grade 4

Essential Question: How do we come to know and appreciate the river environment and our place in it?

Content Questions:

What is our connection to the river environment?

What makes the river healthy?

How can we make a positive difference on the river environment?

Fourth Grade River Biodiversity Overview

Content Question 1: What is our connection to the river environment?

LESSON 1: Our Connection to the River Environment
- Prior knowledge activities
- Read aloud: *A River Ran Wild* by Lynne Cherry

LESSON 2: Schoolyard Nature Observation
- Solo time
- Poetry writing

LESSON 3: What Is a Watershed and How Does It Function?
- Watershed activity with white plastic table cloth
- Watershed address and map

Content Question 2: What makes a river healthy?

LESSON 4: How Is a River Formed?
- Small group activity with stream tables
- Journal responses

LESSON 5: How Do Plants Affect Water Flow and Erosion?
- Small groups activity with stream tables
- Journal responses

LESSON 6: What is Non-point Source Pollution and How Does It Affect Our Watershed?
- Extension of watershed activity where students model non-point source pollution

LESSON 7: River Field Trip
- Macroinvertebrate testing
- Turbidity testing
- Follow up essay assessment

Content Question 3: How can we make a positive difference on the river environment?

Culminating Activity

LESSON

1 our connection to the river environment

Essential Question: How do we come to know and appreciate the river environment and our place in it?

Content Question: What is our connection to the river environment?

Goals

- Students will become familiar with rivers and how people depend on rivers and how people have impacted rivers in both positive and negative ways

Vocabulary

- **Biodiversity:** The variety of organisms found within a specified geographic region
- **Environment:** Sometimes used to refer to the natural world (including land water and air), other times used to refer to any particular area (for instance, the urban environment)
- **River:** Any flowing body of water

Materials:

- *A River Ran Wild* by Lynne Cherry
- Journal
- Crayons, colored pencils or water colors

Background Information

Rivers are important natural resources, both to plant and animal communities and human communities. Many cities have developed along rivers because of the amenities rivers provide. Rivers can be sources of drinking water as well as food. Rivers can be used to convey waste – including sewage, storm water and industrial waste. Farms and industries can pump the water they need directly from rivers. In some parts of the country, rivers are also used to make electricity. Many people enjoy rivers recreationally for canoeing, kayaking, hiking and biking along trails by the river, recreational fishing and nature observation.

Rivers are important habitats not only for the plants and animals that live in their waters, but also for many plants and animals that do not live in the river, but depend on the river as a source of water or food. Animals such as deer and raccoon, come to the river to drink. Raccoons and herons visit the river to find food such as frogs and fish. Trees, such as red maple, sycamore and green ash, can be abundant along rivers because they can withstand the occasional floods that can kill other types of trees.

Above the surface of the water, ducks paddle by feeding on algae and aquatic

plants. Waterstriders also skin the surface of the water. In the water itself, fish such as carp, bluegills and sunfish swim about as do tiny microscopic animals like daphnia and copepods. Uni- and mulit-cellular algae also float in the water. In the sediment, on submerged logs and on rocks at the bottom of the river, a wide variety of macroinvertebrates (animals that lack a backbone that are visible to the naked eye) such as crayfish, caddisfly larvae, dragonfly larvae and aquatic worms live.

Procedure

Hook

You will be reading *A River Ran Wild* aloud

Activity

1) Have a large piece of butcher paper to make a KWL chart.

2) Ask the students what they know about rivers in general and place their answers in the K portion as this will state what they KNOW about rivers.

3) Ask the students what they want to know about rivers and place their answers in the W portion as this will state what they WANT TO KNOW about rivers.

4) The L chart can be filled in as the students LEARN more information about the river.

5) Read the book *A River Ran Wild* aloud to the students.

6) Discuss the book with the students. Possible questions to ask:
- How did the river change over time?
- How did people depend on and enjoy the river? How did this change over time?
- Why did the river get so polluted? Why did people let it get so polluted?
- How did the river come to get cleaned up?
- Have you ever seen anywhere or anyone that needed help? What did you do?

Reflection & Assessment

In their journals, have students draw a picture or sketch of a river. The students may use their drawing or sketch to make a watercolor picture and write about their own personal connection with the river.

Assessment note: no formal assessment for this introductory lesson

Reinforcement & Enrichment

Play river related songs and have students learn river related songs. For a list of river related songs look in the **Resource section** under music.

State Standards

Illinois

1.C.2a Use information to form and refine questions and predictions.

3.C.1a Write for a variety of purposes including description, information, explanation, persuasion, and narration.

12.B.1a Describe and compare characteristics of living things in relationship to their environments.

Indiana

English 4.3.2 dentify main events of the plot, including their cause and the effects of each event on future actions, and the major theme from the story action.

LESSON

2 schoolyard nature observation

Essential Question: How do we come to know and appreciate the river environment and our place in it?

Content Question: What is our connection to the river environment?

Goals

- Students will use their senses to observe nature
- Students will write poetry reflecting their observations and expressing their feelings

Vocabulary

none

Materials

- Journal
- Colored pencils or crayons
- Poetry books (see Resources section under poetry for suggestions)

Background Information

None

Procedure

Hook

Students get to explore their schoolyard in a new way.

Activity

OBSERVATION

Take the students outside to a quiet place where they can observe nature. Have students bring their journals and a pencil with them. Students should sit at least three to four feet apart. Tell students that for the next 10 minutes they will sit quietly without talking and will use their sense of sight, hearing, feeling and smell. Students should record all of their observations in a journal. Tell students to use juicy details and descriptive words.

SHARING

After ten minutes of quiet observation and journal writing, bring students together to share thoughts and journal observations. Tell students that they are now going to create poems from their nature observations.

POETRY WRITING:
Ask students what they know about poetry and what kinds of poetry they have written. Review different types of poetry and vocabulary: free form, rhyming couplets, different rhyming patterns, stanzas etc. Share a couple of short poems that use different writing styles. Tell the students that they can use whatever poetry style they wish. Encourage them to be creative!

Reflection & Assessment

Use the **3-point Journal Rubric** to assess the student's journal writing

Reinforcement & Enrichment

Create a class book of "Nature Poems."

State Standards

Illinois

3.C.1a Write for a variety of purposes including description, information, explanation, persuasion and narration.

Indiana

Science 4.2.5 Write descriptions of investigations, using observations and other evidence as support for explanations.

English 4.5.6 Write a variety of purposes

LESSON

3 what is a watershed & how does it function?

Essential Question: How do we come to know and appreciate the river environment and our place in it?

Content Question: What is our connection to the river environment?

Goals

- Students will be able to define what a watershed is
- Students will know their watershed address

Vocabulary

- **Community:** A group of people, plants and animals living in the same region
- **Downstream:** In the direction of the steam's current (will always be downhill)
- **Drain:** To draw off liquid slowly
- **Lake:** A large inland body of water
- **Landscape:** The topography and resources of an area
- **Stream:** A flowing body of water, flows in a channel
- **Surface:** Top of an object
- **Water cycle:** The continuous movement of water through the environment
- **Watershed:** The area of land which drains into a body of water

Materials

- White plastic tablecloth
- Newspaper
- Spray bottle filled with colored water (fill the water bottle, add two drops of blue food coloring and mix together)
- Map of the watersheds in Illinois (http://www.sws.uiuc.edu/hilites/map.asp) or Indiana (http://www.hecweb.org/watershed/home.htm) for the students to observe
- State map of Illinois or Indiana
- Copy of a US Map (which includes major rivers), one for each student
- Journals

Background Information

Water continuously cycles through the environment. The water we have today is the same water that was present at the times of the dinosaurs and before. When rainwater falls on the earth it can either run over the top of the land towards water bodies such as rivers, lakes and oceans; absorb into the ground or evaporate back into the air. Water that soaks into the ground can be taken up by plants. Some of this water will be transpired (evaporated through the plant's leaves) back into the air by the plants while some of it will be incorporated into the plant's tissue. Water not absorbed by plants can soak deeper into the ground, into the groundwater. Groundwater moves slowly towards rivers, lakes and oceans, or sinks deeper into aquifers (areas underground where there is enough water to supply a well).

A watershed is the land that drains into a body of water such as a stream, lake or wetland. Because water flows downhill, watershed boundaries are always located on the top of hills or mountains. Rain falling on one side of the hill will flow into one water body, while rain falling on the other side of the hill will flow into another water body.

Any changes to the land in a watershed will affect the river or lake it drains into. For instance, replacing forests and prairies with housing developments decreases the amount of water that can seep into the ground. More water flows over streets and sidewalks into street drains that empty into the river (either directly or via a water treatment facility). Thus, the river tends to flood more often when it rains because so much water reaches it so quickly. When so much water is in the river, the water is able to greatly erode the banks of the river. Tree roots are left exposed and the sediment ends up in the river, turning the river water a murky brown. The sediment can clog the gills of fish and insects, cloud the water so much that plants can not photosynthesize and bury insects and fish eggs living on the bottom of the river. While flowing over streets, rainwater also picks up any pollutants such as salt, oil and sand. These pollutants can then reach the river. This type of pollution, which is spread across the landscape and can not, once it reaches the river, be identified as coming from any one particular person or company, is called non-point source pollution. It is one of the major threats to rivers today.

A watershed is more than just land; it is also a community. A watershed community includes all the people and natural resources located within a watershed..

For more information on watersheds look in the **Resource section** under watersheds.

Procedure

Hook

Ask the students if they know their home address. Tell them that by the end of the class they will have a new address.

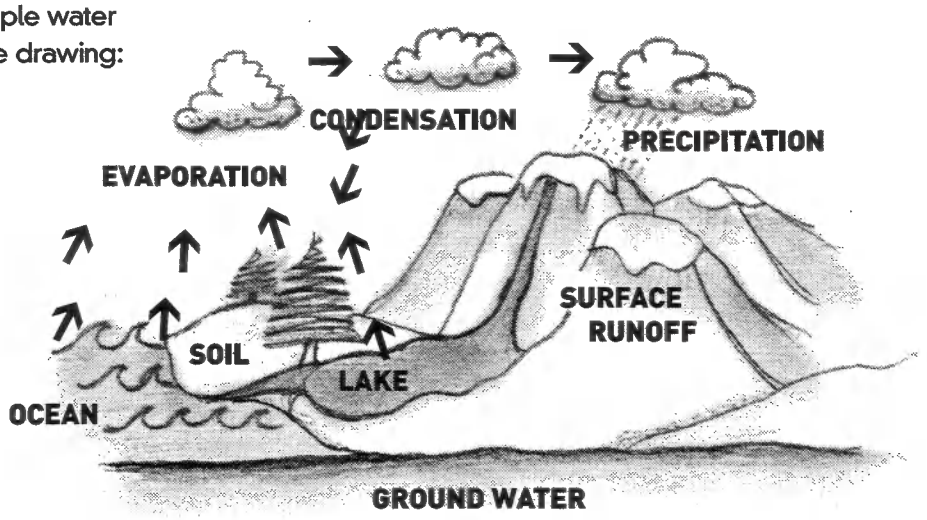
Activity

OBSERVATION

1) Have students draw the water cycle, as they remember it in their journal. Have students share their thoughts and together make a water cycle on the

board. Talk with your students about the implication of water continuously cycling. If water gets polluted how will it get cleaned up? Is the water we drink today the same water dinosaurs drank and the same water generations to come will drink? (YES) Then have students correct their drawings in their journal to show the complete water cycle.

2) Sample water cycle drawing:



WATERSHED DEMONSTRATION (based on an activity by Julie Schultz, EarthForce)

1) Tell students that they are going to be creating a model of a landscape.

2) Have students crumple pieces of newspaper and pile the papers on the floor to create a landscape.

3) Once the papers are all in place, place the white plastic tablecloth over the crumpled newspapers. Make sure that the edges of the tablecloth lie flat against the floor. This will prevent water from running onto your floor.

4) Ask students to predict in their journals where the water will go if rain were to fall on this piece of land. Give students time to record their responses in the journal.

5) Have students stand around the edge of the tablecloth. Spray the colored water on the tablecloth long enough to observe how the water flows over the land.

6) Ask students to point out where water is going (it is flowing down hill into rivers and then into pools of water that could be small ponds or lakes).

7) Have students pay attention to one particular pond or lake. Tell them to carefully observe where the water in the lake or pond comes from – i.e. what part of the landscape drains into the lake. Spray more water on the landscape around this pond or lake while students observe what is happening. Point to locations inside and outside the watershed and ask students if they think water falling here would drain into the pond or lake. Why or why not? If students are unsure, spray water again and have students observe. Invite several students to show what land they think drains into the lake or pond

8) Let students know that the areas of land that drain into a body of water – river, lake or pond – is known as a watershed. Have students locate the watershed boundaries of other water bodies in the simulated landscape. Ask students

what is the same about all watershed boundaries? (They are always located at the top of hills and mountains and encircle the water body.) Ask students to explain how there can be two watersheds right next to each other. (A ridge separates the two areas.) Ask students to hypothesize why it might be important to know where a river's watershed boundary is. (In lessons 5 and 6 students will be investigating several reasons.)

9) Have the students write their observations and thoughts in their journals. Journal entries should include a definition of a watershed (through words and pictures) and their hypotheses about why watersheds are important.

WATERSHED ADDRESS:

1) Display two posters – a state watershed map and a "regular" state map. Have two volunteers locate their city on the state map. Then have two other volunteers locate their city on the watershed map and find their watershed address (the name of watershed they live in).

2) Have students write their new watershed address in their journals.

3) Have students find their local river on a US map and trace where it flows. All rivers will end up in either a lake or ocean. The Chicago, Des Plaines and Fox Rivers in northeastern Illinois all flow to the Mississippi River and the Gulf of Mexico.

4) Share with students that we are all part of a watershed community – the people, plants, animals and other resources that are found in our watershed. Ask the students if they boat, fish, or swim in any of the area creeks, lakes or rivers. Explain to the students that knowing their watershed address and being aware of what is happening in their watershed is important because every member of the watershed community is responsible for caring for the watershed they live in.

Reflection & Assessment

In their journals, have students reflect on what it means to them to be part of a watershed community. How do they affect their watershed and river in both positive and negative ways?

Assessment note: use the **3-Point Journal Rubric** to assess all journal entries for this lesson.

State Standards

Illinois

17.A.2b Use maps and other geographic representations and instruments to gather information about people, places and environments.

11.A.2b Collect data for investigations using scientific process skills including observing, estimating and measuring

12.E.2a Identify and explain the earth's land, water and atmospheric systems.

Indiana

Social Studies 4.3.4 Locate Indiana on a map of the United States; indicate the state capital, major cities, and rivers in Indiana and be able to place these on a blank map of the state

LESSON

4 how is a river formed?

Essential Question: How do we come to know and appreciate the river environment and our place in it?

Content Question: What makes a river healthy?

Goals

- Through experimentation, students will discover how rivers are formed
- Students will understand what erosion is and how it affects rivers

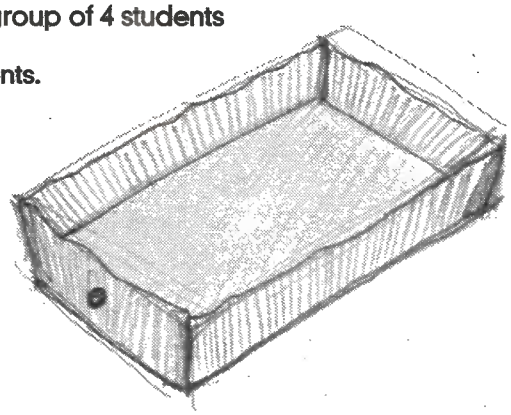
Vocabulary

- **Erosion:** wearing away by rubbing or abrading sediments: soil, sand and gravel
- **Turbidity:** how opaque something is due to the presence suspended solids

Materials

- Student **Direction Sheet** (included), one per student
- **Record Sheet** (included), one per group of 4 students
- Stream table, 1 per group of 4 students.

To make the stream table, take an aluminum turkey pan and punch a hole in the side of the shorter edge of the pan a half inch to an inch from the bottom.



- Large colored plastic cup, 2 per group of 4 students. Pierce a small hole in the bottom of one cup and a larger hole in the bottom of the other. Neither hole should be bigger than half a centimeter in diameter.
- Clear cups, 1 for each group of 4 students
- Bucket filled 1/3 the way with water, 1 for each group of 4 students
- Large spreader or plastic spoon, 1 per group of 4 students
- Soil (made from 3 parts all purpose sand, 1 part humus, 1 part gravel and half part clay), enough to fill all the stream tables half full. (If you can not find clay it can be omitted.)
- Thick books, one per group of 4 students (used to prop up stream table)

Background Information

Land is eroded by water (and air). In fact, erosion is responsible for the winding of rivers and deep canyons like the Grand Canyon. The more energy water has the more erosive it will be. Greater quantities of water moving at greater speeds will have more energy, and thus greater erosive power. The condition of the land will also affect how much erosion occurs. Land that is held together by plant roots will erode less than barren land. Water moving over land with a greater slope will move more quickly and will thus have more energy and more erosive power.

Water in a river comes from its watershed. A watershed is the land that drains into a body of water such as a stream, lake or wetland. Because water flows downhill, watershed boundaries are always located on the top of hills or mountains. Water falling on one side of the hill will flow into one water body, while water falling on the other side of the hill will flow into another water body.

Rainwater falling on a watershed can either run off over the land, reaching the river quickly, or soak into the soil and move through the soil, slowly reaching the river. Water moving over the land can erode the land over which it flows. As the land in a watershed becomes developed – as forests, prairies and wetlands are converted to roads, homes, offices, shopping malls and parking lots – less and less water is able to infiltrate into the land. Consequently, more water runs off over the land. In natural areas, 10% of the rainfall runs off the land compared to 55% in urban areas. Fifty percent of the rainwater soaks into the ground in natural areas, compared to 15% in urban areas. (In both cases, the remaining water is evapotraspirated – transpired by plants and evaporated from surfaces.)

With more rain water quickly running off the land, huge quantities of water can reach the river very quickly. For instance a large rain storm on October 13, 2001 caused the Chicago River at Touhy Avenue to rise from 3.5 ft (already 2 ft above average) to just over 9 ft in the matter of hours. This large volume of water has the power to greatly erode the banks of the river. (Data taken from http://waterdata.usgs.gov/nwis/rt).

For more information on erosion and rivers look in the **Resource section** under rivers and watersheds.

Erosion is a natural process, but when so much water reaches a river so quickly the rate of erosion exceeds the natural rate. Excessive erosion destroys the banks of the river, taking away the soil supporting trees and other plant life. It also turns the water a murky color from all the sediment suspended in it. The sediment clogs the gills of fish, clams and mollusks. It also makes the water so dark that aquatic plants have a difficult time photosynthesizing. In addition, it can bury small animals (macroinvertebrates) living on the river's bottom and cover their habitat with a layer of silt.

Natural erosion will dig a river deeper and wider. In the curves of a river, the outer edge of the curve will be a place of erosion while the inner edge of the curve will be a place of deposition. This is because water on the outer edge of the curve has a greater distance to travel and will thus be travelling at a higher speed. Water moving at a higher speed will have the power to erode. Water moving at a slower speed will have to drop some of the sand it is carrying because it no longer has the ability (energy) to carry it. As water slows, its ability to carry rocks, sand and silt diminishes. As the water slows it will drop the biggest particles first, as the water continues to slow the smaller particles will start dropping to the river bottom.

Procedure

Hook

Tell students that people have been noticing that the land seems to be disappearing, particularly the land around our rivers. Where is it going? Who or what is taking it away? They will be solving the mystery today.

Activity

1) Before class mix up the soil mixture to be used in the stream tables. The mix should contain 3 parts all purpose sand, 1 part humus, 1 part gravel and 1/2 part clay. Fill the stream tables half full with the soil mixture, keeping the soil mixture several inches away from the side of the pan with the hole.

2) Divide students into groups of four. Each member of the group gets a role:

   - **Recorder:** records the group's predictions and results
   - **Soil spreader:** moves the soil around to create a landscape and a stream and places a bucket on the floor under the hole in the stream table and makes sure all water ends up in the bucket and not on the floor
   - **Water maker:** drips water on the stream table
   - **Water collector:** collects runoff water in the clear plastic cup from under the hole in the stream table

3) Pass out student directions.

4) There are two parts to this lesson. In the first one, students will be observing how rivers form. In the second, students will be taking a closer look at erosion in rivers. You may want to model each activity first and then have your students carry out the experiment. (See student directions for details.)

5) After students conduct the experiment, discuss the following as a class:

   - What happened to the banks and bottom of the stream?
   - What happened to the rock, small pebbles and sand? Were they affected the same way by the water?
   - Where did the greatest amount of erosion occur? Why? (On the outside of curves. See background for explanation.)
   - Did the shape and size of the river change over time? How? (We usually think of rivers as permanent and unchanging features of the landscape. But, in reality, sediment is always being eroded and deposited and rivers are capable of moving great distances, particularly after a large storm.)
   - What happened when you added more water to the stream? Why do you think there might be more water in the stream? (There are several possibilities: a rain storm, snow melt, or high amount of impervious surfaces.)
   - Do you think erosion can be both natural and "unnatural"?

Reflection & Assessment

In their journals, have students answer the questions that began the lesson: Where is the land around rivers going? What is causing it to disappear? Use the **3-pointJournal Rubric** to assess journal entries.

Reinforcement & Enrichment

Have students look for evidence of erosion in their neighborhood.

State Standards

Illinois

1.C.2a Use information to form and refine questions and predictions

3.C.1a Write for a variety of purposes including description, information, explanation, persuasion and narration.

11.A.2b. Collect data for investigations using science process skills including observing, estimating and measuring

11.A.2d. Use data to produce reasonable explanations

12.E.1a Identify components and describe diverse features of the Earth's land, water and atmospheric systems.

12.E. 2b. Describe and explain short-term and long-term interactions of the earth's components (e.g. earthquakes, types of erosion)

Indiana

Science 4.2.5 Write descriptions of investigations, using observations and other evidence as support for explanations.

Science 4.3.5 Describe how waves, wind, water, and glacial ice shape and reshape the Earth's land surface by the erosion of rock and soil in some areas and depositing them in other areas.

student directions

Materials:

- Stream table
- Spreader
- Two cups with holes in the bottom, one with a large hole and the other with a small hole
- Bucket filled with water
- Clear plastic cup for collecting water
- Thick book

Group roles:

Recorder: _____

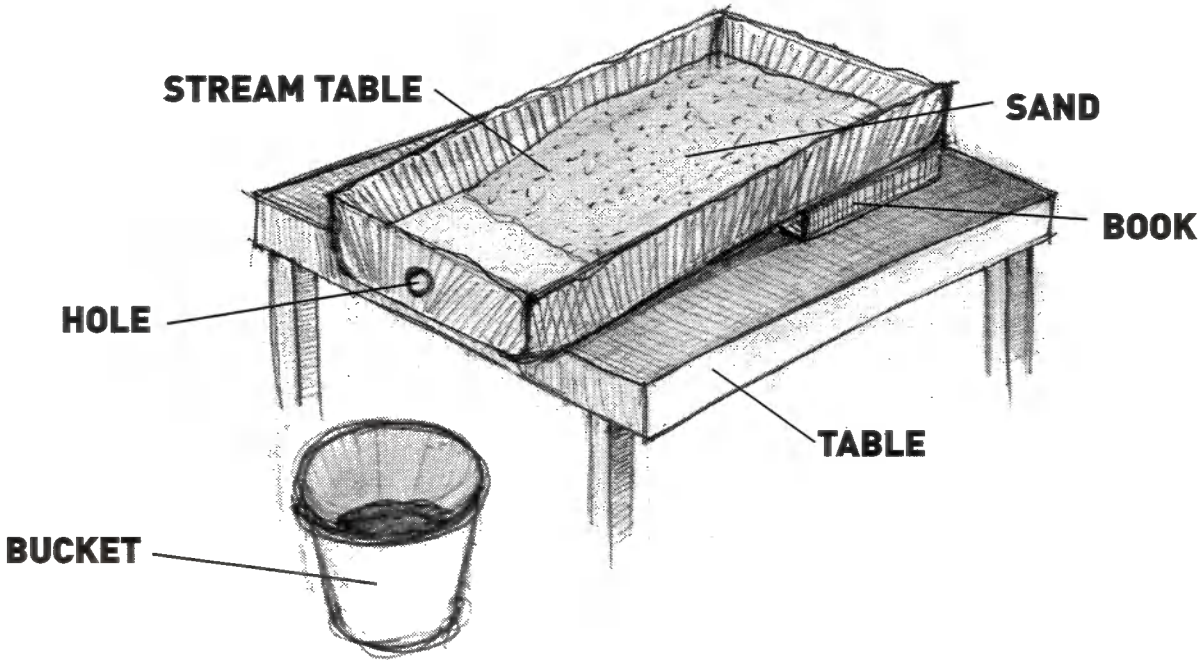
Water collector: _____

Soil spreader: _____

Water maker: _____

Soil spreader:

1) Make the soil slope down towards the side of the pan with the hole in it. The soil should be kept several inches away from the side of the pan with the hole in it.



2) Then create a stream down the middle of the slope by digging a curved channel (no wider than 2 fingers) into the sand. The stream should not be dug all the way to the bottom of the pan.

3) Then place the stream table on the work desk with the hole in the stream table extending over the edge of the table and place a book under the stream table on the side opposite the hole.

4) Then place a bucket on the floor beneath the hole in the stream table so that all the water ends up in the bucket and not on the floor.

Recorder: Ask the group to predict what they think will happen when water flows down the river. Where will the water go? What will happen to the land? To the water as it flows down the river? Record the group's predictions.

Water collector: Hold the clear plastic cup directly under the hole to collect the runoff from the stream.

Water maker: Fill the cup with the SMALL hole in the bottom with water (making sure to plug the hole with your finger). Place the cup over the top of the steam and release your finger to make the water flow.

Everyone: Observe what is happening to the stream channel. Things to pay particular attention to are:

- What is happening to the bottom of the stream?
- What is happening to the sides of the stream?
- Is the same thing happening on the inside and outside of the curve in the river?
- Are the larger pebbles and smaller sand grains reacting the same?
- Is the shape and size of the river changing or staying the same?

Water collector: When the clear plastic cup is full, place it on the table. The rest of the water will fall into the bucket.

Recorder:

1) Ask the group to discuss their observations, both of the stream table and the water collected in the clear plastic cup. Record the group's observations.

2) Ask the group what they think would happen if much more water was flowing in the river. Record the group's prediction.

Repeat the experiment, this time using the cup with the LARGE hole in it.

After repeating the second experiment,

Recorder: Ask the group the questions under the "Draw Conclusions" section on the Record Sheet.

Record the group's answers.

record sheet

Recorder: _____

Group members: _____

_____

_____

_____

Make Predictions: When you add water to the stream:

- Where will the water go?

_____

_____

_____

- What will happen to the land?

_____

_____

_____

After completing the first experiment, predict what will happen if you add much more water to the stream.

_____

_____

_____

Make Observations:

- What happened to the land around the stream after you added water?

- What is happening to the bottom of the stream?

- What is happening to the sides of the stream?

- Is the same thing happening on the inside and outside of the curve in the river?

- Are the larger pebbles and smaller sand grains reacting the same?

- Is the water you collected from the stream different from the water you added? If it is, describe the difference.

- What happened when you added more water to the stream?

Draw Conclusions:

- Can the shape and size of rivers change over time?

- Erosion is a natural process that helps create rivers and canyons. Do you think erosion can ever be destructive and "unnatural"? Explain.