Science is Elementary

Inquiry and Engagement Using hands on Labs

Earth Science
Book 2

Simpson/Pack/Tucker
Draft

1. Percolation and Porosity in Soils

Retention of Water in Soils

Equipment

1000 ml Beaker Large Graduated Cylinder	Large funnel Coffee filter	Measuring Cup Stop Watch

Aim "To determine how well soils drain and retain water"

Procedure..each Table group samples one soil.

1. Collect the equipment listed above-One set per table.
2. One student per group is to collect 1 cup of one soil.
3. Place the filter in the funnel and add 1 cup pf soil
4. Place the funnel in the Graduated cylinder
5. Collect 250 ml of water in the large beaker
6. Pour this into the funnel and time how long it takes to drain into the Graduated Cylinder.
7. When is has stopped draining measure how much water is in the Graduated Cylinder
8. Compare this to the amount you started with. Can you explain your findings?
9. Share your results with the rest of the class..

Complete the table below

Soil	Original Amount of water (a)	Amount of water in the Graduated Cylinder (b)	Difference a-b= (Retention of water)	Time it took to drain
1	250ml			
2	250ml			
3	250ml			
4	250ml			

Which soil has the best drainage?

Which soil retained the most water?

Main Question : Why is so important that soils drain as well as retain water?

CONCLUSION Write a summary of your experiment and include your results.

2. Erosion

On your table you will find a large sand tray with material already laid out in it. Draw a picture with labels of what you see. Once this is done begin adding water using the watering can at the point marked with the toothpick. Observe and record any changes.

Before	After

Observations

What happens to the smaller particles when water is added using a watering can?

Now add tissue paper and tooth picks to the side of the hill. What happens if you pour water onto it now?

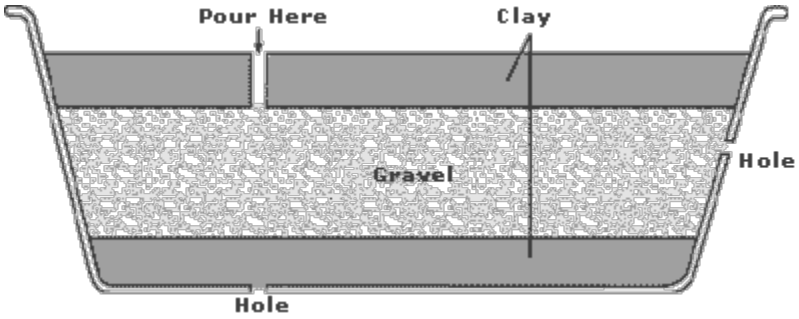
How can we reduce erosion on hill slopes?

3. A Model Aquifer

Purpose
This activity will help students understand how ground-water systems are unique and how contamination spreads easily underground. To do so, students will build a model of an aquifer. They will "recharge" the aquifer by pouring water into designated areas in the model and collecting water from holes they have made in the box holding the model. By doing this activity, students will determine how water moves through the aquifer and which materials make the "best" aquifer.

Materials
Each group of students will need:

- a clear rectangular 3-gallon-sized, plastic box or tub. Use the longest box you can find,
- sub soil …clay or similar,
- sand,
- gravel,
- measuring scoop made of a plastic gallon milk jug with the top cut off,
- graduated cylinder,
- petri dishes or small beakers for catching water that flows out of the aquifer,
- water, and
- a copy of the illustration below of the model aquifer.



Model Aquifer (Activity 1)

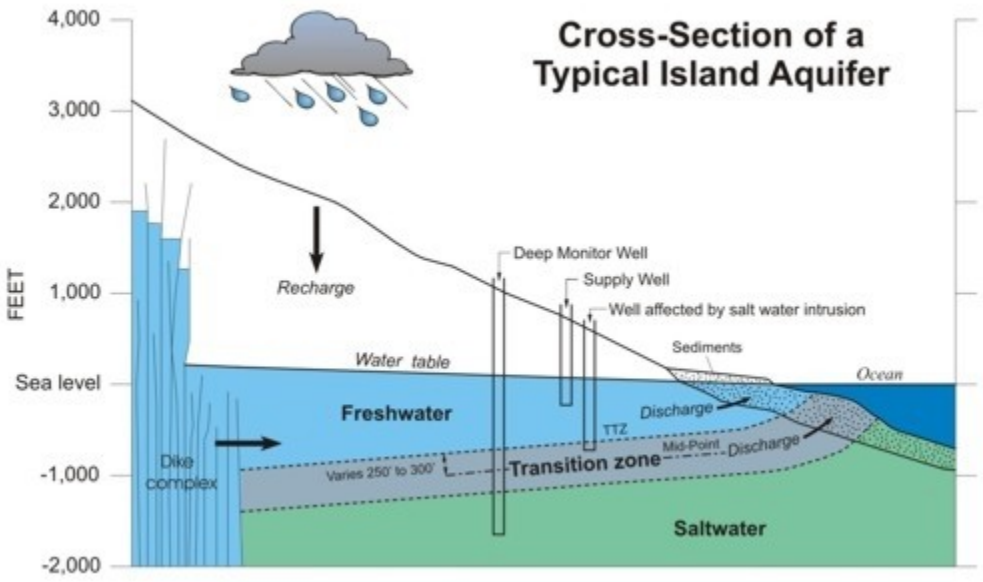
Procedure \

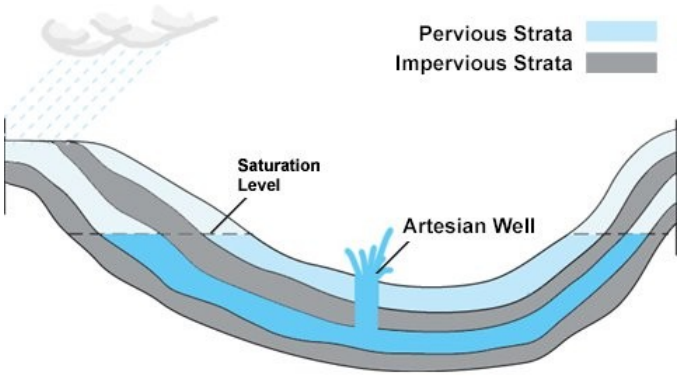
1. **Groups**. Students will be working in groups to build model aquifers. Each group will be using different mixes of materials in their aquifers. Some will be using all sand; some will be using all gravel; some will be using a mix of sand and gravel.
2. **Setting up the Tub**. Punch holes in the plastic tub. Holes should be no smaller than 1 mm and no larger than 2 mm.
3. **Making Aquifer Materials**. Measure out the different aquifer materials using the measuring scoop. Make sure each group uses the same volume of material - sand, gravel, or half and half - for the aquifer. Have the students who are using the half-sand half-gravel mixture prepare the mixture before measuring it or packing the mixture into the aquifer.
4. Students should **pack the tubs** with the "aquifer" materials. The bottom layer should be very thin - 2 mm - and well packed. You may cover this with a layer of clear wrap. Students should then add the aquifer material - 2-3 scoops, depending on the size of the tub. The upper layer of clay - 1-2 cm thick - should also be well packed.

5. The next step is to elevate the tub so the holes where water will emerge are accessible. The tub could be elevated with blocks. Students should position the petri dishes to catch the water that comes out of each hole.
6. To observe how the aquifer model works, students should pour water in the hole in the clay at the top, 10 mL at a time, until drops appear at the holes. After drops appear, students should pour in one final graduated cylinder full of water. Students should record the amount of water that is poured into the model. In the petri dishes, they will collect the water that comes out of each hole, then measure the amount of water in an empty graduated cylinder.
7. When you have finished pouring water into their aquifer models compare the water-holding capabilities of different materials.
8. refer to previous lessons and the ideas of percolation, porosity and permeability.

Extension

1. Describe how a town built on top of this model could access and use the water in the aquifer for its water supply.





4. Soil Characteristics

"The sum of us is greater than all our parts"

Observations
You notice that two trees planted at the same time are quite different in height and overall size.

Questions
1. Why are the trees not the same size?
2. Did the get the same amount of water and sunlight?
3. Were they the same size when planted/
4. Are the soils the same?
(We are told that 1-3 can be discounted as they were the same for both trees.)

Hypothesis
"Trees will grow at different rates depending upon the type of soil they are planted in."

Data Collection.
Each soil sample will be tested for the following.

1. Color
2. pH
3. texture
4. Structure
5. Porosity
6. Salinity
7. Living Organisms
8. Minerals
9. Organic Matter

Procedure

1. Collect the two samples of soil and record the color of each one.
2. Test the ph by mixing 2 tea spoons of soil and 200ml of water in a small beaker. Insert the pH probe and record the level on your sheet. Refer to the key to determine the suitability of each soil in terms of its pH.. Record your results.
3. Use your thumb and forefinger to feel the texture of each soil. Record your findings.
4. Determine the structure of each soil by preparing a microscope slide for each and viewing the on the microscope. Record what you see using a diagram and labels.
5. Test the porosity/drainage of each soil by filling a cup half full with water. Use a pencil to put 6 holes in the bottom of the cup before adding the soil. Collect 200ml of water and pour it into the cup timing how long it takes to drain through into a large beaker. Measure the amount of water in the beaker and calculate the difference. Explain your findings.
6. test the salinity of the water in the beaker for each soil using a conductivity probe. Also test tap water and salt water as a comparison.
7. use a sample on a microscope slide to identify any living organisms.
8. put 200 ml of water in a beaker and add one tea spoon of soil. Observe what happens. Floating material represents Organic matter and material that sing minerals. Record your findings.

Analysis
Using the compare and contrast web sheet identify similar and unique characteristics of your soils.

Conclusion
Choose the soil that is best for growing plants and give reasons for your answers. Was your hypothesis correct?

Soil Characteristics : A Summary.

1.Soil Odor (smell) waft your hand towards your nose for each sample and describe what you can smell.
2. Color. Describe the colors you see in the soil.
3. Texture **Rub the soil through your thumb and forefinger.** **Describe how it feels. Is it gritty, smooth, sticky etc?**
4. Structure(arrangement) **Take a small sample and mount it on a microscope slide.** **Place this on the microscope and draw a picture to show your observation.**
5. Organic matter (Dead Animals or Plants) **Fill 4 beakers half full with water and add 5 teaspoons of each soil. If you see something floating then you can say organic matter is present.**
6. Living Organisms **Look for movement e.g. worms**
7. pH (0-14) Low is acid, high is alkaline **Use the hand held computer and pH sensor to test each soil when it is mixed with sterile water in a test tube.**
8. Porosity.. **How well does the soil drain. Use a cup with 5 holes in it. Fill half full with water. Add 250ml of water and time how long it takes for the water to drain away.**
9. Conductivity…salt concentration **Use the sensor to determine conductivity for each beaker from Part 5**
10. Good for Growing plants? Which soil would you choose and why?

Soil Data Table

Soil Characteristics	Soil 1	Soil 2
Odor		
Color..Your Obsevations		
pH- How acid is the soil?		
Texture..The feel of the soil		
Structure.. The arrangement and shape of particles		
Porosity..How well does it drain?		
Conductivity-salt levels		
Living organisms..Is there evidence of any?		
Minerals What sinks in the container		
Organic Matter_What floats		
Conclusion		

5. Weather and Climate

Part A Weather in the Schoolyard

	1	2	3	4	5	6	7
Cloud Cover							
Rainfall							
Wind Speed							
Light Intensity							
Temperature							
Dew Point							
Absolute Humidity							
Relative Humidity							
Air pressure							
Altitude							

Part B Section A : The Greenhouse Effect

Objective:

Students will observe the effects of carbon dioxide gas.
Students will build and test physical models relating to the greenhouse effect. Students will demonstrate how carbon dioxide can create acid rain and effect living and non living parts of an ecosystem

Purpose:

The purpose of this lesson is for the students to investigate and model the greenhouse effect.

Materials:

2 two liter plastic soda bottles (washed out)
scissors or box cutter
2 long thermometers
3 strips of cardboard (1/2" x 1")
soil
sand
water (in spray bottle)
plastic wrap
rubber bands (medium size)

Procedure

1. Cut two liter bottles at the point where the neck begins to narrow.
2. Tape the thermometers and strips of paper inside each bottle. (The cardboard is used to cover the bulb end of the thermometer to protect from direct rays of the light bulb.)
3. Fill each liter bottle with two cups of soil.
4. Dampen the soil with water from the spray bottles. Count and use the same number of sprays for each bottle of soil.
5. Cover one bottle with plastic wrap and keep the bottle secure with a rubber band. The other bottle will be left open and will be the control bottle.
6. Position the lamp approximately 20 to 30 centimeters above the bottles.
7. . Record the beginning temperature for each bottle.
8. Turn the lamp on.
9. Record the temperature every minute for 15 minutes.
10. After you are finished recording the temperature, graph your data by plotting the temperature on vertical axis and time on the horizontal axis. One colored pencil can be used to graph the experimental reading as a solid line and the control reading as a dotted line. Also, the use of the CBL and graphing calculator can be used to measure temperature.

Analysis

A. How do the results of the activities in these exercises relate to the greenhouse effect?

B. What effect does increased cloud cover have on the earth's temperature? What evidence from this experiment support your answer?

C. What outcome would arise in the average global temperature have on the earth's coastlines? What other possible effects could an increase in global temperature have on the earth?

D. What can be done to slow down or stop the greenhouse effect? What might prevent progress being made toward solving the problem of global warming?
E. What role does deforestation play in the greenhouse effect and global warming?

Review

1.What happened to the temperature in both the control and experimental bottle for all treatments? Explain.

2.What was the final outcome of the temperature in the control and experimental bottle? Explain.

3.Based on question 2, was there any difference in the experimental and the control bottle? Explain.

4. What purpose did the control serve in the experiment?

5. What do you think would occur with the temperature if different soil colors were used?

6. Why should the number of spray from the water bottle remain constant throughout the procedure?

7. What other variables should be considered in this experiment that might affect that outcome of the data?

8. How might this experiment be extended to investigate the absorption of heat energy in different regions on the surface of the earth?

Part B Section B The purpose of this lesson is for students to examine the relationship between the increase in temperature and the increase in panes of glass. By asking the question, "Why does the greenhouse effect work?", students will generate a measurable hypothesis by relating the number of panes to an increased greenhouse effect.

Materials Required

Cardboard	**3 glass panes for every box (have**
Black construction paper boxes	**them cut to fit in the box at the store)**
3 thermometers for every box	**Glue**
1 classroom thermometer	**Electrical tape**
6 blocks of wood for every box	**Scotch tape**

Procedure

1. Using glue, completely line the inside of a cardboard box with black construction paper.
2. Tape down one thermometer towards the left side of the box, at the bottom. Be sure the thermometer can still be read.
3. Get two blocks of wood. Place one block to the far left and one to the far right so that they will support a pane of glass.
4. Carefully place one pane of glass on top of the wood blocks.
5. Position a second thermometer in the center, on top of the glass pane.

Repeat steps 3 and 4.

6. Position the third thermometer to the right on the topmost glass pane.

Repeat steps 3 and 4

7. Students put their boxes in direct sunlight.
8. Students read their thermometers and record their data once a day, at the same time.
9. In addition, students record the class room temperature.
10. Compute the average daily temperature for each thermometer.

Analysis results:

Discussion/Conclusion

Have students examine the relationship between the increase in average daily temperature and an increase in the number of panes of glass. Think about why this is happening. Relate to the greenhouse effect. A pane of transparent glass allows solar radiation to pass through but not heat. This is the same role that greenhouse gases play in the greenhouse effect. Therefore, in this model, the effect of the increasing number of panes of glass is equal to the effect of increasing greenhouse gas levels.

Applying the Knowledge

1. What happens to a car that has been sitting in the sun on a hot day with its windows rolled up?
2. Why does the car get so hot?
3. What happens to the sunlight that passes through the windows into the car?
4. What is keeping the heat inside of the car?
5. Solar radiation passes through the gases in the earth's atmosphere. What doesthe solar radiation do?
6. What would happen if something were to block the heat from leaving the atmosphere?
7. What blocks the heat from leaving the earth's atmosphere?

6. Heating of Land and Water

Equipment
4 Glass containers
Soil Samples Loam and sand
Water samples Salt and Fresh
Temperature Probes and Hand Held Computer

Procedure

Fill each container with the appropriate samples

Loam Sand Salt water Water

Place each container in a sunny window with a temperature probe inserted and connected to the computer. Set the computer to Graph mode and press Start. Watch what happens over a period of two hours.

Analysis
1. Print off your graphs and describe what they show.

2. Can you suggest reasons for your findings?

3. Why is this important when we discuss weather?

Conclusion

7. Chalk and Vinegar

Over time, water, wind and chemicals can wear down rocks. This wearing down of rocks is called **erosion**. Sand is made by erosion. It took millions of years to make all the sand on the beaches.

Main Activity

Materials

- chalk
- ruler
- vinegar
- activity log
- drinking glass
- pencil or pen

To Do

1. What do you think would happen if you left the chalk in vinegar overnight? Write down your guess on a sheet of paper.
2. Measure and record the length of the piece of chalk on your activity log. Be sure to record the date and time.
3. Fill the glass with about 1/2 cup of vinegar and place the chalk in the bottom of the glass.
4. Leave it overnight. Remove the chalk and measure its length again.
5. Observe and record what is happening to the chalk and the vinegar, as it dissolves.

Questions

Chalk is made of a whitish mineral called limestone. Why do you think the chalk wore down, or "eroded"? Can you find examples of the different types of erosion in your neighborhood?

9. Discover How Tides are Formed

Objective: To demonstrate how the pull of gravity of the moon and sun cause the tides in the ocean basins of the of earth.

Preparation: Collect small glass jar with top; iron filings; two magnets (one preferable larger than the other).

Procedure: Place iron filings in glass jar and screw on the top. Place the two magnets in different positions around the jar to simulate the moon and the sun. The larger magnet should represent the sun, but should be farther away. As the magnets are rotated about, the iron filings (represented seawater) should respond to the pull of gravity and should move accordingly in the glass jar. Be sure to point out the connection between magnets and filings and the tidal cycle.

Discussion:
1. What do the iron filings represent? (water)
2. What does the pull of the magnets represent? (gravitational pull of the moon and sun)
3. Why does the smaller magnet cause more attraction of iron filings? (closer)
4. What happens when the magnets are in line on the same side of the jar? What happens on the opposite side. (more pull – again, more pull).

9. Acid Rain

Discuss with your lab group members how you think acid rain may actually form.
What conditions are necessary for Acid Rain to occur?
Why should we be concerned about acid rain?

Materials (per Lab Group)

- Electronic data collection Display device
- pH sensor
- Lemon Juice
- Chalk, slate, Limestone and marble samples
- 500 ml bottle, or any clean soda bottle 16 oz or smaller
- Eye dropper
- Balloon
- Straw
- Baking soda
- Vinegar (White vinegar is a 5% solution of acetic acid.)
- Water
- 25 ml graduated cylinder
- Spoon
- Funnel
- Two l5O ml beakers
- Bromothymol blue indicator solution*

Part I: Making predictions

1. Write your predictions for the following:
   - What will happen when you mix vinegar and baking soda?
   - What Gas has been produced?

2. Write your predictions for the following:
   - What is the PH of Water?
   - What will happen to the Ph of the water when you add CO2?
   - Draw a predictive graph to show the changes in Acidity as CO2 is added.

3. Predict how acid rain will react with the following.

Sample	1. Chalk	2. Slate	3.Limestone	4.Marble
Predicted Reaction				

Part II: Creating Acid rain

- Pour 50 ml of vinegar into the bottle
- Put about 40 ml of water into each beaker
- *Add a few drops (it may need as much as half a medicine dropper) of indicator to the water in the beakers. It should turn the water blue or blue-green.*
- Using the funnel put two heaping teaspoons of baking soda into the balloon
- Carefully place the end of the balloon over the top of the bottle, taking care to prevent the baking soda from falling in
- Once the balloon is in place, lift it up to allow the baking soda to fall into the bottle
- The carbon dioxide formed in the reaction between vinegar and baking soda should blow up the balloon
- Pinch or twist the balloon to save the gas, and while holding the gas in the balloon, take the balloon off the bottle
- Twist the end of balloon around one end of a straw. Then place the other end of the straw in the water in one of the beakers
- SLOWLY release the pinch or twist that is holding the gas in the balloon, allowing it to bubble into the water
- At the same time insert a Ph probe and set your computer to Graph mode. Observe how the acidity changes as CO2 is released into the water.

Observations/ Conclusions:

What happens to the color of the indicator?

What is the pH of the water?

How does acid rain change the pH of water?

Part III: The Impact of Acid Rain

- Test the reaction of your acid rain solution with each of the following.

Sample	1. Chalk	2. Slate	3.Limestone	4.Marble
Reaction				

Conclusions

1. How did your predictions from Part I compare to the results from Part II and III?

2. What factors do you think contributed to your findings?

3. What relationship is there between acid rain levels and changes to certain rocks?

4. How will acid rain impact upon the health of
    - A stone building (limestone or granite)
    - An ecosystem? (plants, animals and soils)

5. What happens to acid rain as temperature increases?

10. Wonderful Waves

Objectives:
1. The student will learn that waves are generated by wind.

2. Students will create a model that uses wind to create waves.
3. Students will conduct an experiment that will demonstrate the effect that waves have on the coastline (erosion).

Procedure:
1. Ask the class what they think causes waves. Discuss their ideas.
2. Give each group one of the pans and instruct them to fill them with 2 to 3 inches of water.
3. About 1 foot from each pan (on the narrow side), place an electric fan or have a student hold a paper fan at a closer distance.
4. Ask the students to predict what will happen when the fan blows across the water's surface. After the students have recorded their predictions, let each group blow their fan at a low speed and then report their results.
5. Have the students repeat step 4 using a higher fan speed and record their results.
6. Ask the students what effect they think these waves might wave on the coastline. Have them record their predictions.
7. Have the students empty the water out of their pans and then reuse their pans in which to build a coastline out of sugar cubes. (This should be built in sort of a step like formation.)
8. Have the students draw a picture of what their coastline looks like before the experiment. Then spray the coastline with the water bottle until you see some sort of change occurring (when the sugar starts to melt).
9. Have the students draw a picture of their coastline after spraying the water. Were their predictions correct?
Closure:
Discuss the term erosion with the students. Explain that the previous experiment was an example of one form of erosion. (Waves caused erosion of the coastline and the wind is the cause of these waves.)