Lesson 3 Ecosystems

Overview

Lesson Three examines ecosystems so that we can understand how sediment harms life in an aquatic ecosystem. The interaction of matter and energy are examined. The ecosystem worksheet allows the student to review the major concepts. We begin a two day quantitative lab in which the amount of water the soil can absorb is measured.

Objectives

1. Define and give examples of ecosystems
2. Identify the role of the essential parts of every ecosystem; plants, animals, decomposers, abiotic (nonliving) factors and energy.
3. List at least four abiotic factors of ecosystems
4. Describe energy flow in food webs
5. Distinguish between energy and matter; recognize that energy runs the cycles (rock cycle, water, cycle, carbon cycle in ecosystems) in which atoms (matter) are used repeatedly, but energy is not returned to its source.
6. Use a computer spreadsheet to determine the percent of water (by mass) in saturated soil.
7. Identify the soil as saturated when it is holding as much water as it can hold.
8. Conduct a quantitative laboratory experiment using balances and graduated cylinders to determine the percent of the saturated soil's mass that is due to water.
9. Analyze and interpret data collected to construct a reasonable explanation from direct and indirect evidence.

TEKS for 6th Grade

(3) Scientific investigation and reasoning. (A) (B)
(b) Knowledge and skills.
(12) Organisms and environments. (E)

TEKS for 7th Grade

(3) Scientific investigation and reasoning. (A) (B)
(4) Scientific investigation and reasoning. (A)
(b) Knowledge and skills.
(5) Matter and energy. (A) (B) (C)

TEKS for 8th Grade

(b) Knowledge and skills.
(11) Organisms and environments. (A) (B) (C) (E)

Recommended Procedure

This lesson can be done in one day if the students are familiar with ecosystems, balances and graduated cylinders.
If they are not familiar with the equipment or the concept of ecosystems, it will take at least two days.

1. Collect the Rock Cycle from the previous day.
2. Return the Sedimentation Observation Activity and review if necessary.
3. Show the Power Point/overhead for Lesson Three. Have the students take notes.
4. If the students are unfamiliar with ecosystems and/or the equipment review the equipment and units of volume and mass and have them practice making measurements. Then they can start on ecosystem worksheet for homework.
5. If the students are reviewing ecosystems (they are familiar with the material and the lab equipment) have them start the % Water the Soil Can Hold Activity after the overhead/Power Point presentation, up to the point where they dry the soil (after step 9). They will do the ecosystems review sheet for homework.
6. The students who are taking two days to do lesson 3 will begin the % Water the Soil Can Hold Activity on the second day and if time, will start on the power point or overhead for lesson 4. They will turn in the Ecosystem Worksheet by the end of the period.

Materials needed for this lesson

For each pair of students:

1. funnel (or cut off plastic bottle) that will hold more than a ½ cup of soil,
2. two pieces of filter paper (coffee filter paper works fine) ,
3. a plastic spoon,
4. 100 ml of water and a graduated cylinder,
5. container under the funnel to catch the water that runs through,
6. a scale or balance accurate at least to the tenth of a gram,
7. heat lamp or lamp with a big bulb to dry the soils overnight,
8. a rack to support the drying filter paper,
9. a pipette or eye dropper (to aid in getting exactly 100 ml of water),
10. and about a ½ cup of soil, either sand or loam.

Soil type assigned_____

Name_____

% Water the Soil Can Hold Activity

Purpose: We will determine the amount of water that soil can hold as a percentage of its mass when the soil is saturated.

Materials for each pair of students: funnel (or cut off plastic bottle) that will hold more than a ½ cup of soil, two pieces of filter paper (coffee filter paper works fine) , a plastic spoon, 100 ml of water and a graduated cylinder, container under the funnel to catch the water that runs through, a scale accurate at least to the tenth of a gram, heat lamp or lamp with a big bulb to dry the soils overnight, a rack to support the drying filter paper, a pipette or eye dropper (to aid in getting exactly 100 ml of water), and about a ½ cup of soil, either sand or loam.

Procedure:

1. Write the type of soil you are given at the top of the paper and put the filter paper in the funnel.
2. Place about a ½ cup of soil in the funnel that is lined with filter paper. (This might have already been prepared for you.)
3. Arrange the funnel so that the water that runs through the soil is collected in a container.
4. Carefully pour 100 ml of water onto the soil in the funnel being careful not to make the soil spill over.
5. When the water has nearly stopped dripping out of the funnel, the soil in the funnel is said to be **Saturated**. It is holding as much water as it can possibly hold.
6. While waiting for the water to run through your soil, WRITE YOUR NAME ON A PIECE OF DRY FILTER PAPER AND determine the mass of the clean dry piece of filter paper. Record the mass to the nearest tenth of a gram. Ask for assistance if you don't understand recording to the nearest tenth of a gram. The teacher must initial this mass before you go on.

Mass of dry paper alone: _____g.

7. Determine how much water came *through* the soil into the container and record:

Volume of water that came through the soil:_____ml

8. Place about a tablespoon of saturated soil on the paper you just weighed and weigh again with the saturated soil.

This is the mass of the paper plus **saturated** soil. Record mass here: _____g.

9. Now place your filter paper with the saturated soil (Put your hand under it so the paper will not break) on a rack under a lamp to dry overnight.

NEXT LAB SESSION

10. Determine the mass of the dry paper with the DRY soil and record:

Mass of dry paper with dry soil_____g.

Questions and Calculations

1. How man milliliters of water did you put on the soil in the funnel?_____(units too)
   Hint, you may need to reread your instructions from yesterday.
   How much water came through the soil? _____. EXPLAIN why there is a difference:

2. When was the soil saturated?

3. WHY did the soil on the paper weigh less in procedure #10(today) than in procedure #8 (last lab) above?

4. EXACTLY how much less did the paper and soil weigh after the soil dried? SHOW WORK AND USE UNITS. I expect to see numbers. This is the mass of the water that adhered to the saturated soil in the tablespoon. This is the mass of the water.

5. EXACTLY how much did the saturated soil ALONE without the paper weigh? SHOW WORK AND USE UNITS. I expect to see numbers.

6. If you know how to calculate the % of the saturated soil's mass that was due to water, show work here:

7. Now go to a classroom computer and enter your data. The spreadsheet will calculate the % of your saturated soil's mass that was due to water.

sand or loam	mass of paper #7	paper + sat. soil #8	paper + DRY soil #10	soil alone in	water in g	% mass due to water

   Record the % of the mass that was due to water here:_____

8. Put your % up on the class data chart and record the other data entered by other groups.
   Class data
   % water in the saturated soil

sand									
loam									

While you are waiting for all the members of the class to enter their data, work on your homework.

Conclusion:

Is the % water in the saturated sand and the saturated loam the same?
EXPLAIN YOUR ANSWER. This means you back up your statement with facts and explanations.

Ecosystem review worksheet

Name_____

To answer the question of why sedimentation (soil particles coming into water and eventually settling down) is a nonpoint source of water pollution (pollution being anything in the water that harms life), we must first review **ecosystems.**

- An Ecosystem is plants and animals living in balance in a specific nonliving (abiotic) environment.

A Prairie is an example of an ecosystem

- What kinds of plants?
- What kinds of animals?
- How does **rainfall in prairie** compare to a desert (a different ecosystem)?

How does **temperature** compare to arctic tundra (another ecosystem)?

How does prairie **soil** compare to ocean beaches (another ecosystem)?

- What do we mean by essential?
  Plants, animals, source of energy, decomposers and abiotic (non-living) factors are all necessary for an ecosystem. Therefore we say they are essential. They live in a balanced web.

Instructions

After reading the above, taken from the power point, answer these questions:

1. What is an ecosystem?

An Ecosystem is plants and animals living in balance in a specific nonliving (abiotic) environment

2. List four different ecosystems: (1) *prairie* (2) *desert* (3) *arctic tundra* (4) *ocean beaches*
   Of course they could mention any other ecosystems such as woodlands, freshwater aquatic ecosystem etc.
3. List 3 different essential biotic (living) parts of any ecosystem:
   a. *Plants, b. animals and c. decomposers*
4. List four different abiotic parts of any ecosystem:
   a. *temperature*
   b. *amount of rainfall*
   c. *kind of soil*
   Once again, they could list others such as the length of the day, the amount of sunlight (cloud cover) whether the water was fresh or salty etc.
5. Which essential part of the ecosystem produces the food for all the living organisms?
   ____*plants*_____
6. Which essential part of any ecosystem breaks down dead and waste materials?
   *decomposers*_____
7. What is the source of energy for all the earth's ecosystems? __*sun*_____-
8. Does energy cycle back around to the sun in the same way that atoms cycle in an ecosystem or the rock cycle? Yes/no *circle "no"*
9. List an ecosystem you are most familiar with _____ and list from that ecosystem you just named the: *they could list any ecosystem, such as a prairie*
   a. Plants _____*grasses, cedar, live oaks etc*_____ _____
   b. Primary consumers (animals that eat plants)_____ *rabbits, deer, raccoons*_____
      Secondary consumers (like carnivores that eat other animals) __*coyotes, roadrunners,*
   c. Decomposers *bacteria, snails, earthworms*
   d. Rainfall (light, medium or heavy, compared to average) *light to medium*
   e. Describe the temperature and seasons *freezing in the short day winters, hot in the long day summers*
   f. Describe rocks, minerals and or soil: *the soil is variable in depth and pH, depending on the source of soil*
   g. Describe currents—wind or water currents *usually has wind blowing, can have tornadoes*

Teacher's Guide Italics are for the teacher and are not found on the version used with the students

This activity is suitable for grades 6 through 12. Older students will be expected to do more on their own and younger students will need more guidance. The students should be familiar with the balance or scale, understand about the importance of recording the mass to the tenth of a gram, know the metric unit for volume and how to read the bottom of the meniscus in the graduated cylinder to determine the volume, before they begin this activity.

Soil type assigned_____ *they will put loam or sand here*

Name_____

% Water the Soil Can Hold Activity

Purpose: We will determine the amount of water that soil can hold as a percentage of its mass when the soil is saturated.

Materials for each pair of students: funnel (or cut off plastic bottle) that will hold more than a ½ cup of soil, two pieces of filter paper (coffee filter paper works fine) , a plastic spoon, 100 ml of water and a graduated cylinder, container under the funnel to catch the water that runs through, a scale accurate at least to the tenth of a gram, heat lamp or lamp with a big bulb to dry the soils overnight, a rack to support the drying filter paper, a pipette or eye dropper (to aid in getting exactly 100 ml of water), and about a ½ cup of soil, either sand or loam.

Procedure:

1. Write the type of soil you are given at the top of the paper and put the filter paper in the funnel.
2. Place about a ½ cup of soil in the funnel that is lined with filter paper. (This might have already been preparing for you.)
3. Arrange the funnel so that the water that runs through the soil is collected in a container.
4. Carefully pour 100 ml of water onto the soil in the funnel being careful not to make the soil spill over.
5. When the water has nearly stopped dripping out of the funnel, the soil in the funnel is said to be **SATURATED**. It is holding as much water as it can possibly hold.
6. While waiting for the water to run through your soil, WRITE YOUR NAME ON A PIECE OF DRY FILTER PAPER AND determine the mass of the clean dry piece of filter paper. Record the mass to the nearest tenth of a gram. Ask for assistance if you don't understand recording to the nearest tenth of a gram. The teacher must initial this mass before you go on.

Mass of dry paper alone: _____g.

7. Determine how much water came *through* the soil into the container and record:

Volume of water that came through the soil:_____ml

8. Place about a tablespoon of saturated soil on the paper you just weighed and weigh again with the saturated soil.

This is the mass of the paper plus **saturated** soil. Record mass here: _____g.

9. Now place your filter paper with the saturated soil (Put your hand under it so the paper will not break) on a rack under a lamp to dry overnight. *If you have a suitable drying oven, this could also be used.*

NEXT LAB SESSION

10. Determine the mass of the dry paper with the DRY soil and record:

Mass of dry paper with dry soil_____g.

Questions and Calculations

1. How man milliliters of water did you put on the soil in the funnel?_____(units too)
   Hint, you may need to reread your instructions from yesterday. *They put 100 ml of water on the soil.*
   How much water came through the soil? _____. EXPLAIN why there is a difference:
   They should have less than 100 ml of water coming through the soil into the container below the funnel because the soil absorbed some of the water.
2. When was the soil saturated? *The soil is saturated when it is holding as much water as it can possibly hold. Because this definition is given above, so there is no excuse for hissing this question.*

3. WHY did the soil on the paper weigh less in procedure #10(today) than in procedure #8 (last lab) above?
   The soil weighed less today because the water in the soil evaporated overnight.
4. **EXACTLY** how much less did the paper and soil weigh after the soil dried? This is the mass of the water in the soil. SHOW WORK AND USE UNITS. I expect to see numbers. This is the mass of the water that adhered to the saturated soil in the tablespoon.
   They will subtract the mass of the filter paper plus saturated soil (#8) from the mass of the paper with dry soil (#10) to get the mass of the water evaporated. The unit of grams should be used.
5. **EXACTLY** how much did the saturated soil ALONE without the paper weigh? SHOW WORK AND USE UNITS. I expect to see numbers. *They will subtract the mass of the paper alone (#6) from the mass of the paper with the saturated soil (#8) to get the mass of the saturated soil alone. Gram units should be used.*
6. If you know how to calculate the % of the saturated soil's mass that was due to water, show work here:

*Mass of water (#4)/mass of the saturated soil alone (#5) * 100 = % of the saturated soil's mass that was due to water*

7. Now go to a classroom computer and enter your data. The spreadsheet will calculate the % of your saturated soil's mass that was due to water.
   I set this up on an Excel program, but any spreadsheet program will work. The students are often amazed at how quickly and easily the machine can do the calculations they slaved over. You can make the point the scientists use spreadsheets so that all they have to do is enter the data and the machine does the repetitive calculations.

sand or loam	mass of paper #7	paper + sat. soil #8	paper + DRY soil #10	soil alone in	water in g	% mass due to water

Record the % of the mass that was due to water here:_____

8. Put your % up on the class data chart and record the other data entered by other groups.
   Class data
   % water in the saturated soil

sand									
loam									

While you are waiting for all the members of the class to enter their data, work on your homework.
The answers will vary depending upon the sand and loam used.

CONCLUSION:
Is the % water in the saturated sand and the saturated loam the same?
EXPLAIN YOUR ANSWER. This means you back up your statement with facts and explanations.

The answers will vary depending upon the sand and loam used. The important thing to watch for is the use of numbers and averages to support their statement