a new neighborhood in a previously undeveloped area. The neighborhood should include greenspace, places for people to live, and a school. Brainstorm at least 2 other things that you feel it is essential to include in the new neighborhood, and then work with your group to draw a plan.
- 2) The Awesomeville Fun Association has decided to build an amusement park. The developers would like to include a rollercoaster and a small petting zoo. Brainstorm a list of other things you think the park should include. Work in your group to choose the 5 most important aspects of the park and then draw a plan.
- 3) Awesomeville Elementary School is going to build a new playground. Brainstorm a list of ideas for the new playground. Work in your group to decide on no more than 10 design elements and then work together to draw a plan.
- 4) Awesomeville City Council has decided to update an already developed area. People are already living in the current buildings, and the buildings must stay where they are. The updated neighborhood plan needs to include a network of trails and a bus stop. Brainstorm at least 3 other things that you think the neighborhood should have. Work in your group to draw a new plan for the neighborhood.

PLANNING FOR LIVABILITY

Learning Objectives

Students will

- be introduced to the concept of livability and the principles of smart growth
- draw connections between what they have learned about sustainability and what planners do

Background Information

Smart growth is an urban planning theory that attempts to address the three major considerations of sustainability in development. How can development occur that is **environmentally** considerate, equitable **socially**, and attractive **economically**? Development has an impact on many factors ranging from health, schools, taxes, commute time, the natural environment, business opportunities, and more. The way in which a community develops will impact the quality of life residents have both now and in the future.

Smart growth revolves around intentional planning. It seeks to answer the question, “how can the structure and design of an area create a vibrant community where people want to live, work, and play?”

Smart growth aims to achieve an equitable, high quality of life while creating a community that is economically competitive with plenty of business opportunities.

Mixed housing types makes it possible for young adults to afford their first homes, for families of varying sizes and stages to find a safe and attractive home within their budget and for senior citizens to find a space that will accommodate them as they age, regardless of their income or race.

A business built in close proximity to residences may help boost the local economy in the region, reduce commute times and increase accessibility, and may also attract people to an area.

These factors coupled with basic facilities such as schools, parks, and community centers all working together are part of smart growth. By following the ten basic principles of smart growth, planners aim to create attractive and livable neighborhoods.

In a community built on these principles, a resident can walk from their apartment to the grocery store, or bike from school to work. People feel safe and able to navigate their community easily.

The Smart Growth Network developed a set of ten basic principles regarding smart growth:

1. Mix land uses
2. Take advantage of compact building design
3. Create a range of housing opportunities and choices

Planning for Livability Journal Prompts

What is livability?

Is livability the same as sustainability? How are the two concepts the same or different?

Describe a community that is “livable” based on what you have learned.

Is your community a “livable” community? Why or why not?

If you could be a planner and plan how your neighborhood would look in the future, is there anything you would like to change about your neighborhood? What would you make your neighborhood look like? What would you add or take away, and why?

4. Create walkable neighborhoods
5. Foster distinctive, attractive communities with a strong sense of place
6. Preserve open space, farmland, natural beauty, and critical environmental areas
7. Strengthen and direct development towards existing communities
8. Provide a variety of transportation choices
9. Make development decisions predictable, fair, and cost effective
10. Encourage community and stakeholder collaboration in development decisions

The Partnership for Sustainable Communities, made up of U.S. Department of Housing and Urban Development (HUD), the U.S. Department of Transportation (DOT), and the U.S. Environmental Protection Agency (EPA), has identified ***six principles of livability***, as key components to consider when planning a community. They are as listed. In the paragraph below, these principles are bolded in relation to Greenville development.

- 1. Provide more transportation choices** (safe, reliable, reduce household costs, environmentally conscious, promote public health).
- 2. Promote equitable, affordable housing** (energy efficient, choices for everyone regardless of age, income, or race; close to transportation opportunities).
- 3. Enhance economic competitiveness** (access to employment centers, educational opportunities, etc).
- 4. Support existing communities** (transit-oriented development, mixed-use, land recycling).
- 5. Coordinate policies and leverage investment** (allow for policies that remove barriers to collaboration and allot for future growth, increased accountability, etc.).
- 6. Value communities and neighborhoods** (capitalize on communities unique characteristics; invest in healthy, safe, and walkable neighborhoods).

Greenville is currently planning a comprehensive development strategy that follows the livability principles as identified by HUD. Community planners have identified three areas of focus and are seeking to revitalize the west side of Greenville. The plan will ***support more transportation choices***, by improving bike lane infrastructure, sidewalks, and a new proposed Bus Rapid Transit System, connecting the west side of Greenville to downtown and beyond. The acquisition of property allowed for the development of many different types of new homes, which families can apply for and live in, therefore ***promoting equitable and affordable housing***. Falls Park and revitalization of the west side of downtown has made it a very attractive place for businesses, ***enhancing economic competitiveness, and supporting existing communities***. Addressing transportation, businesses, housing, and the creative use and redevelopment of formerly polluted areas, will lead to the creation of an area where people can live, work, play, and grow within a smaller area. This development plan also

preserves the history and culture of the community, while striving to still make it a place for a healthy and safe area.

Planning for livability is beneficial environmentally, as it preserves natural lands, protects water and air quality, and seeks to reuse already-developed land. In Greenville's west side, resources are also conserved as energy is spent reinvesting in existing infrastructure and sprucing up historic buildings.

Planning for Livability Activities

Divide students into 6 groups. Assign each of the groups one of the principles of livability. Each group should work together to **discuss and brainstorm** the ways that their principle relates to sustainability.

Ask students to come up with one hypothetical example of development that ignores their principle and one that uses their principle.

Ask a spokesperson from each group to **present to the class**.

Write the 10 principles of smart growth on the board. Using what they have learned throughout Community Quest, ask students to choose one of the principles and write a short paper that answers the following questions:

- In your own words, what does this smart growth principle mean?
- How is this smart growth principle related to sustainability?
- Do you think that this smart growth principle is important when considering what Greenville will look like in the future? Why or why not?

Compare and contrast: Write on the board “city” and “suburb.” Under it, list words that students suggest come to mind when thinking about each.

What are some of the main differences between cities and suburbs? How are they similar?

Next, write “ideal community” on the board. Have students list off what they would like to see there if they were creating their own. Draw from the livability and smart growth principles. To prompt ideas, ask questions such as:

- What conveniences would you like to have in this community? What stores would be needed and where would they be? Should stores be close to homes or far away?
- Where would you play and get exercise?
- How would you get around? Do you prefer to walk, bike, drive, use public transportation?
- What other things would the ideal community need?

Have students look over all three lists and discuss whether or not this “ideal community” would be considered a suburb, city, or neither. Would it meet some of the qualifications for smart growth? After discussing the “ideal community,” have students **draw maps or pictures of their ideal communities** based off of the discussion. They should incorporate the concepts they have learned in this lesson and recorded in the class charts about urban and suburban areas. Their maps should show residential and commercial areas as well as different modes of transportation.

Host a class debate. Separate the students into four groups and tell them that they will be arguing from the perspective of their assigned position. Remind students that this is an opportunity to thoughtfully consider the perspectives planners have to go through when making decisions.

Allow everyone a set amount of time to work in their groups to come up with arguments supporting their side of the debate. Students should be encouraged to consider the costs, benefits, and environmental and social impacts of their proposed solutions. This activity will demonstrate conflict of interest in common property uses and highlight how difficult it can be to agree on a solution.

After each group has had an opportunity to present their arguments to the class, allow another 5 minutes for students to discuss the issue and the opposing plans in order to try and find an alternate proposal that would make everyone happy.

Allow anyone with an alternate proposal time to present to the group.

Debate Topic 1

Old man Drumble passed away and gave the Drumble Mansion to the city. His property includes a large house, pool, tennis courts, horse stables, a garden, as well as fields and meadows. The city is trying to decide whether this property should become a shopping destination, a park, a neighborhood, or serve as a sight for industrial processes. The community meeting about how to develop the property has four very different and strong positions. Discuss and try to come up with a strategy that the majority of the groups can agree on.

- A developer wants to knock the mansion down and build a mall.
- The historic society wants to preserve the site as is.
- The neighborhood association wants the mansion to be converted into more houses; they are concerned about traffic and pollution if a mall comes in.
- The City's Park and Rec department want to turn the grounds into a park.



Planners use many different types of meetings and forums to solicit public input.

Top: A focus team listens to a presentation from Clemson University planning students

Middle: Small groups draw their ideas at a park planning design charrette

Bottom: Individuals are asked to place stickers on the issues that they feel are most important in their community

Debate Topic 2

An old mill was located in a flood plain and it shut down and is currently vacant. Should this property become a park, be reused as multi-family housing, or become a golf course, or a museum?

- A local developer wants to build a golf course on the property, arguing it will boost economic development in the area.
- The historic society wants to keep the mill as it is and turn it into a museum.
- The Neighborhood Association wants access to the river and unpolluted water, and wants the property to become a park.
- The environmental group wants the land set aside as a park for conservation.

Debate Topic 3

There is an old highway running through the City. It is very bumpy and narrow with two lanes running in each direction. The city is trying to decide how to maximize the potential of this transportation corridor. Should the highway be widened, removed, turned into a greenway, or turned into a trolley system? Discuss and come up with the best solution. Also, discuss the social, environmental, and economic impacts of each proposed solution.

- The Department of Transportation (DOT) wants to widen it and make it a freeway.
- The city wants to divert traffic to an alternative route outside of the City and turn the road bed into a greenway and trolley system.
- The city residents want to gain access to the river front across the highway, so they want it removed. Not to mention, they don't like the noise of traffic right outside.
- The suburban commuter group would take longer to get to their jobs if the highway was removed, so they want the road widened and repaved.



Glossary

A

Aesthetic

Visual qualities, usually pertaining to a sense of beauty.

Affiliation

A group that one is associated with.

Affordability

The ability to bear the cost of a good or service without exceptional difficulty; within financial capability.

Agriculture

The cultivation and management of land for production.

Air Quality

The state of the air around us. A measurement of the pollutants in the air, such as nitrous oxides, ozone, carbon monoxide, and sulfur dioxide. Poor air quality negatively impacts human health.

Air Quality Index

An index for reporting daily air quality in different regions. A measurement of how clean or polluted the air may be and what the health impacts of breathing that air will have on human health over the course of a few hours, days, or years.

Alternative

Different or unconventional options.

Altruism

Unselfish regard for oneself for the benefit of another.

Aquatic

Relating to or living in or on water.

Arboretum

Garden parks dedicated specifically to trees.

Architecture

The art and science of creating and designing structures such as buildings.

Automobile

A passenger vehicle designed to carry 10 passengers or less, excluding motorcycles, usually has four wheels; a private form of transportation.

B

Barrier

An object or item that keeps things separated from one another.

Biodiversity

The amount of different species of plants and animals in a particular ecosystem, including genetic diversity within a species.

Biome

A group of large related ecosystems characterized by the type of vegetation that grows within a particular climate. Examples include: arctic tundra, deserts, and tropical rain forests.

Bioswale

Vegetated landscape features consisting of swales and slow drainage courses designed to help filter and remove pollution from surface runoff water.

Boundary

Official line, visible or invisible, that defines limits of a land area, such as a block, census tract, or county.

Brownfield

An underutilized or abandoned property where redevelopment is hampered by environmental contamination or the possibility of the property being contaminated by a hazardous pollutant, usually due to past land use as industrial or commercial facilities. Cleaning up and reinvesting in brownfield properties promotes economic development, protects the environment from further contamination, reduces blight and takes development pressure off greenfields.

Budget

A plan estimating the amount of money to be allocated towards various expenses for a set period of time.

Buffer Zone

A neutral area designed to mitigate conflict. In the context of planning, a buffer zone helps mitigate frictions between commercial-residential district boundaries.

Bus Rapid Transit (BRT)

Bus Rapid Transit is a type of transit that is more efficient than the traditional bus system and less costly and quicker to implement than light rail. A BRT is defined by four main components: 1) dedicated bus lanes, 2) at-grade boarding, 3) pay-before-you-board stations, and 4) signal-prioritized intersections.

Business

A commercial establishment engaging in the exchange of goods and services.

C

C & D Waste

Anything discarded during construction and demolition.

Census

A complete data collection of all demographics of a population, including businesses and commercial establishments. Census data allows planners to project future community needs.

Certification

An official approval attesting that a facility/staff are qualified and are legally able to perform specific tasks or services according to a set of established standards.

Charity

An organization, usually nonprofit, that works to help the underserved or needy individuals in a population; or the giving of money or things with no expectation of reward.

Charrette

A type of meeting held by planners that is open to the public during which design professionals work to draw various ideas and scenarios based on public input

City Council

The legislative body of a city, consisting of the mayor and elected council members.

Civic

Relating to a city.

Clean Water Act

A set of Federal legislation regulations and amendments passed in 1972 that allows the US Environmental Protection Agency to regulate the discharge of pollutants into US water bodies.

Clear Cut

The forestry practice of clearing all trees in a stand, leaving it empty.

Climate

Description of the characteristic weather conditions in particular geographic areas, usually based on average temperature and rainfall.

Commercial

The provision of goods and services for financial profit; includes: purchases, sales, transactions, growing, processing, manufacturing, etc.

Commons

A resource shared by everyone and owned by no one; land managed by the public.

Community

All populations inhabiting an area at a specific time. For people, community is a social science construct about the relationships that people may form and can include individuals joined by shared interests, geographic residence, history, or ethnicity.

Commute

The distance and time it takes for an individual to travel, usually between home and work.

Concrete

Something that is physical as opposed to virtual. Also a building material made from sand, rock, and water.

Conservation

The protection and management of resources or property to ensure longevity and preservation.

Construction

The act or process of creating structures on a property; subject to design standards of the district.

Contaminant

A material or substance (physical, biological, or chemical) that is out of place and may cause harm or damage.

Contamination

The existence of undesirable materials in the wrong place, making an area unfit for its intended use.

Cultivate

Grow or raise, usually used to denote the growing and raising of crops for human consumption or use.

D**Delineation**

A pictorial definition or designation.

Density

The concentration of items or individuals per unit size. In city planning, density refers to the concentration of dwelling units per acre of land.

Derelict

Something that is rundown due to neglect and abandonment by the owner; not taken care of.

Desertification

The degradation of soil and vegetated areas due to human activity resulting in poor soil and lack of vegetation including expansion of arid environments.

Design

Layout and aesthetics.

The creative thought and implementation of a project in a way that is to be functional, innovative, and engaging. In planning, design includes items such as street alignment, landscaping, site layout, building elevations, and signage.

Development

Human induced change of a land area intended to bring about growth. Includes construction of new buildings, zoning, building relocation, improving real estate, paving, excavating, etc.

Discharge

Release.

Dissolved Oxygen

The amount of oxygen gas dissolved in water; a measurement of water quality.

Diversity

Variety, not being the same; being composed of many different elements. Examples include housing stock diversity and cultural diversity.

E**Earthship**

A type of housing that utilizes the structure of the natural environment to reduce energy and water consumption. Often involves earth berms, grey water systems, passive solar heating, tires filled with soil to create the housing foundation, and reclaimed materials for construction. They are unique in design and vary based upon location.

Easement

An authorization for a person or agency to use a portion of land for a specified purpose by the property owner.

Economics

The social science studying the production, consumption, distribution, and transfer of goods and services.

Economy

The resources and wealth of a nation.

Ecoregion

A land area defined by its environmental conditions such as distinct geography, natural communities, and plant and animal species.

Ecosystem

All living and nonliving components of a community interacting to form an ecological system. Examples include deserts, grasslands, tundra, marshes, lakes, and tropical rain forests.

Efficiency

The comparison of production outputs to required inputs. For something to be considered efficient, it must be able to have the greatest output for minimal input.

Effluent

The output of a process; example: water from a waste water treatment plant.

Emission

The release of chemicals, particulates, or pollutants into the air.

Environment

All factors living and non living that affect an individual throughout the individual's lifecycle.

Erosion

The movement of soil particles or sediments by wind or water.

Ethnicity

Affiliation with a social group that shares a common heritage, culture, or nationality.

Excess

More than the required amount.

Expenditure

The amount of money that is spent, or the act of spending money.

Expense

Cost.

F**Filtration**

The process or act of separating something. Usually the process or act of separating solids out of a liquid, and allowing the liquid to pass through.

Forestry

The management of forests; includes developing, cultivating, growing, harvesting, transporting, and selling trees

for commercial use and management of forest ecosystems for wildlife habitat, recreation, conservation, and other uses.

Fuel

Matter that is used up to produce heat or energy.

G**Garden**

A managed plot of land used to grow plants such as flowers, fruits, vegetables, and herbs.

Geography

The physical features of an area or the study of the earth and its physical features.

GIS

Geographic Information System (GIS)
A spatial computer system capable of storing, visualizing, analyzing, retrieving, and transferring geographic data of an area.

Government

The organization that exercises authority and regulation over a society for the good and welfare of those under it. A government's power is given by the people.

Green Building

Any structure that is designed, planned, constructed, and operated in a way that minimizes its impact on the environment, increases efficiency, and protects human health.

Green Space

Undeveloped areas of a city that are specifically set aside for recreation, aesthetic relief, or wildlife conservation.

Green Way

A linear park that provides passive recreational opportunities, pedestrian and bicycle paths, and the conservation of open spaces.

Grist Mill

A mill for grinding corn, wheat, and other grains into flour. Early mills used the force of a river to turn a water wheel or turbine which then turned gears to power the rest of the operation.

Ground Water

Water accumulated underneath earth's surface, filling all pores and spaces in rock or soil. It serves as a reservoir for springs and wells and is replenished by surface water.

H**Habitat**

The physical environment an organism, species, or population naturally dwells.

Heritage Preserve

Land areas designated to preserve the cultural and natural history of the region.

Housing and Urban Development (HUD)

The U. S. Department of Housing and Urban Development's mission is to "create strong, sustainable, inclusive communities and quality affordable homes for all. HUD is working to strengthen the housing market to bolster the economy and protect consumers; meet the need for quality affordable rental homes: utilize housing as a platform for improving quality of life; build inclusive and sustainable communities free from discrimination; and transform the way HUD does business."

Humus

The dark brown, nutrient rich topsoil of a soil sample; organic matter that has reached a point of stability in which all organic matter (such as dead leaves and wood) has decomposed.

Hybrid Car

An automobile that combines a gasoline motor with an electric powertrain; produces one-tenth the pollution of a gasoline-only vehicle.

Hydrology

The movement of water through and over the land. Includes evaporation, precipitation, absorption, above and below ground flow, recharge, discharge, and other parts of the hydrologic cycle.

I-K

Ideology

A set of ideas that form the basis of a political, economic, or other system.

Impairment

A loss in function or diminishment of value.

Impermeable

An impenetrable surface, where substances cannot pass through or seep into.

Income

The amount of money that an individual or business receives over a set period of time in return for providing goods or service.

Industrial

Relating to the manufacture of goods. An area that is zoned for industrial use allows factories and other large buildings such as storage facilities.

Infill

The acquisition and redevelopment of vacant lots in developed areas; building within existing development patterns.

Infiltration

The downward movement of water as it permeates the ground and moves into the subsoil.

Infrastructure

The public facilities and services that serve the common needs of a community, such as sanitation systems, transportation networks, industry, residential, and commercial areas, parks, schools, etc.

care of living and non living features such as walkways, walls, gardens, lawns, fountains, ponds, and other design features. Most often used in conjunction with the built environment.

LEED

Leadership in Energy and Environmental Design, a certification program run by the U.S. Green Building Council that capitalizes on the integration of innovative design and environmental sustainability. This program provides graded certifications for green buildings on a point scale.

Legacy

Something that is left behind once a person, animal, or thing is gone.

Legislative

A land use or zoning decision that is applicable to a large body of individuals.

Light Rail

An urban transportation system that utilizes small trains or single cars and an electrified rail to transport passengers along an exclusive right of way, meaning that no other vehicles are allowed to travel in the same lane as the light rail cars.

Livability

An indication of a community's quality of life based on factors that include natural environments, economic prosperity, social stability and equity, educational opportunity and cultural, entertainment and recreation possibilities. The U.S. Department of Housing and Urban Development (HUD) has identified six principles of livability, as key components to consider when planning a community.

Local

Belonging to or coming from a nearby neighborhood or area.

Market

A place where people meet to buy and sell goods, or the intentional advertising of goods to a specific group of people.

Mayor

The presiding officer at City Council meetings, representing a City and its Council; in a council government system, the mayor has no more legislative power than any other member of city council.

Mining

Material extraction from the land.

Mixed Use

A real estate project with planned integration of some combination of retail, office, residential, hotel, recreation or other functions. It is generally pedestrian-oriented, maximizes space usage, and tends to mitigate traffic and sprawl. It often incorporates amenities and architectural expression.

Monoculture

Typically used to describe crops on farmland, referring to agricultural systems where the majority of the crop is of the same species, resulting in low crop diversity.

Multi-Family

Housing that allows multiple groups of people to live in a single building. Examples include apartments, duplexes, townhomes, and mixed use developments.

Multi-Modal

A transportation system that makes use of multiple types of transportation and allows individuals to access these systems easily at set points.

Municipality

The governing body of a city or town.

L

Land Use

The way individuals use the land. In planning, land use is often designated and zoned.

Landscaping

The alteration of the appearance of the land through the planned placement and

M

Map

A tangible, visible expression of a geographic region utilizing symbols to depict roads, homes, schools, forests, etc.

N

National Park

Land and coastal areas set aside by the federal government for protection and recreation due to their scenic, ecological, or historical significance.

Native

Belonging to or coming from a particular place, innate.

Natural

Something existing or occurring apart from human intervention or activity.

Neighborhood

A group of homes; varying in size but defined by geographic boundaries.

Network

An interconnected system where nodes, points, or individuals are influenced by the actions of the other points in the system.

Nomadic

A group of people that move at intervals. Migratory.

Non Profit

An organization whose purpose is dedicated to the benefit of others. These groups include social services, welfare, education, etc. and are also exempt from taxation.

Nonpoint Source Pollution

Pollution that comes from a diffused source, such as sediment runoff, fertilizer, and pesticides and that are influenced by the topography of the land.

O**Open Space**

A land area set aside by zoning that is to remain undeveloped. Open spaces are areas then used for recreation or resource protection and also provides visual relief to developed areas.

Orientation

How something (such as a building) is positioned on a piece of property.

P-Q**Park**

Private or publically owned open-space land set apart for recreational, educational, cultural, aesthetic, and/or environmental use.

Passive Heating

A type of energy systems that uses solar energy directly through environmental design rather than using pumps or blowers to transfer heated air or water. The interior of a structure acts as the solar collector.

Permeable

Can be passed through. Most often used in relation to water.

Philanthropy

Doing something or giving something that will benefit someone else or a community without any expectation of reward.

Photosynthesis

The chemical process all green plants undergo to make their own food. Energy from the sun, carbon dioxide, and water create glucose for the plant, and oxygen is released as a by-product.

Plan

A proposal or diagram that maps out a course of action intended to lead to a future goal.

Planner

A job in which people help develop a broad vision for a community and what it can be by identifying values and creating development goals and then implementing a strategy to achieve those goals; a branch of urban planning.

Point-Source Pollution

Specific sources of pollution that are easily identifiable, such as a smoke-stack or factory drain.

Pollution

Contamination of air, water, or soil by undesirable materials. Can be physical, chemical, or biological. Not all pollutants are innately harmful, but when taken out of natural context or in high quantities, they can become pollutants.

Population

A group of individuals sharing genetic information of the same species that occupy a habitat at a given time.

Projection

A future estimate based on a recurring present trend.

Proximity

Physical closeness.

Public Transportation

A service provided to the public for traveling by vehicles such as bus, train, metro, etc. Transportation networks usually have a specific route, schedule, and fare, but are available to all.

Public Use

Government-owned facilities available for the public to use, such as schools, parks, and cultural buildings.

R**Reclaimed**

The reuse of materials without making it into something new. Reclaiming materials from buildings that are about to be demolished or renovated can save a significant amount of waste from being thrown into landfills and can be cheaper than using new materials.

Recycled

The reuse of materials by making used materials into something new. Recyclable materials include anything from floor tiles to siding to glass and plastic. Using recycled materials for building instead of newly harvested (virgin) materials, saves energy, protects natural resources, and is often less expensive.

Region

A geographic area bound together by similar characteristics, greater than the boundaries of local governance.

Remediation

The clean-up of a polluted area to an uncontaminated state.

Reservoir

A natural or artificial basin used for the storage, regulation, and control of water.

Resident

An individual who lives and works in a particular location; not a visitor.

Residential

Land designated as a place where people live; an area used predominantly for dwelling.

Resource

A source of supply one can draw from for support. Examples include: wood as a resource from trees, money, etc.

Riparian Buffer

A vegetated space alongside rivers or water sources that reduce the impact of storm water runoff by keeping the water shaded, stabilizing the bank, protecting water quality, and providing a wildlife habitat.

Road Diet

The reduction of travel lanes in a roadway, often reducing travel lanes in order to add other amenities such as sidewalks, bike lanes, turn lanes, transit lanes, street trees, or parking.

Rural

Land areas that are less-developed, consisting mainly of open spaces and areas used for farming, forestry, and resource extraction.

S**Sediment**

Soil matter, such as sand, silt, clay, and minerals, that has been or is being moved by wind or water.

Service

The action of doing or providing something for someone else.

Service Learning

A type of volunteering project in which students combine volunteering with scientific learning. The distinctive element of service-learning is the integrative

learning approach, simultaneously providing a service to the community and educating the student, paving the way for developing critical thinking skills and career interests, as well as class collaboration.

Silviculture

The growing of trees for agricultural purposes.

Single-Family

Homes that hold one family or small group of people on a parcel of land; most common in suburban and rural areas.

Social

Of or pertaining to the interactions of a group of people.

Society

A community of people, usually people who share a set of laws, a cultural heritage, or some other binding factors.

Soil Profile

A vertical section of soil that shows the horizons, or layers of material beneath the surface of the land.

Species

All organisms that share a genetic heritage and can reproduce viable offspring.

Stakeholder

An individual who has a vested interest in a project or place.

Storm Water Runoff

Surplus water runoff resulting from rainfall that does not seep into the earth. Impermeable surfaces in cities and the compaction of soil contribute to large amounts of stormwater runoff.

Suburban

Usually residential development that occurs just outside of a city; characterized by the need for personal automobiles as a major form of transportation and lower population density than a city.

Success

Accomplishment, or attaining a desired outcome.

System

A network of interdependent relationships within a whole.

T**Term**

The set length of time that a government or elected official serves in office.

Top Soil

The surface layer of soil, rich in organic matter and humus.

Topography

A representation of earth's physical land surface showing elevation, position, and slope.

Trail

A maintained path or network of paths used by people on non-motorized forms of transportation, such as walking, biking, horses, etc. Trails are also usually denoted by a clearly marked trail head.

Transit-Oriented Development (TOD)

A higher density mixed-use development within walking distance (half mile radius) of transit stations. TODs increase location efficiency, provide a sense of place, and establish a rich mix of housing, shopping and transportation. This form of development can generate revenue for the public and private sectors and provide value to its residents.

Transportation

The act of moving goods or people from one place to another. The system or vehicle that moves goods or people from one place to another.

U**Urban**

Of or pertaining to a developed area or city.

Urban Heat Island

An area of human development that is warmer than the surrounding undeveloped area.

V

Vehicle

A transportation device used to move people or goods from one place to another such as a car, train, or bus.

Vegetation

Plant life.

Virtual

Something that is not concrete; often meaning something that is online but doesn't exist in the same form in the real world. Such as a virtual marketplace

W-Y

Walkability

An environment that is friendly to the presence of people walking, shopping, living, and enjoying time in an area. Walkability expands transportation options and creates safe and inviting streets that adequately meet the needs of people with a range of mobility.

Water Body

An area of water accumulation. (river, stream, lake, pond, wetland, ocean, marsh, swamp, etc.)

Water Cycle

The processes that water follows when it changes form and moves across the earth. Usually includes evaporation, transpiration, condensation, and precipitation.

Water Quality

The physical, biological, and chemical characteristics of water that determine the suitability of water for any intended use.

Water Table

The upper surface of the ground that is completely saturated with water.

Watershed

Total land area surrounding a particular body of water that all water drains into; watersheds vary in size and in geography depending on the size of the water body, the topography of the land, and the land use patterns that occur in the watershed as well as surrounding watersheds.

Wealth

The amount of material items, or money, one has in their possession.

Weather

The state of the atmosphere (temperature, cloud cover, precipitation or lack thereof, etc.) at a specific time in a specific place. The weather of an area is always changing, while climate remains relatively constant.

Weathering

The act of changing in appearance or texture (or wearing down) over time due to exposure to constant atmospheric conditions.

Wetland

A habitat where the soil is saturated at least some part of the year.

Z

Zoning

The classification of land types designating what type of land use should be placed where in a geographic area, usually based on population density. Zoning's original purpose was to protect people and their environment by insuring that land use types are evenly distributed throughout an area and that some land use types are separated from others.

Appendix I

The Urban Water Cycle Game

Directions:

Print out the water cycle dice and cards.

Fold the seven dice into squares, using tape or glue to secure the tabs on the inside of the dice.

Set up 7 stations in the classroom, and place a corresponding card and die at each station. The stations can be randomly placed throughout the room.

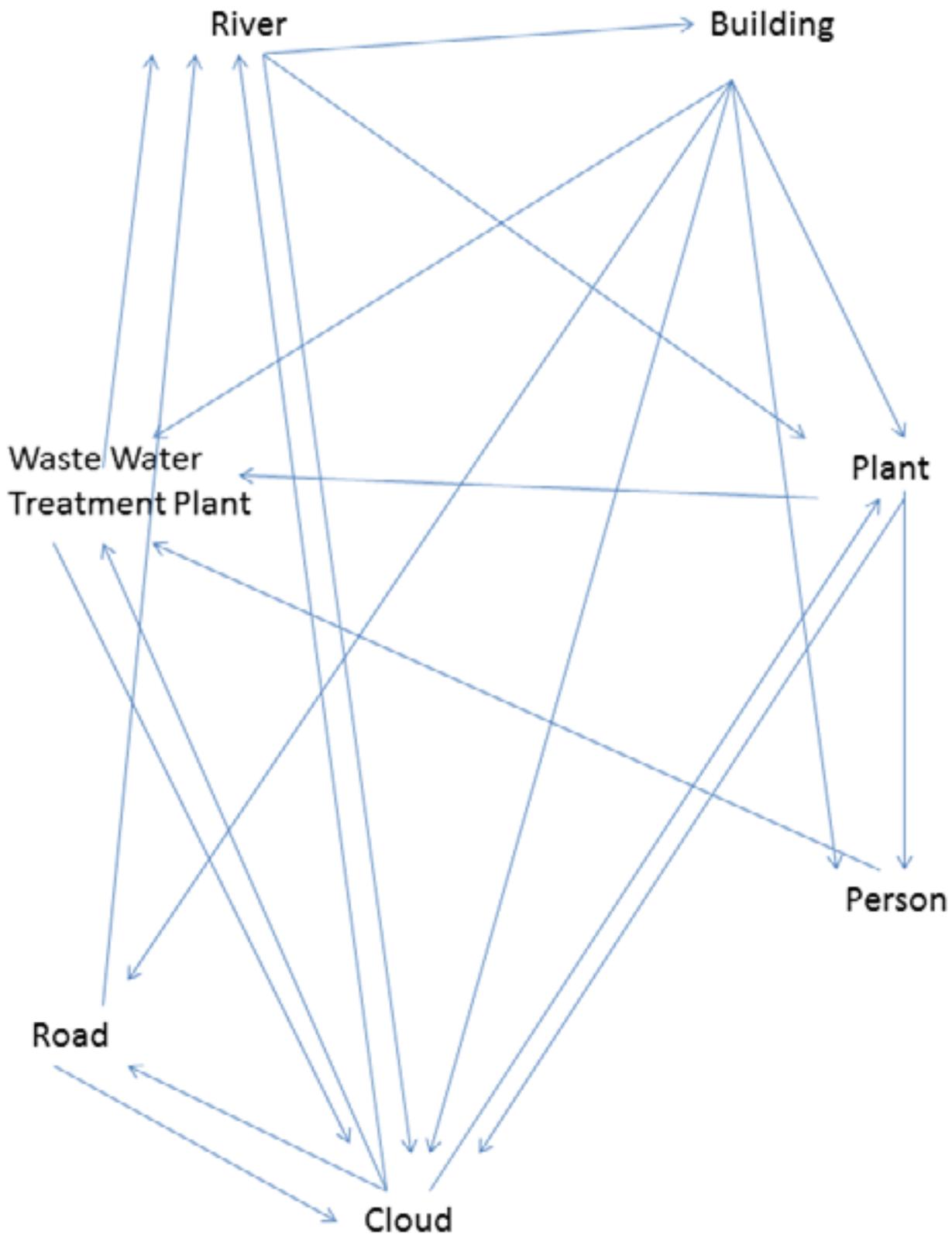
Place a colored pencil, marker, or crayon at each station that corresponds with the color of the station. (or use colored beads)

Explain to students that they will play the part of a water droplet moving through the urban environment. When they reach a station, they should use the colored pen to mark a tally or dot on their paper, roll the die, and follow the instructions on the die to go to their next station.

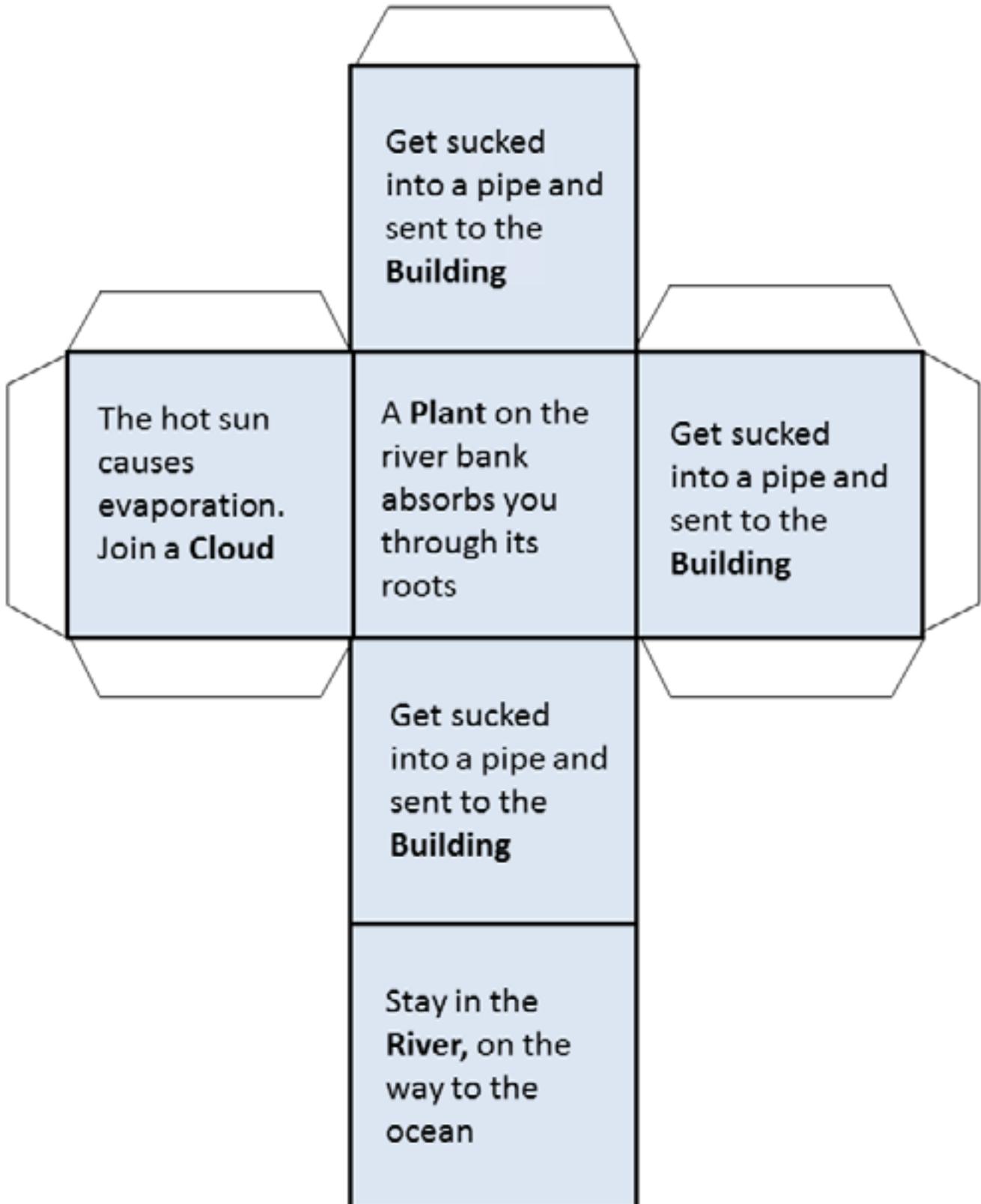
If told to remain at a station, they should go to the back of the line, mark their paper a second time with the same color, and roll again.

Play the game for an allotted amount of time and then call the students back for discussion.

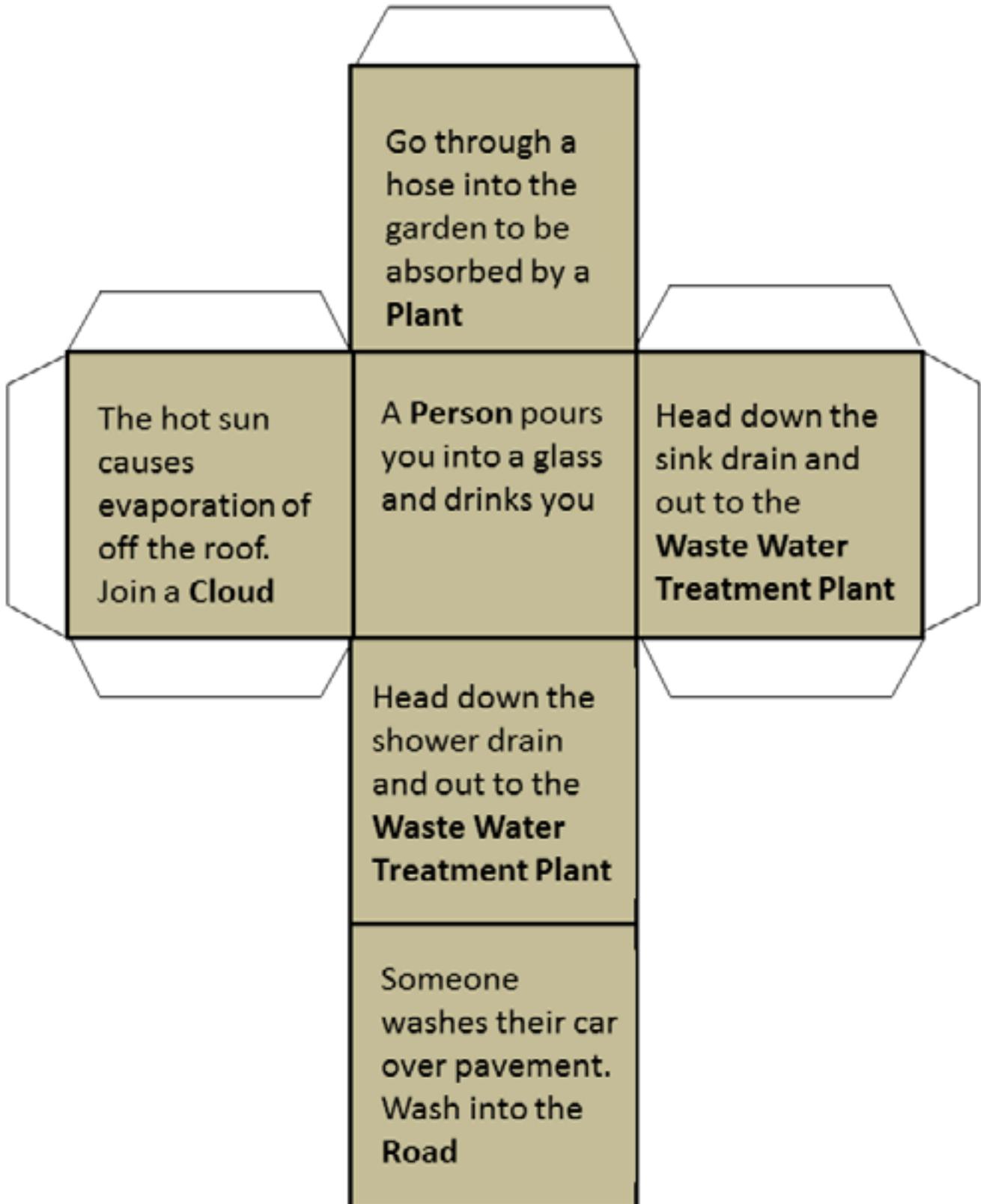
Diagram of possible paths for a water droplet in the Urban Water Cycle Game



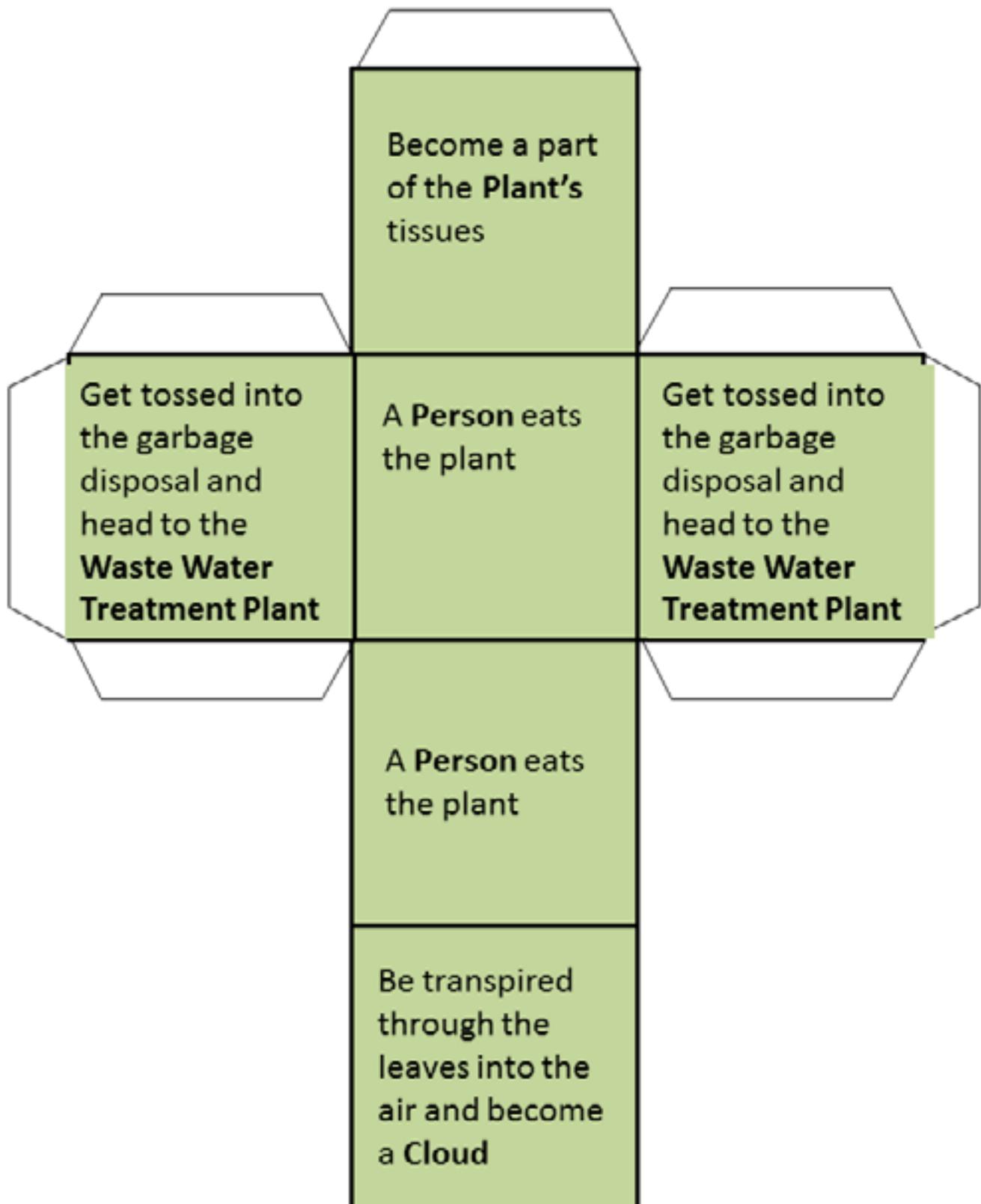
RIVER



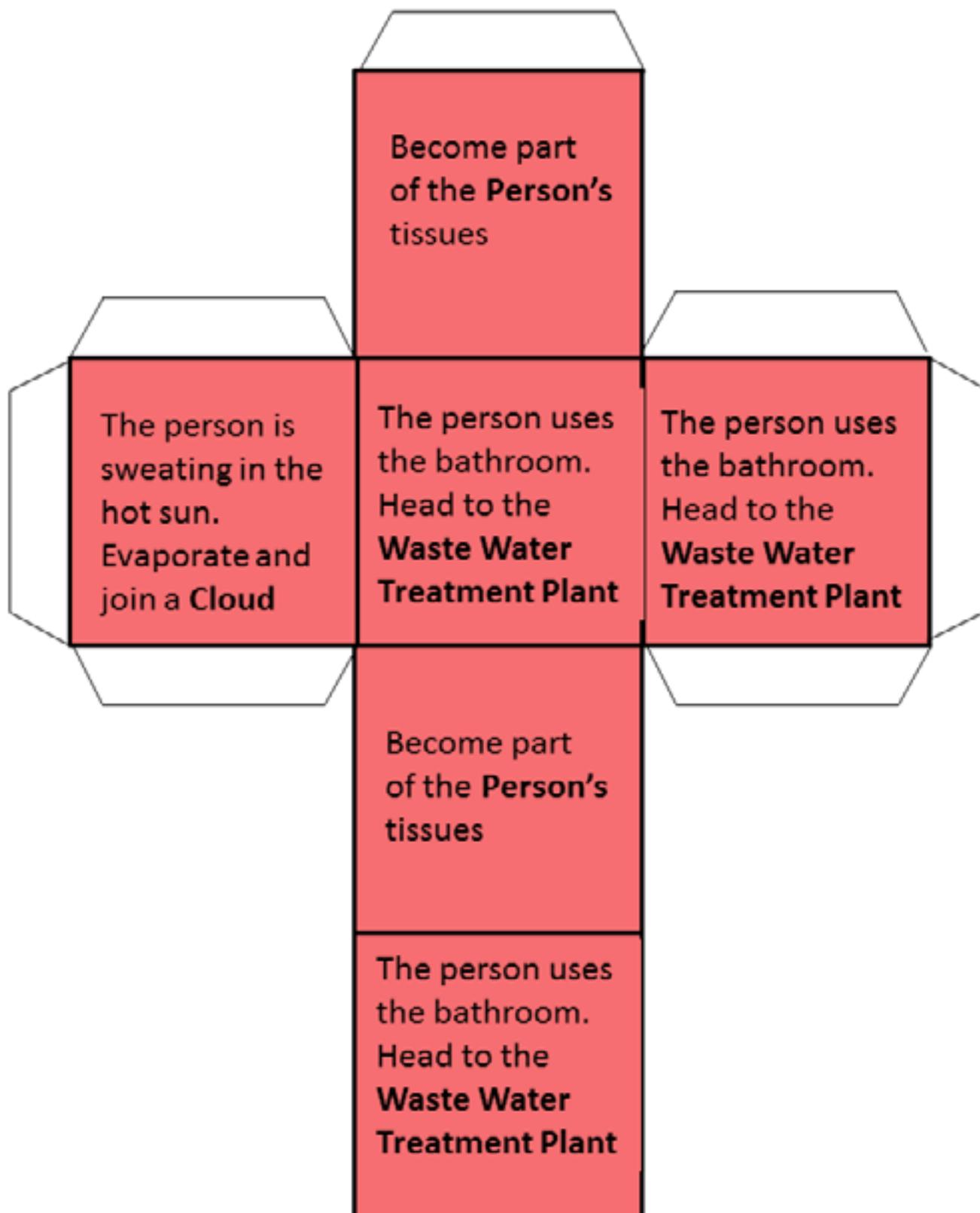
BUILDING



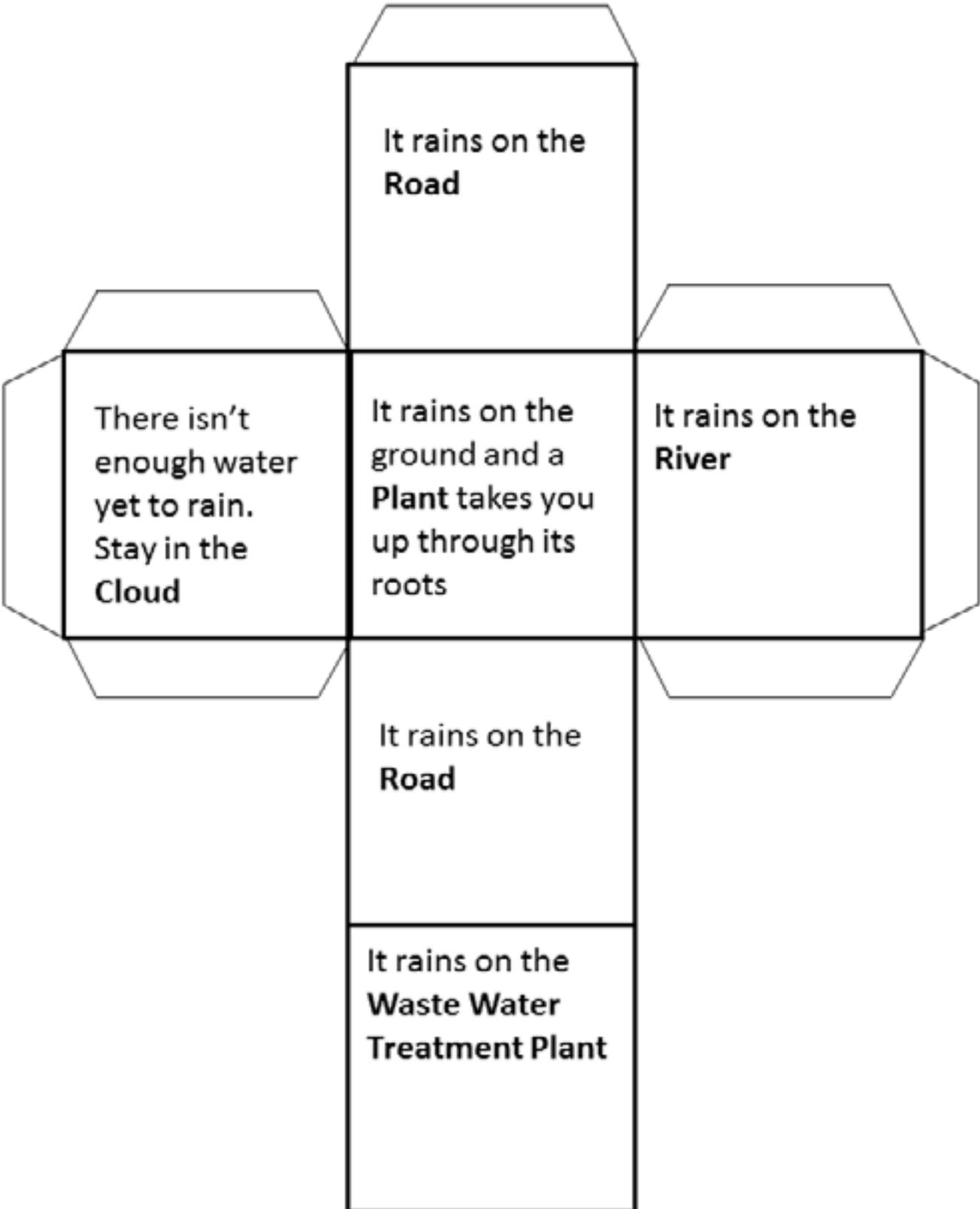
PLANT



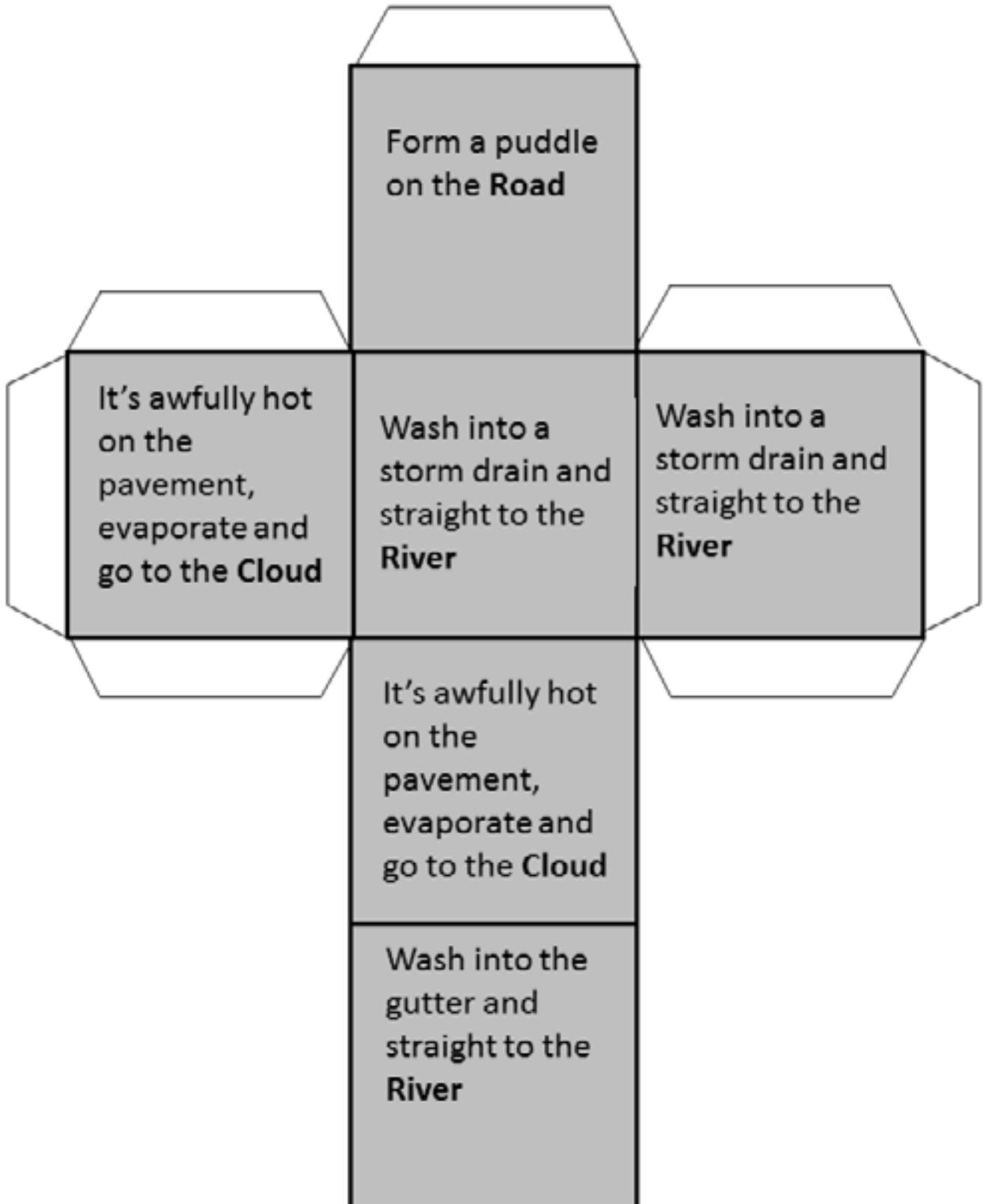
PERSON



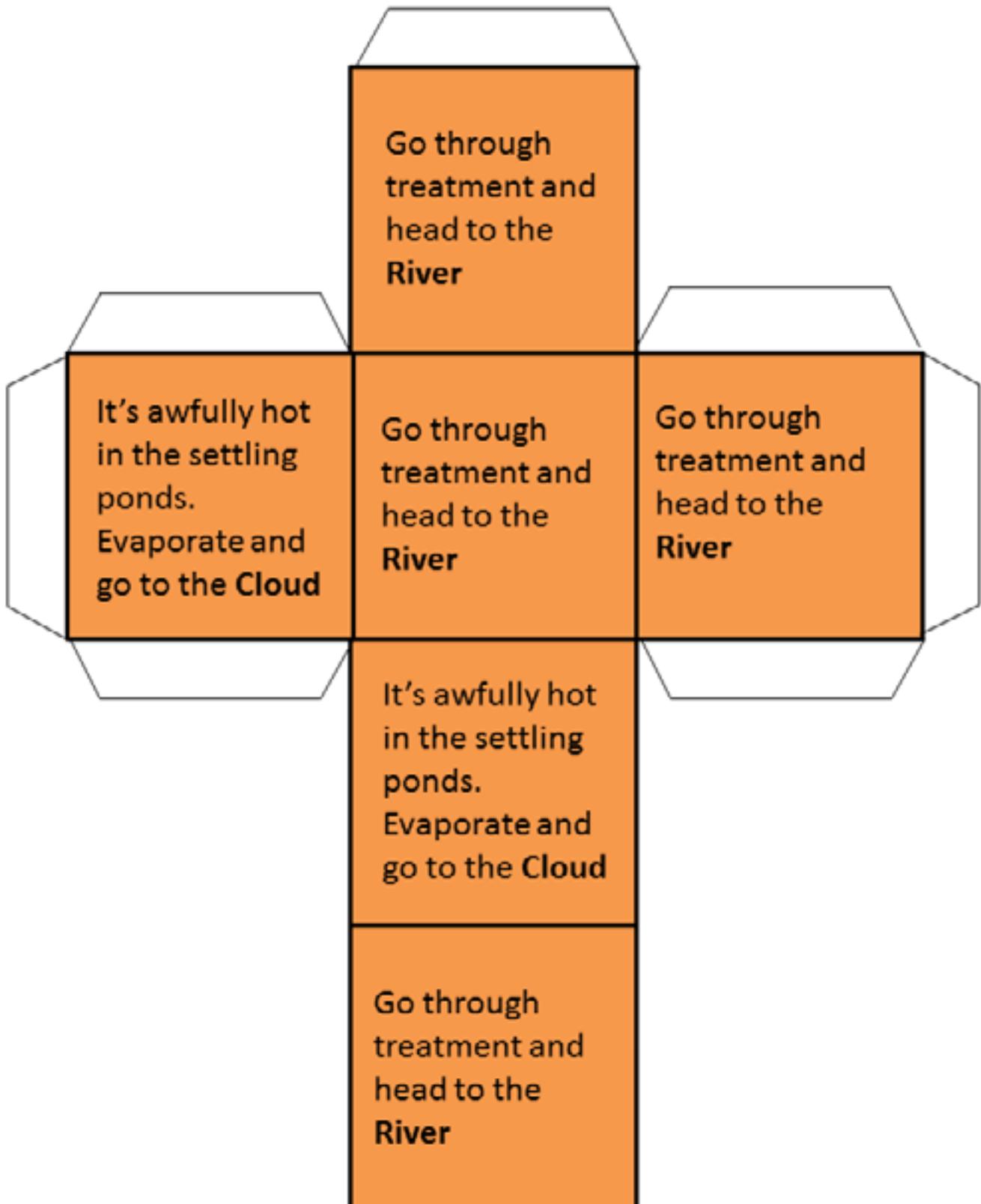
CLOUD



ROAD

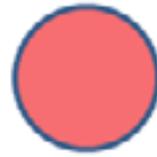


WASTE WATER TREATMENT PLANT





River



Person



**Waste Water
Treatment Plant**



Building





Plant



Road



Cloud



Appendix II

Transportation Cards

TRANSPORTATION CARDS

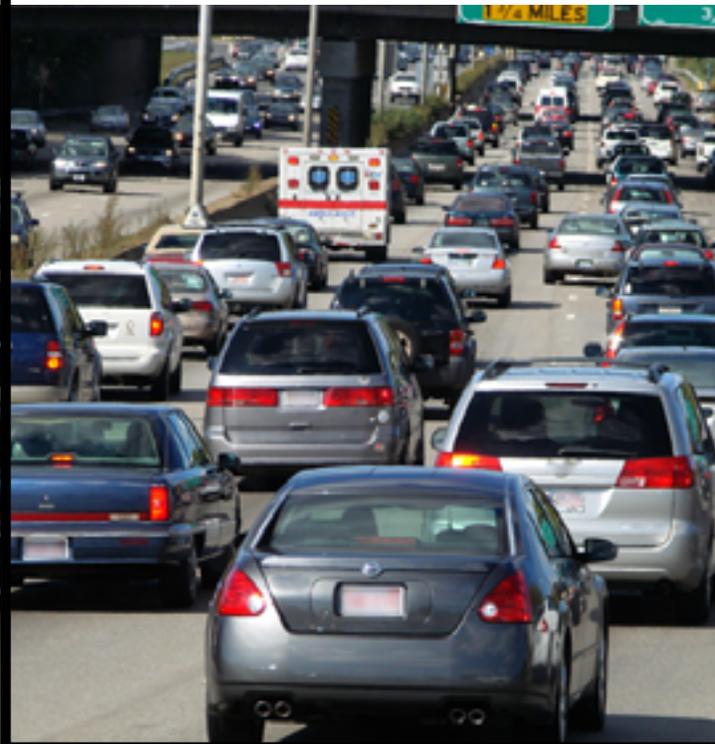
BUS



WALKING



CAR



BICYCLE



TRANSPORTATION CARDS

PLANE



TRAIN



BOAT



MOTORCYCLE



TRANSPORTATION CARDS

KAYAK



SCHOOL BUS



FERRY



SUBWAY



TRANSPORTATION CARDS

GOLF CART



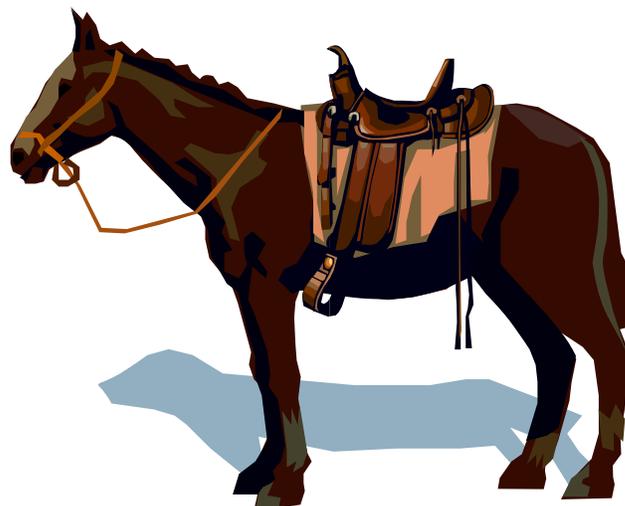
CRUISE SHIP



SKATEBOARD



HORSE



TRANSPORTATION CARDS

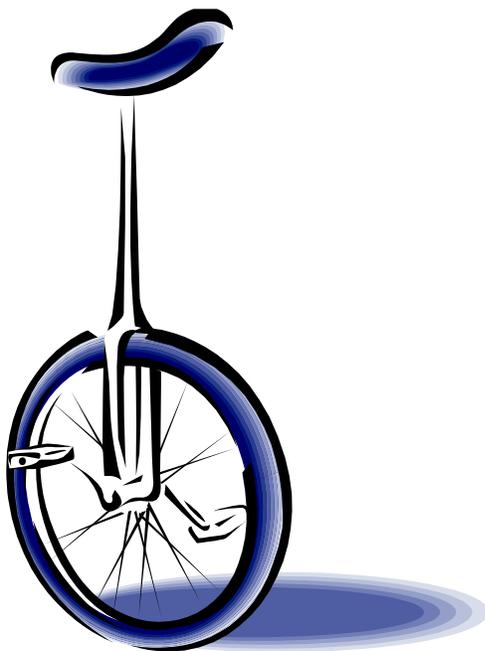
SAILBOAT



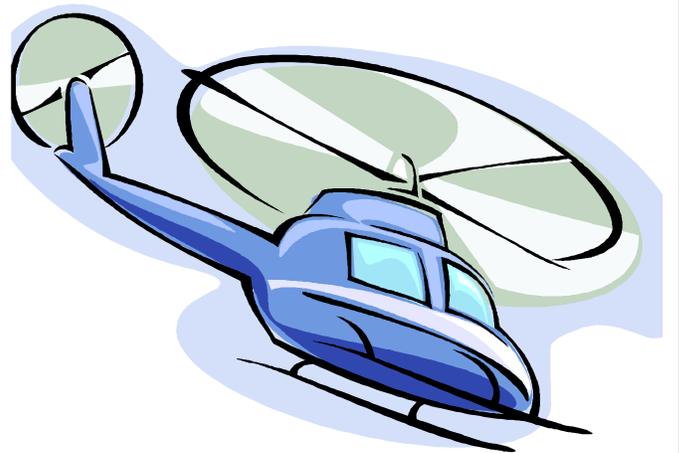
HOT AIR
BALLOON



UNICYCLE

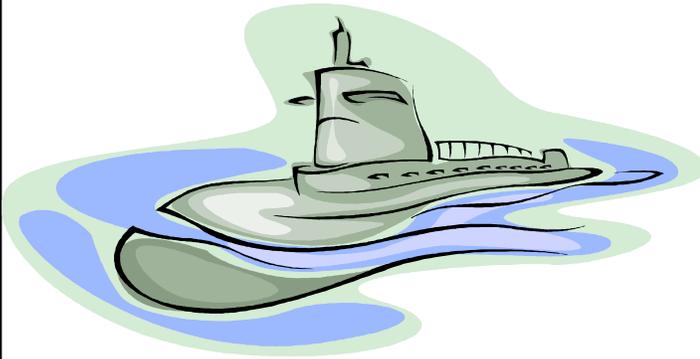


HELICOPTER



TRANSPORTATION CARDS

SUBMARINE



TROLLEY



ROLLER SKATES



SLED



TRANSPORTATION CARDS

TRACTOR



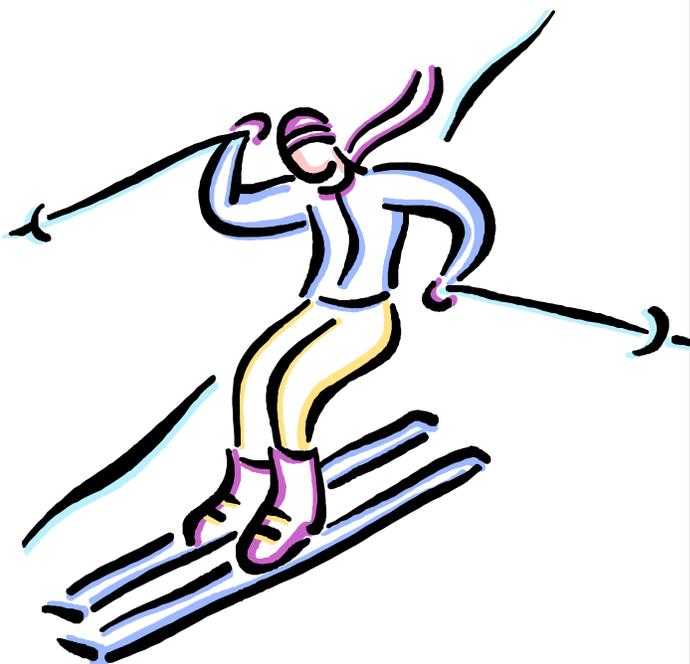
ELEVATOR



SNOW MOBILE



SKIS



Appendix III

Affordability Simulation

Description:

This game is a three month simulation, modeling various income and expense scenarios people have to account for in life. Each week 2 situational cards will be selected at random instructing students to pay the mandatory “needs” or optional “wants.” Students will be responsible for keeping up with their monthly fees and tallying up their totals at the end of each week. The class will be divided up into three different income brackets, as listed.

Ideally, this game will be most impactful if students are able to go through the simulation multiple times, experiencing different incomes.

Group 1 (Purple)

- Savings—\$500
- Income—\$300 per week
- Rent—\$600 per month

Group 2 (Orange)

- Savings—\$1000
- Income—\$500 per week
- Rent—700 per month

Group 3 (Blue)

- Savings—\$1500
- Income—\$700 per week
- Rent—\$800 per month

Mandatory Expenses

- Utilities— \$100/month
- Food— \$50 due every week
- Transportation
- Rent

Instructions:

Pass out the attached worksheet (affordability simulation table) and assignment cards to students. Tell students that these cards tell them what their mandatory expenses are each month, and potential jobs they would have with this income.

Students will write their savings amount on the worksheet under “Week 1, Savings.” This is when the simulation begins. Next, have students write their income under “Week 1, Income.” This is the amount of money they have available to work with, which they add up under “Total Available.” Now, we’re ready to begin. First order of business, RENT is DUE! Under “Week 1, Rent,” have students deduct their prescribed rent. Next, students must also deduct -\$50 for food for the week. Have them write this under “Week 1, Groceries.” During Week 1, students also have the opportunity to purchase a pet for \$50.

As of right now, students have no way to get to and from work. This is their first mandatory purchase. Have students deduct their chosen transportation cost under “Week 1, Transport.” Students in Group 3 must purchase a car and pay for gas every month. Students in Group 1 and Group 2 have the option of buying a car, a bike, or bus pass. Everyone must choose one. See costs below. Students will write under “Expense Type” what type of transportation they have.

Transportation:

- Car: \$500 (initial) + \$100/month (gas)
- Bike: \$100
- Bus Pass: \$10/ week

Finish up week one by having students calculate how much money they have left and entering it under “Week 1, Total.” This concludes week one. The final value will now be moved to “Week 2, Savings.” Their tables should look similar to the one shown below.

	Week 1	Week 2
Savings	\$500	\$50
Income	+ \$300	+ \$300
Rent	- \$600	
Needs	-\$100 (Bike) -\$50 (Food)	
Purchase	—	
Total Remaining	\$50	

Week 2 has begun! Have students deposit their income. Remind students to deduct -\$50 for food. Students also have the opportunity to purchase insurance for \$100 to cover them for three months. If they choose to purchase insurance, students will deduct -\$100 for insurance under “Week 2, Extras, Needs” and then they will write “insurance” under “Expense Type.” Remind students to deduct other recurring fees, if necessary (bus fee). See complete list of recurring fees below. Also, select two situational cards from the stack. Read them aloud. If a mandatory purchase for all, have students write it out under “Week 2, Extras, Needs.” If optional, have students list it under “Week 2, Wants.” These purchases should also be identified under “Expense Type.” Total up all costs and transition into Week 3, where the only new mandatory fee is utilities.

Continue on with this sequence until you reach the end of the game. Students may need to be reminded to pay rent, bus fares, food, and utilities. Throughout the game, you may want to have students raise their hands when they decide to make a “fun purchase.”

List of Mandatory fees:

- Week 1: transportation, rent, food
- Week 2: food, bus
- Week 3: Food, utilities, bus
- Week 4: Food, bus
- Week 5: Rent, food, bus, gas for cars (\$100)
- Week 6: Food, bus
- Week 7: Food, utilities, bus
- Week 8: Food, bus
- Week 9: Rent, food, bus, gas for cars (\$100)
- Week 10: Food, bus
- Week 11: Food, utilities, bus
- Week 12: Food, bus
- Week 13: Food, bus, rent, gas for cars (\$100)

Discretionary Suggestions for Teachers:

-In creating this game, we wanted to make it as flexible as possible depending on the teacher's individual preferences. Some suggestions for spicing up the game are as follows:

- Teacher can gray in open boxes on the worksheet so that students will know what they have to pay when. For example, "Week 1, Rent" and "Week 5, Rent" would be open boxes, while weeks 2-4 would be marked.
- "Bonus Cards" are included as a reward for hard work, providing a one-time \$100 boost in income. These can be given to students at random or specifically given to those who are demonstrating hard work and effort during the simulation.
- Have students raise their hands whenever they purchase something they want. The hope is that this will make students aware of how their classmates are spending their money and influence how they feel about spending theirs.
- We included a "Group 4" card with empty rent, savings, income, etc. so that a teacher may incorporate more variety into the classroom if desired.
- One fun suggestion is to pick out of some of the situational cards and provide actual incentives to accompany the card. For example, students that choose to buy candy will receive a mint. Incorporate this into class discussion. How did seeing the candy in front of you impact your decision to purchase it? How did the purchases of your peers influence your desire to purchase as well?

Questions for discussion or reflection:

1. Were you surprised at how quickly you spent your money?
2. How did you feel when you saw your friends hands go up when they got to do something fun and you couldn't afford it? If you could afford the activity, but didn't buy it, why?
3. Was there anything that you wanted to buy but were unable to afford? What was it, and how did that make you feel?
4. What if you had a large family, how do you think that would impact your budget?
5. Did you actually need all of the things you purchased? What could you have done without?
6. If you played again, would you make different choices in how you spent your money?
7. Did you play the game differently depending on the card pulled? How do the card pulling and the surprise expenses relate to real life?
8. What would happen if you got sick and suddenly couldn't go to work? How would that impact your budget?
9. How did it feel moving from a low-income budget to a higher income? How did that impact your spending?
10. How did it feel moving from a higher budget to a lower one?
11. How is this simulation similar to what people spend in reality? How is it different?
12. What factors, if any, influenced the income people received in the game? How is this different or similar to real life?
13. If you chose not to fix a cockroach infestation in your house because of the cost, how do you think that would have impacted you a month or two months later?
14. For those that received a bonus, how did that extra bit of money impact your spending?

Group 2

Required Fees

- Savings: \$1000
- Income: \$500/week
- Rent: \$700/month
- Utilities: \$100/month
- Food: \$50/week
- Transportation: Listen to Teacher
- Jobs: writer, teacher, landscaper, police officer

Group 4

Required Fees

- Savings:
- Income:
- Rent:
- Utilities:
- Food:
- Transportation:
- Jobs:

Group 1

Required Fees

- Savings: \$500
- Income: \$300/ week
- Rent: \$600/month
- Utilities: \$100/month
- Food: \$50/week
- Transportation: listen to Teacher
- Jobs: sales associate, store clerk, janitor, etc.

Group 3

Required Fees

- Savings: \$1500
- Income: \$700/week
- Rent: \$800/month
- Utilities: \$100/month
- Food: \$50/week
- Transportation: You drive a car. It costs \$500, plus \$100/month
- Jobs: Lawyer, surgeon, physical therapist, consultant, veterinarian

NEED

Everyone With a Pet Must Purchase



Oh no, Fido and Fluffy have the measles!

If you have a pet, you must take it to the veterinarian.

Pay 50\$

NEED

Everyone Must Purchase One of the Options Listed



You need a new pair of shoes for work. You can

Go to the thrift store and buy a slightly used pair for 10\$

Go to Shoes 4 Less and buy a new pair for 30\$

Go to the department store and buy a brand name pair for 50\$

NEED

Everyone With Transportation Must Purchase



Oops! You didn't see that pot hole in time!!

If you have a bike, you need a new tire. Pay 20\$

If you have a car, you need to get it realigned. Pay 100\$

NEED

Everyone Must Purchase



Oh no, your refrigerator broke

Hire a repair man
Pay 50\$

NEED

Everyone Must Purchase one of the Options Listed



You are very sick. You can

Go to the doctor if you have insurance and pay 20\$

Go to the doctor if you don't have insurance and pay 100\$

NEED

Everyone Must Purchase



Your roof was damaged in a recent hail storm

Get your roof repaired.
Pay 120\$

NEED

Everyone must purchase



You need medicine.

If you have insurance,
Pay 10\$

If you don't have insurance,
Pay 40\$

NEED

Everyone With a Pet Must Purchase



Oh no, Fido and Fluffy have fleas!

If you have a pet, you must purchase flea shampoo.

Pay 20\$

NEED

Everyone Must Purchase One of the Options Listed

Your good work pants were ruined.



Go to the thrift store and buy a slightly used pair for 10\$
Go to Pants Mart and buy a new pair for 30\$
Go to the department store and buy a brand name pair for 50\$

NEED

Everyone With A Car Must Purchase

Your car isn't working properly. Time for an oil change.



Change the oil yourself. Pay 40\$
Take your car to a mechanic. Pay 80\$

NEED

Everyone Must Purchase

Oh no, your stove broke



Hire a repair man
Pay 50\$

NEED

Everyone Must Purchase one of the Options Listed

You have a toothache and need to go to the dentist.



If you have insurance pay 20\$
If you don't have insurance pay 100\$

NEED

Everyone Must Purchase

You had friends over and they ate all of your food.



You need more groceries
Pay 40\$

NEED

Everyone must purchase

You need glasses



If you have insurance, Pay 30\$
If you don't have insurance, Pay 80\$

NEED

Everyone Must Purchase

You need light bulbs, toilet paper, and soap.



Pay 20\$

NEED

Everyone must purchase

Your clothes are all dirty and your laundry machine is broken!



Buy a new washing machine for 160\$
Buy a used washing machine for 80\$
Go to the laundry-mat every week for 10\$

(add 10\$ to weekly expenses)

WANT

(Everyone May Purchase)



You've worked hard all week long.

Go out to dinner and a movie with friends.

Pay \$30

WANT

(Everyone May Purchase)



It's your birthday!
Go out to dinner with friends to celebrate and have some cake.

Pay \$30

WANT

(Everyone May Purchase)



Your house is looking a little bit drab.

Plant some rose bushes

Pay \$30

WANT

(Everyone May Purchase)



Your room is looking a bit drab.

Paint your room a new color.

Pay \$40

WANT

(Everyone May Purchase)



You've been working really hard. Take a vacation:

Pay 50\$ to go camping two nights

Pay 150\$ to go to a day spa

Pay 500\$ to go to the beach for 3 days

WANT

(Everyone May Purchase)



You need a fun day! Go to the zoo with friends.

Pay \$10

WANT

(Everyone May Purchase)



You need a hobby

Buy art, music, or sports supplies

Pay \$30

WANT

(Everyone May Purchase)



You've been working really hard. Take a vacation:

Go on a cruise

Pay 500\$

WANT

(Everyone With a Pet May Purchase)



Fluffy and Fido rolled in something really stinky!

Take your pet to be groomed.

Pay \$20

WANT

(Everyone May Purchase)



Your favorite sports team is in town

Go to the game

Pay \$50

WANT

(Everyone May Purchase)



The circus is in town!

Go to the circus

Pay \$30

WANT

(Everyone May Purchase)



The fair is in town!

Go to the fair and ride 3 rides

Pay 20\$

Go to the fair and ride all of the rides and play games

Pay \$50

WANT

(Everyone May Purchase)



Oh No! There are ants in your kitchen!

Hire an exterminator

Pay 50\$

WANT

(Everyone May Purchase)



Everyone has been talking about this cool new band

Go to a concert with friends.

Pay \$50

WANT

(Everyone May Purchase)



You found an awesome new outfit at Clothes Mart.

Pay \$40

WANT

(Everyone May Purchase)



Your Television Broke
Buy a new TV

Pay 150\$

WANT

(Everyone With a Pet May Purchase)

Fluffy and Fido need a place to sleep

Buy your pet a dog house or pet bed

Pay \$40



WANT

(Everyone May Purchase)

Buy a new video game for your favorite game system.

Pay \$20



WANT

(Everyone May Purchase)

Your doctor suggested that you join a gym to stay healthy.

Pay \$60



WANT

(Everyone May Purchase)

You lost your cell phone.

Buy a used flip phone
Pay 50\$

Buy a new smart phone
Pay 120\$



WANT

(Everyone May Purchase)

An extra large package of your favorite candy is on sale at the grocery store.

Pay \$10



WANT

(Everyone May Purchase)

Buy a new tablet or computer.

Pay \$500



WANT

(Everyone May Purchase)

You lost the ear buds for your music player. Buy a new pair

Pay \$20



WANT

(Everyone May Purchase)

It's your best friend's birthday. Buy them a present and take them out to lunch.

Pay \$40



WANT

(Everyone May Purchase)

Your friends are taking a trip to the mountains for a retreat. Go with them.



Pay \$150

WANT

(Everyone May Purchase)

Your hair is getting long.

Get your hair cut



Pay 30\$

BONUS

(Teacher Discretionary Card)

You've been doing a really great job at work!



Receive 100\$
Bonus Income

BONUS

(Teacher Discretionary Card)

You've been doing a really great job at work!



Receive 100\$
Bonus Income

