Under Your Feet

geology and soil

CISPUS ROCK HOUNDS

Focus To explore the local geology, rock types, volcanoes, and stratigraphy.

Group Size 20 students

Time Required 2 hours

Materials
4 rock hammers
4 pairs of goggles
4 magnifying glasses
Rock samples

Physical Setting Mt. St. Helens room, soil pit, and the Cispus River

Process

Activity 1: INSIDE INVESTIGATION
1. Begin with a discussion of Mt. St. Helens. Possible topics would include eruption history, volcano type (Stratovolcano), and the social implications involved with living near a volcano.

2. Next, discuss Igneous, Sedimentary, and Metamorphic rocks. Have samples of each category and pass them around the room. Since the Cispus area is composed mostly of Igneous rocks, spend some time talking about extrusive and intrusive rocks, and cooling time in relation to crystal size (cooled fast = small crystals, cooled slow = larger crystals; *refer to **ROCK 'N ROLL***). Observe different crystal sizes under the magnifying glass.

3. Then, move the discussion to stratigraphy and the formation of sedimentary rocks. Most children think that there is only soil covering the earth, so the goal here is to convey that the earth is constantly changing due to what falls upon the land (you may wish to conduct this portion of the discussion at the soil pit to provide examples).

4. Before leaving the Mt. St. Helens room, encourage the students to explore the displays there. Have them tell the group something they learned from the displays.

Activity 2: SOIL PIT STUDY
1. The class is now ready to go outside. The first stop should be the soil pit to observe the stratigraphy of the area. One aspect to discuss might be how catastrophic the 1980 eruption of Mt. St. Helens was and how small of a layer of ash it left. Compare this layer with the layer of ash left by the 1708 eruption of Mt. St. Helens and have the students imagine the magnitude of the 1708 eruption. Use the soil pit to illustrate points from your discussion.

Activity 3: ROCK RATIONALE

1. Take the class to the river to explore the many different kinds of rocks. Notice that most of the rocks are round and not angular. Have the students use the rock hammer to break open rocks and observe their crystals. A discussion on safety is very important here (refer to ***ROCK 'N ROLL***).

2. Back at the classroom, have the students recall what they learned. There are many approaches to the subject of geology at Cispus, whichever you choose, have fun!

MYSTERY OF THE MISSING LINK

Focus To use lecture, reading, and creative problem solving in understanding the impact vandalism has on archaeological sites. And to develop an appreciation for the laws and regulations guiding use and preservation of these sites.

Group Size 12 students

Time Required 1 hour (*includes travel time to and from Layser cave*)

Materials Flashlight
Writing tools
Handout: ***Questions Of The Missing Link***

Physical Setting Interpretive displays outside the entrance to Layser Cave and the areas inside the cave.

Process **Activity 1: GETTING THERE**
1. Turn left at the main entrance to Cispus. At the stop sign turn left onto road 28, crossing Yellowjacket Creek and the Cispus River.

2. At the junction of road 23, turn left, back toward Randle, and proceed about 2 miles until the Layser Cave road. From there it is about 1 1/3 miles up the road to the parking area. The trailhead is on the right hand side of the road.

Activity 2: THE LESSONS
1. Stop and read the interpretive sign, then proceed directly to Layser Cave (when the path forks, take the one to the right). Before entering the cave read all the interpretive displays--especially the one detailing the vandalism and theft that occured there, and the sign explaining the laws relating to these crimes. Then, enter the cave, and complete the rest of the questions in this lesson. Allow about 2-3 minutes to return to the vehicle, the Cispus Center is about 9 minutes away.

Activity 3: FOLLOW UP
Have the students look at the display in the dining hall and discuss the exhibit.

Questions Of The Missing Link

WHAT happened at Layser Cave shortly after its discovery?

WHAT area of the cave was affected? **HOW** large an area was impacted?

STATE briefly what the law says about this sort of activity.

As a result of the crimes carried out here, **HOW** has our understanding of past events here been impacted?

WHO owns this property?

HOW do you feel about this loss?

WHY is the scientific excavation of archaeological sites the best way to analyze the past?

WHY is it wrong to collect artifacts on Public Lands?

WHAT should you do, if while visiting an area on Public Lands, you find some arrowheads, or other such artifacts?

WHAT are some other occupations essential to understanding prehistoric times?

ROCK 'N ROLL

Focus To use geological field study as a recreational activity.

Group Size Entire class

Time Required 2 hours

Materials

Rock samples
(*igneous*: granite and obsidian;
sedimentary: sandstone and shale;
metamorphic: marble and onyx;
local: iron pyrite/fool's gold and agate)
Handout: ***Rock 'N Roll information sheet***

Rock hammer
Sifting pans
Safety goggles

Physical Setting Indoor or outdoor classroom, and Yellowjacket Creek gravel bar

Process

Activity 1: LECTURE & DISCUSSION

1. Pass around the rock samples, showing the three categories of rocks. Show the effect of fast cooling vs. slow cooling on the size of crystals in a rock sample. Show samples of iron pyrite and native agate. (Refer to the information sheet, or use it as an overhead visual).

2. Explain procedures for safety and rules about keeping rock samples from the creek.

Activity 2: FIELD STUDY

1. Hike to an outdoor classroom on the Yellowjacket Creek bank.

2. Demonstrate how to use a sifting pan and how to determine the difference between real and fool's gold. Then, have students look for agate and fool's gold.

3. Set-up a station where an adult or high school student will break open rocks for younger students (see attached safety guide). This activity will leave you feeling *rocky*. Don't take safety for *granite*!

Rock 'N Roll

information sheet

Fast vs. Slow Cooling in Crystal Formation

Generally rocks which cool rapidly have smaller crystals than those which cool slowly. To show this, go to your local monument carver and get samples of different kinds of granites which show different sized crystals. Monument carvers generally have shards that they are delighted to unload. Marble might also be available.

Safety Considerations:

Breaking rocks can be hazardous. There are safety glasses available from the Cispus staff; although, not enough for everyone. For safety, there should be one rock-breaking station. It should consist of one large, flat rock to act as the anvil, and one older student or adult stone-breaker with safety glassses and a rock hammer.

The breaker needs to organize the students so that he or she receives only one rock at a time. When the breaker calls out "EYES!", that is the signal for the students to turn their backs to the breaker and protect their eyes from flying rock chips. Be sure to have band-aids for the breaker to cover cuts on hands from flying rock chips.

Keeping Rock Samples:

Students should leave most rocks behind. Our rationale for allowing students to take samples from Cispus is that we bring in agate to supplement the few agates that occur naturally here, and the fool's gold samples are being replenished annually by rocks washed down Yellowjacket Creek. We tell the students to take only one small rock of these two types so that the bus doesn't get a flat tire, and so that others can have the fun of finding rocks too. This way they can have mementos of their stay at Cispus, without depleting the rock sources.

WALK BACK IN TIME

Focus To use guided inquiry and simulation activities in exploring the past.

Group Size 10 students

Time Required 1.25 hours (*includes traveling time to and from Layser Cave*)

Materials
Flashlight
Writing instrument
Handout: ***A Step Back In Time***
Archaeologist (*opt.*):
•call Randle Ranger Station (206) 497-7565 for assistance; they can bring excavated artifacts from Layser Cave and demonstrate the use of an at-latl
•call Larry Nelson (206) 497-5630, he's a local Deputy Sheriff, amateur archaeologist, and professional flint knapper; he gives a great slide show presentation and flint knapping demonstration, **BE SURE TO CALL SEVERAL WEEKS IN ADVANCE SO THEY CAN SCHEDULE YOU IN!!**

Physical Setting Layser Cave

Process

GETTING THERE:
1. To take the students to Layser cave, turn left at the main entrance of Cispus. At the stop sign, turn left on road 28, crossing Yellowjacket Creek, then the Cispus River.

2. At the junction of road 23, turn left (back towards Randle), and proceed about 2 miles to the Layser Cave turn-off on the right hand side (there are signs along the road indicating the turn-off). Travel up this gravel road 1 1/3 miles to the parking area. The trailhead is on the right hand side of the road.

THE LESSON:
1. Stop at each interpretive display. This activity has questions for each stop.

2. When the trail forks, take the left path for another interpretive display. Then go right and up to the entrance of the cave. Be sure to examine the displays before entering (especially the warning--see ***Mystery Of The Missing Link***, for a related lesson).

A Step Back In Time

1. **WHAT** is an at-latl? **WHAT** is its purpose?

2. **HOW** accurate is this tool?

3. **WHY** weren't a bow and arrow used?

(proceed to the next stop, be sure to turn left when the trail forks; let an adult lead)

4. **WHY** would this be a good spot for a camp?

5. **WHAT** landmarks do you recognize?

(proceed to the right to the entrance to the cave; read and examine all the displays before entering the cave)

6. As you enter, pretend that you are stepping back 1000 years in time with each footstep. In 5 steps you are inside the cave, and 5000 years into the past. Close your eyes and picture yourself and your family living here in the summer 5000 years ago. In the space below **MAKE A SKETCH,** showing where the various activities of your family took place (sleeping, eating, cooking, tool making, meat drying, hide preparation, clothes making, singing, dancing, and story telling).

8. **HOW** do we know that a family lived in Layser Cave?

9. **WHY** didn't they stay here year round?

10. **WHERE** else would they have gone to gather other types of food?

11. **LIST** at least 5 artifacts found during excavation at Layser Cave.

12. Layser Cave was named for the man who made its discovery. If you had been head of the family living here 5000 years ago, **WHAT** would you have named your summer home?

13. As you leave the cave and return to modern times, **HOW** has the landscape changed? **WHAT** did nature change? **WHAT** did man change?

WHICH ROCK IS IT?

Focus To learn about classification and identification using specific traits.

Group Size Entire class

Time Required 30 minutes

Materials 4 white, kitchen-sized garbage bags (*per group*)

Physical Setting Along the Cispus River or Yellowjacket Creek

Process

Activity 1: GROUP PROPERTIES
small group activity and class discussion

1. Divide the class into groups of 4-7. Mark off a 2 ft. square area for each group.

2. Students in each group determine criteria and sort rocks from their area into 4 groups, placing each group on a separate bag.

3. Gather the class at each station. Have group members explain their criteria for sorting, and how they decided upon it.

Activity 2: PET ROCK
individual project and group follow-up

1. Each student selects a favorite rock and writes a description of its properties.

2. Give each rock a code letter and play a game to match the rocks with the correct written description.

WINDOW INTO THE PAST

Focus To understand the cyclic relationships between earth, water, plants and animals through soil study.

Group Size Entire class

Time Required 30-40 minutes

Materials 3 soil cylinders (*Forestry room*)
Traditional Soil Profile (*as a transparency for the overhead*)
Norm's Pit--tephra pit (*as a transparency or student handout*)
Handout: ***Things To Think About***

Physical Setting Forestry classroom and tephra pit (*fenced pit next to the auditorium*)

Process **Activity 1:**
This part of the lesson is spent in the forestry room using an overhead projector and the soil cylinders. The instructor will direct the students.

1. Using the Traditional Soil Profile as a reference, observe the layer of soil collected from three areas in the soil pit and displayed in the soil cylinders.

2. Observe the layers of soil in the tephra pit (soil cylinder display in the Forestry room).

The information accompanying the overhead would include:

Section A:
UNWEATHERED ROCK: *Original rock* that has been unaltered by the environmental forces of water and wind.
Section B:
IMMATURE SOIL I: *Unweathered rock* and *original rock* in the first stages of breakdown, caused by the action of environmental forces and small organisms. This material will support small amounts of plant life.
Section C:
IMMATURE SOIL II: *Unweathered rock, immature soil I* and *newly formed top soil.* The percolating of water and minerals through these materials continues to deepen the thickness of the layers. The newly formed top soil, which contains clay and organic materials, now supports a greater amount of plant life. Root action, decayed plants, and the increased action of small organisms aids in the continued breakdown and refinement of the soil.

Section D:
MATURE SOIL: *Unweathered rock, immature soil I, Immature soil II, newly formed top soil,* and *a layer of fine particles* separated from the top soil. This layer is predominantly clay. In the deepening top soil, plant life and small animal activity flourish.

Activity 2: NORM'S PIT (tephra pit)
This portion of the class will be held at the "Pit", where students will see how this soil has been created in several stages over the last 13,000 years.

1. Discuss the ***Typical Soil Profile***:
Seasonally, river deposits added new layers of material to the ground over several hundreds of years. These re-occurring events increased the soil depth so gradually that little or no change would have been noticed in a person's life-time. The results of events such as the gravel left by glacial action, and the airfall of pumice from the 1498 A.D. eruption of Mt. St. Helens, dramatically changed the soil profile in a short and noticeable amount of time.

NORM'S PIT

Level 5-A, -B (top/youngest layer) topsoil--if you look carefully you can see the ash from the 1980 Mt. St. Helens eruption

Level 4 sand to small pebble sized (Wn, 500 BP, 1500 A.D.)

Level 3 darker, finer grained material--made up of soil from vegetable decomposition, wind and water deposit

Level 2 mottled white and brown pumice (Yb, 3900 BP); from Mt. St. Helens

Level 1 large gravel at the lowest level of the pit. Stream gravel from glacial action (13,000 BP)

Things To Think About

1. Looking at the location of the tephra pit, where do you think the ancient stream flowed?

2. Which direction did it come from, and where did it go?

3. Why do you think that river valleys (bottom land) are considered good farm land?

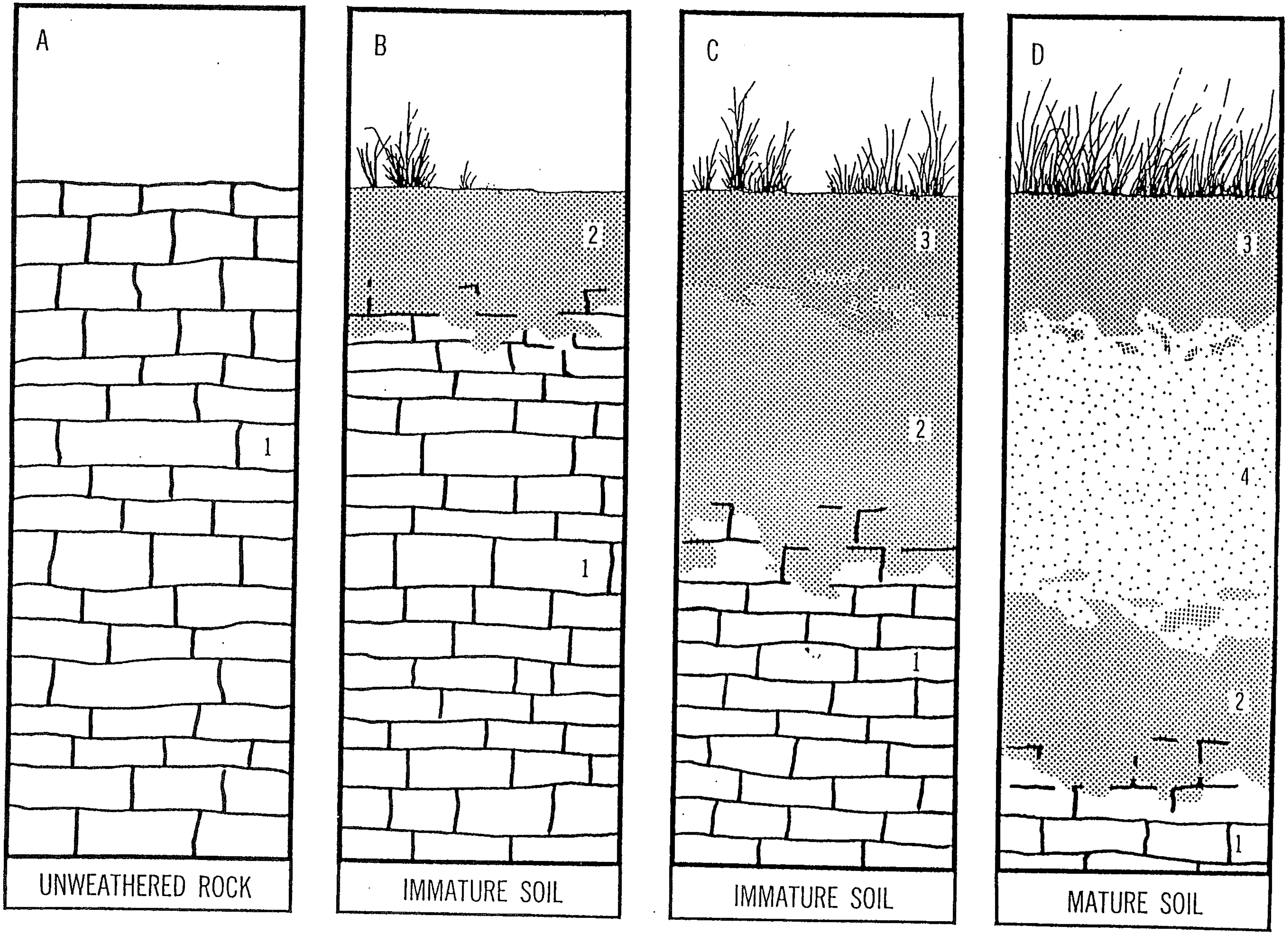
4. Compare the ash layers from the 1980 and 1498 eruptions of Mt. St Helens. Why do you think the 1498 layer is so much thicker?

5. Look at roots running through the various layers of the soil. What actions do you think they produce?

6. Is the soil profile under the Pavilion the same as that of the Tephra Pit? Why, or why not? What is the composition of the soil layers?

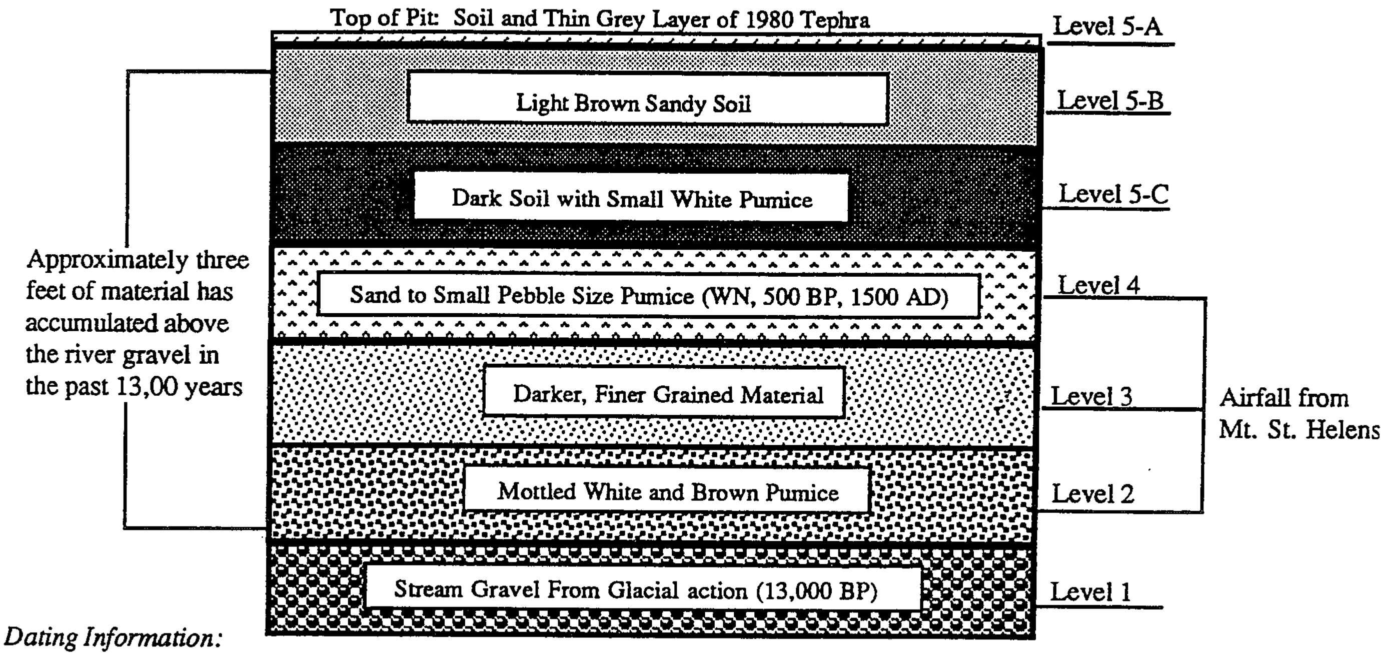
7. Where are other sites at Cispus (such as cut-away banks) where the soil profile can be seen?

Traditional Soil Profile



CISPUS LEARNING CENTER

Norm's Pit



Dating Information:
P=Present/1950, when carbon 14 dating was developed
BP= Before Present/1950

The flat surface beyond (east of) the Tephra pit represents a terrace formed by a stream during the last major advance of glaciers into this area, approximately 13,000 years ago. The gravel at the bottom of the pit face, plus the relatively smooth surface that extends along Road 76 from the Yellow Jacket .Creek Bridge supports this conclusion
Other events have affected this surface since then and the layers above the gravel can be uses as clues in determining what happened.

Approximately 3 feet of material has accumulated above the river gravels in the past 13,000 years. The most recent event, the 1980 eruption of Mt. St. Helens, is represented by a very thin, light gray layer of the ash fall (Tephra) material. At the time of the eruption, there was approximately 1 1/2 inches of Tephra on the ground, but the thin gray layer is all that remains as evidence of that catastrophic event.

The most dramatic event represented in this pit is the 3500 year old "Yn" eruption of Mt. St. Helens. Here it is represented by a layer of granular pumice less than a foot thick. In other places not far from here it is nearly 4 feet thick. Tephra from this eruption can be found in northern British Columbia, nearly 600 miles from here.

CHEWY CONGLOMERATE

Focus

To create an edible "rock" in this hands-on activity. Should follow an activity involving the observation and identification of rocks. Rock conglomerates are sedimentary rocks made up of a wide range of grain sizes, like pebbles cemented in a finer sandlike material.

Group Size

Entire group

Time Required

30 minutes

Materials

One part peanut butter
One part nonfat dry milk
One tablespoon honey per cup of peanut butter (*this is the "cement"*)
12" piece waxed paper per student
Zip-lock baggies for finished products

The following suggested condiments are the coarse part of the"rock":
raisins
chopped nuts
m & m's
granola
dried fruit bits
Allow approximately 1/4 cup peanut butter and nonfat dry milk per student. Amount and types of condiments will depend on the teacher. A 1/4 cup of mixture will give each student a "rock" about 2 inches in diameter.

Physical Setting

A Cispus classroom with easily accessible hot, running water

Process

1. The peanut butter, nonfat dry milk and honey mixture should be prepared by an adult. Amount of each ingredient used will depend on the number of students in the group. The large mixer in the Cispus kitchen works great for mixing. It could be prepared before arriving at Camp.
2. Set up a clean table with condiments in containers placed down the middle of the table.
3. Each student is given a 12 inch piece of waxed paper to work on.
4. An adult or counselor puts 1/4 cup of the conglomerate mixture onto the student's waxed paper and student then adds the condiments he/she desires in his "rock."
5. Student may eat it immediately or place in a zip-lock baggie with his/her name on it.

CHIP OFF THE OLD ROCK

Focus To explore the affects of weathering on rock using observation, prediction, measurement and experimentation skills.

Group Size Entire class, divided into small groups.

Time Required 30 minutes

Materials

Glue or a hot glue gun	Pie pans
Box of sugar	Balance
Water-misting bottles	White drawing paper

Physical Setting Cispus classroom

Process

1. Assign students to work in groups of two or three. Tell half the groups that they will be Tumblers and the other groups that they will be Misters. Give each small group ten sugar cubes. Put some cubes aside for comparison at the end of the investigation.

2. Each group should create a rock formation out of the sugar. Have each student glue their rock formations into a solid form using glue or the hot glue gun. Caution students that a little glue goes a long way. Let them dry overnight. If you've used regular glue, the formations may take longer to dry.

3. Have each group draw a picture of their rock formation. Weigh it, and record the weight.

4. Explain that the Misters will place their rock formations in a pie pan in preparation for spraying them with water. Then the Tumblers will place their rock formations in empty yogurt or margarine containers and seal them.

5. Have each group form a hypothesis about what they think will happen to their rock formations (i.e. "If we shake our rock formation for two minutes, it will change shape.").

6. When you give the signal to begin, the Misters will spray their rock formations with water and shake them around in the pie pan for two minutes. The Tumblers will shake their sealed containers vigorously for two minutes.

7. After the experiment, have each group weigh their rock formations again. Have the Misters and the Tumblers display their rock formations alongside the rock (sugar cubes) that you have set aside. What rock comparisons can they make between the rocks? How do the results compare with the hypothesis? How can you compare these results to the effects of weathering on rocks?

CLEARING THE MUDDY WATERS

Focus To develop the concept of sedimentation as a flip side to erosion.

Group Size Entire class

Time Required Initial 5 minutes
Follow up 5-15 minutes later during the same day, or next day

Materials

Pebbles	Clay
Fine sand	Silt
Coarse sand	Clear glass jar with a screw top

Physical Setting Classroom before or during Cispus

Process

1. Fill the jar 1/2 full of water. Finish filling the jar with about equal parts pebbles, coarse sand, fine sand, clay, and silt (or any combination that is available). Shake the jar and then allow to sit undisturbed.

2. Discuss how water erodes a mixture of dirt, sand, and rocks. Discus what students think will settle out first and why.

3. Wait an hour or more and compare student predictions with actual results. Students could draw the layers, with measured thickness and appearance (color, texture). This serves best as a lead in for field observations.

CRACK, CRUMBLE AND CARRY

Focus

To define weathering, erosion, and deposition. To demonstrate the effects of erosion or weathering on the earth, and to find evidence of these forces in the Cispus environment.

Group Size

Entire class

Time Required

1.5 hours total
1 hour class time
1/2 hour for Wear-It-Away-Walk

Materials

Laminated cards for each experiment
Materials listed on each experiment card
Clip board and paper/pencil

Physical Setting

Classroom setting and a forest trail

Process

1. By conducting a variety of simple demonstrations, your group can discover more about how the forces of weather, erosion, and deposition are constantly shaping the surface of the Earth. Afterward, they can take a "Wear-It-Away-Walk" on a nearby trail to find examples of these processes at work in the forest or their home community.

2. Before you begin the class, have each of the demonstration activities glued on a card and the expected results and explanation glued to the back. Laminate each card.

3. Discuss the processes of weathering, erosion, and deposition (see attached resource page).

4. After your discussion, divide the group into teams of four or five children and give each team one of the demonstration cards. Explain that each person on each team must conduct the demonstration on the card and record the results. Tell the students that they should share materials.

5. Then explain that the members of each team should pool their information and put together a team presentation for the rest of the group. Tell the students that each team's presentation should include the following:

A. An explanation of what they did, including a list of materials they used, how they set up the demonstrations, what controls they used, and so on.

B. A discussion of the results of their demonstrations and what conclusions they drew from their results. They should also explain how their demonstration relates to weathering, erosion, or deposition.

C. An explanation of why some of the data that each person gathered differed (if it did), even though each person did the same demonstration.

D. A description of another way to demonstrate the same concept.

6. Explain that each group can show the actual materials from the demonstration, conduct the demonstration in front of the group if it's a quick one, make charts or graphs to record their data, or use a flip chart to explain what happened. Also, encourage each person in each team to take part in the team's presentation. Encourage other students to ask questions or challenge with ideas for further investigations.

7. You should also mention that these are indoor demonstrations that simulate some of the processes of weather, erosion, and deposition, and they are not exactly what happens outside. For example, explain that some of the materials used in the demonstrations, such as vinegar, lemon juice, and hydrogen peroxide, aren't the actual substances that would cause rocks to weather. But these chemicals act in a similar way to those that do shape the landscape.

8. After all the presentations have been made, take the "Wear-It-Away-Walk" with clipboards for students to record their "finds".

NOTE: Some of these activities require more time than others. Allow several days for all the demonstrations to be completed before having teams share their results and conclusions.

#1 PLASTER AND ICE

WHAT YOU NEED:
Plaster of Paris, water, a small balloon, two empty pint milk cartons (bottom halves only), a freezer

WHAT TO DO:
1. Fill balloon with water until it is about the size of a Ping-Pong ball. Tie a knot in the open end.
2. Mix water with Plaster of Paris until the mixture is as thick as yogurt. Pour half of the plaster into one milk carton and the other half into the remaining carton
3. Push the balloon down into one of the plaster filled cartons until it is about 1/4 inch under the surface. Hold the balloon there until the plaster sets enough so that the balloon doesn't rise to the surface. Let the plaster harden for about 1 hour.
4. Put both milk cartons in the freezer overnight. Remove containers the next day to see what happened.

WHAT HAPPENED:
What happened to the plaster that contained the balloon?
What happened to the plaster without a balloon?
Why was there a difference?
Which carton acted as the control? Why?
How does this experiment illustrate what happens when water seeps into a crack in a rock and freezes?

#2 A SOUR TRICK

WHAT YOU NEED:
lemon juice, vinegar, medicine droppers, and two pieces each of limestone, calcite, chalk, and quartz.

WHAT TO DO:
1. Put a few drops of lemon juice on one piece of each rock sample.
2. Put a few drops of vinegar on the remaining four rocks.
3. Look and listen carefully each time you add vinegar or lemon juice to the samples.

WHAT HAPPENS:
What happens when you put lemon juice on each rock?
What happens when you put vinegar on each rock?
Did the lemon juice and vinegar act the same way on each rock?
Why did some of the rocks react differently?
What does this experiment have to do with weathering?

#3 STEEL WOOL AND WATER

WHAT YOU NEED:
3 shallow dishes. 3 pieces of steel wool, salt, water.

WHAT TO DO:
1. Place each piece of steel wool in a separate shallow dish.
2. Pour equal amounts of water over 2 of the pieces of steel wool and leave the third piece dry.
3. Sprinkle one of the wet pieces with a thick layer of salt.
4. Observe and compare the 3 pieces every day for a week.

WHAT HAPPENED:
What happened to each piece of steel wool?
Which piece changed the most?
Which piece of steel wool acted as the control?
What does this experiment have to do with weathering?

#4 A PENNY FOR YOUR THOUGHTS

WHAT YOU NEED:
4 new pennies, 4 shallow dishes, salt, vinegar, hydrogen peroxide, hand lens, masking tape, pen, measuring spoon.

WHAT TO DO:
1. put each penny in a shallow dish, head side up.
2. Cover one penny with 3 teaspoons of salt
3. Cover the second penny with 3 teaspoons of salt and 3 teaspoons of vinegar.
4. Cover the third penny with 3 teaspoons of salt and 3 teaspoons of hydrogen peroxide.
5. Leave the fourth penny uncovered.
6. Label the dishes according to the ingredients added.
7. Let the pennies stand for 2-3 days. Then, remove and clean them off. Use a hand lens to study the pennies and compare the effects of the various substances.

WHAT HAPPENED:
How did the pennies in each dish change?
Did some of the pennies change more than others?
What do you think would happen if you left the pennies for another week?
Which penny acted as the control? Why?
Pennies are made of copper and zinc--two elements found in many types of rocks. How does this information and the results of the experiment relate to weathering?

#5 SHAKE IT UP

WHAT YOU NEED:
15 rough stones of fairly uniform size, 3 lidded containers (coffee cans), 3 clear cups or jars, pen, paper, masking tape

WHAT TO DO:
1. Separate the stones into 3 piles of 5. Put each pile on a sheet of paper.
2. Label the piles A, B, and C. Label each can and jar in the same manner.
3. Fill all the cans halfway with water. Place each pile of stones into the matching can (pile A into can A, etc.). Let the stones stand in the water overnight.
4. The next day, hold can A in both hands and shake it briskly, 100 times.
5. Remove the stones from can A and pour the water into jar A.
6. Repeat the process with can B, shaking the can 1000 times instead. Switch shakers or rest if necessary.
7. Do not shake can C. Remove the stones and pour the water into jar C.
8. Compare the 3 piles of stones and the 3 jars of water

WHAT HAPPENED:
How do the piles of stones differ? Can you explain why?
Which pile acted as the control? Why?
How do the jars of water differ?
How does this experiment compare to the action of stones in a fast-moving stream?

#6 ICE ON THE MOVE

WHAT YOU NEED:
sand, several flat pieces of shale or limestone, ice cubes, 2 paper towels, ice cube tray, a freezer

WHAT TO DO:
1. Mix several teaspoons of sand with water and pour the mixture into ice cube trays and freeze.
2. Use a paper towel to pick up one of the sandy ice cubes.
3. Hold the ice tightly against a piece of shale or limestone and slowly push it across the rock several times.
4. Examine the surface of the rock.
5. Do the same thing with a regular ice cube on another piece of rock.

WHAT HAPPENED:
Compare the rock surfaces. What are their similarities and differences?
How does this experiment explain the way glaciers help shape the land?

#7 THE LAYERED JAR

WHAT YOU NEED:
large jar with a lid, water, pebbles or gravel, coarse sand, soil.

WHAT TO DO:
1. Put a layer of pebbles, sand and soil in the jar.
2. Fill the jar with water and cover.
3. Shake the jar until everything in the water is jostled about.
4. Set the jar down and watch what happens in 10-15 minute intervals for about an hour. Then check it several hours later.

WHAT HAPPENED:
How did the water look after you shook the jar?
Which material settled to the bottom first? Why?
Which material settled last? Why?
Based on this experiment, when a fast-flowing river carrying pebbles, sand and soil begins to slow down, what will settle out first?
What will be carried farthest downstream?

A WEAR-IT-AWAY-WALK

After the class has a better understanding of how the Earth's wearing-down and building-up forces work, go on a hike to look for signs of weathering, erosion, and deposition in the area. Find and record on white art-paper the following examples of weathering:

1. Find signs of erosion caused by water on bare hillsides and slopes. Also look on the banks of rivers or streams and sites where erosion showing trees and grass have been removed.

2. Look for places where trees and other plants are growing out of rocks, such as a crack in a sidewalk. Look for bits of soil in the cracks.

3. Look for lichens on rocks. Lichens can start to grow in rock crevices, and as they grow they produce a mild acid which can help break rocks down.

4. Look for smooth rocks in stream beds and on beaches.

5. Look for loose rock and soil at the bases of slopes.

6. On a rainy day, check for soil washing away under storm drains and down gutters.

WHAT YOU SHOULD EXPECT:

1. **PLASTER AND ICE:** The plaster containing the balloon should have cracked as the water in the balloon froze and expanded. When water seeps into cracks in the rocks and freezes, it eventually breaks rocks apart.

2. **A SOUR TRICK:** The Lemon juice and vinegar both contain weak acids. The lemon juice contains citric acid and the vinegar contains acetic acid. These mild acids can dissolve rocks that contain calcium carbonate. The lemon juice and vinegar should have bubbled or fizzed on the limestone, calcite, and chalk, which all contain calcium carbonate. There should not have been a reaction on the quartz, which does not contain calcium carbonate. Water often contains weak acids that dissolve rocks containing calcium carbonate and other minerals.

3. **STEEL WOOL AND WATER:** When iron gets wet, the water acts as an agent to speed up oxidation. (Oxidation occurs when oxygen combines with another substance). In this case, oxygen in the water combined with the iron in the steel wool to form iron oxide, or rust. Rust is a weaker material than the original metal and it erodes quickly. When salt is added to the water, wool in salt water will be the one that changes most.

4. **A PENNY FOR YOUR THOUGHTS:** If the pennies are left long enough, the pennies with salt, salt and vinegar, vinegar, and hydrogen peroxide should all change. Salt will react chemically with the copper to produce copper chloride. Vinegar and salt will slowly dissolve the copper, forming green copper salts. And the hydrogen peroxide will speed up the reaction.

5. **SHAKE IT UP:** The longer the stones were shaken, the more rounded their edges should be. Jars **A** and **B** should have some sediment in the bottom, but **JAR B** should have more since more shakes would have broken off more bits of rock. The same thing happens to rocks that are carried along in rivers or are churned about by the surf.

6. **ICE ON THE MOVE:** The ice cube with sand acts like sandpaper, and should leave scratches on the rock surfaces. The control should not show scratches. When glaciers move across land, they pick up and move rock material. Some of this rock material can scratch and gouge rock surfaces.

7. **THE LAYERED JAR:** When the jar is first shaken, the water appears cloudy. As the particles settle, the water becomes clearer. First the heaviest material - the pebbles or gravel - settles to the bottom. Then the sand settles out. And finally the lightest material - the clay and silt in the soil - settles on top. When a river slows down, the same thing happens, with the heavy boulders and rocks dropping out first and the fine silt and clay being dumped last. This is why a fertile delta often forms at the mouth of a river.

DOWN & DIRTY: Soil Profile

Focus To use field study and sensory observations to understand that soil is not homogeneous but a composite made up of layers, which are deposited and modified through an understandable process.

Group Size Entire class, working in teams of 4

Time Required 1.5 hours

Materials

Soil pH kit	Yard stick
Soil thermometer	Magnifying glasses
Handout: ***Dusty Deeds***	

Physical Setting Cut bank near a stream *(Covell, Angel Falls trail, Cispus River)* or a road cut.

Process

1. Students look around at the material on top of the ground. They need to note if the soil is flat or sloped, what is present on top of the ground. Look for soil removal due to erosion.

2. Find an area along a stream or river, where the soil has been cut into by erosion. Road cuts often expose the layers of soil. Soil pits are available across the road from Cispus Center.

3. Using an area where the layers of the soil are exposed, have students look for the color of the different layers of soil: How do they smell? What is the texture? Is there any sign of animal or plant life, living or dead? Is the soil wet or dry? Is the soil cold or warm? Look closely at the soil with a magnifying glass.

Draw the layers of soil in the left column of the Soil Profile Task sheet . Use a meter stick to measure the thickness in centimeters, a pH kit to determine the relative acidity or alkalinity of the soil. Use a soil thermometer to measure the temperature of each layer.

Record results on the Soil Profile Task sheet, central column.

Explain why the soil has the color, odor, pH, temperature, etc. that you found in each of the layers.

Share your results with other groups.

DUSTY DEEDS

Name______________________

Teacher______________________

Using the observations and measurements of the layers of soil, draw the layers in the DRAW column, record your observations and measurements in the DATA column and record your ideas about why the different layers have a different appearance, pH, depth, etc. in the INTERPRETATIONS column.

DRAW DATA INTERPRETATIONS

Contents of **Duff**______________________

Depth __________" to __________

A Horizon: **Topsoil** Depth ______"to ______"

Color______________________

Texture: Sandy______Silt______Clay______

Structure: Columns________Blocky________

Plates________Granules________

pH________Temp. ______oF Plant Roots____

B. Horizon: **Subsoil**: Depth______" to_____"

Color______________________

Texture: Sandy______Silt______Clay______

Structure: Columns________Blocky________

Plates________Granules________

pH________Temp. ______oF Plant Roots____

C. Horizon: **2nd Subsoil** Depth____" to ____"

Color______________________

Texture: Sandy______Silt______Clay______

Structure: Columns________Blocky________

Plates________Granules________

pH Temp. oF Plant Roots

NOWHERE TO RUN

Focus To help students understand how rain, melting snow or runoff from buildings can cause soil erosion, and how plants can prevent this. Students will also learn how soil compaction causes flooding, puddling, run-off, and erosion. They will learn about how surface water moves over and through soil.

Group Size Small groups of 3-4 can be supervised in one area
Entire class is possible

Time Required 30-45 minutes

Materials One plastic water pitcher for each group of 3
Ready supply of water to refill pitchers
Plastic pipettes
Small digging implement, such as an old teaspoon
Pencils and hard surface for writing on.
Handout: ***Run, Water, Run!***

Physical Setting Various locations around the Cispus area

Process 1. Discuss with students what happens to rain after it falls. Where does it go? Why does some rain or snowmelt move through the soil while other times it will puddle up or run off? How does soil become compacted around Camp Cispus? What is the effect of the runoff from the buildings, downspouts, etc.? Are there areas in Camp where large amounts of rain or runoff can be absorbed? What allows this?

2. Divide students into groups of three. Distribute water pitchers, pipettes, spoons, question and observation sheets with hard surface (cardboard pieces?) for writing on, and pencils. Allow groups to move around Camp looking for evidence of rain and runoff movement and its effects on the soil, especially in areas of soil compaction. Students should try sprinkling water (not just dumping large amounts!) slowly on different areas and observing whether or not it soaks in or runs off or both. They should try exposed soil and soil where grass or other plants are growing, sloping areas, flat and sloping trails, compacted and non-compacted areas. They can also dig very small holes in different areas with spoons, adding water, and observing effects.

3. Gather groups together and discuss findings and implications. Do further testing and observations.

NOWHERE TO RUN

QUESTIONS AND OBSERVATIONS

1. WHERE IN CAMP CISPUS DO YOU SEE EVIDENCE OF WATER RUNOFF? WHAT SEEMS TO CAUSE THIS?

2. WHERE DOES THE RAIN AND RUNOFF GO IN CAMP CISPUS? WHAT NEGATIVE EFFECTS MIGHT RUNOFF HAVE ON THE ENVIRONMENT?

3. BY POURING OR DRIPPING WATER FROM PITCHERS AND WITH PIPETTES, WHAT CAN YOU DISCOVER ABOUT THE SOIL AROUND CAMP AND HOW IT IS AFFECTED BY COMPACTION, RAIN, AND RUNOFF? (IF IT'S RAINING, YOU MAY NOT NEED TO ADD MORE WATER!)

4. HOW COULD THINGS BE CHANGED/IMPROVED AT CAMP CISPUS TO PREVENT SOIL COMPACTION AND ITS NEGATIVE EFFECTS? PERHAPS YOU COULD MAKE SUGGESTIONS TO THE CISPUS MANAGEMENT!

READING THE LANDSCAPE

Focus To gain a basic introduction to glaciers by examining the natural features of the Cispus Valley

Group Size Entire class

Time Required 1 hour

Materials
Notebook
Pen
Topographic map
Textbooks picturing glaciers *(see source list)*
Handout/Reading: ***Imagine the Past***

Physical Setting
Confluence of Cispus River and Yellowjacket Creek
Cispus library

Process

Activity 1: DISCUSSION INVESTIGATION

1. Have students discuss what they think a glacier looks like; how do they think one forms? Possible topics include: River of ice, compression, plucking rocks, scouring, retreating, advancing.

2. Continue by asking "What clues in the landscape indicate this valley was scooped out by a glacier?" Possible discussion of U-shaped valley, glacial flour, flat face of tower rock.

3. Improvise an imaginary re-enactment of the Mt Adams glacier advancing and reshaping the Cispus valley (see **Imagine the Past** page for ideas/reading). Ask the students to close their eyes for this activity. In your story try to incorporate the students' ideas and answers about glaciers.

Activity 2: FOLLOW UP

Hike back to the center's library. Using a topographic map of the Cispus region and geology texts (see list), look at pictures of glaciers. End with having the children draw the glacier shaping the Cispus Valley.

IMAGINE THE PAST

Listen to the wind and the water. Imagine it beginning to snow and snow and snow. Imagine sitting here for seven years, for 70 years! All the while snow accumulates, layer upon layer, freezing solid. Imagine the snow spilling down out of the mountain, off the hills into this river- because of gravity, because this is the lowest place in the valley. The river fills up with snow, compacting into dense unchippable ice--like a giant ice snake slinking up the valley, gripping rock chunks, freezing boulders to its belly, rubbing and grinding against both sides of the valley. This glacier is 500 feet thick, taller than the trees.

Now imagine the snow stops, the cold dissipates. The sun comes out and everything starts to soften and drip. The glacier starts to melt where it's thinnest, at the tail, ice turns into water that runs down the river...free. Stones and rocks once clenched and frozen, packed under massive ice, have crumbled to dust and sand. Others are fractured and shorn. The sun keeps shining . It's warm and balmy. Little by little the tough, stubborn ice melts, dripping away. Every year the glacier shrinks a little bit, revealing scuffed valley walls, the clean, shorn face of Tower Rock, melting away until it's no longer a valley-long snake but a slug or a worm existing in the coldest iciest place in a cleft of Mt. Adams, where it began.

RESOURCES

Available in the Cispus Library

A Field Manual for the Amateur Geologist, Alan Cvancara

Essentials of Earth History, W. Lee Stokes (pg 428)

The Earth, An Introduction to Physical Geology, Tarbuck and Lutgens (chp. 11, pg 257)

Physical Geology, Edgar Spenser (chp. 24, 457-517)

THAR'S GOLD IN THEM HILLS

Focus To introduce students to recreational geology.

Group Size Entire class, 1-3 per pan

Time Required 30-60 minutes

Materials Gold pan *(Cispus Center has some gold pans, or use aluminum pie tins with fluted sides)*
Small glass or plastic jar with lid

Physical Setting Yellowjacket Creek

Process *The following instructions came with "The 49er GOLD PAN™" (818)768-3888, Sun Valley, CA 91352. The instructions have been paraphrased:*

1. Fill the gold pan one-quarter full of paydirt. Paydirt is sand and dirt from sand bar along Yellow Jacket Creek. Cover the paydirt with water. Now lightly hit the ridge of the pan 7 to 8 times to settle the gold to the bottom. With a dipping motion in the stream, wash off the excess rock and sand over the horizontal leaning riffles on the edge of the pan. Repeat the process until only a small amount of sand is left in the pan.

2. Next, position the pay dirt over the gold traps and hit the ridge of the pan, as before, to settle the gold to the bottom. Then turn pan in a circular, flat motion, allowing the gold and black sand to fall into the gold traps.

3. Find more nuggets and flakes of gold by using a 49er Gold Crevice Tool. The 49er Gold Crevice Tool is used to reach deep into the various cracks and crevices of the stream bed to remove the heavy paydirt. An oven baster (huge eye dropper) works instead of the Crevice Tool.

4. Transfer the remaining black sand and gold specks to a clear plastic or glass container with a screw top.

5. There are several ways to determine if the gold colored specks are gold or not. One way is to smash the speck between two flat knife blades it see if it crushes or flattens. If it flattens it is gold. This only works with larger particles.

6. Many jewelers and high school chemistry labs have or can make an acid solution called Aqua Regia. This is a mixture of concentrated nitric and sulfuric acid. Gold will not dissolve in any single acid. It will dissolve in this mixture. This is a hazardous mixture and you may want to ask a jeweler or high school chemistry instructor for help testing the gold.

WHAT DUG THIS?

Focus To discover what natural forces created, and are still changing the Cispus River Valley.

Group Size Entire class

Time Required 1-2 hours

Materials Geology of the Cispus Environmental Center Area (*available in the office*)
Drawing paper
Charcoal (*buy, or get it from the fire pit*)

Physical Setting Locate points where there are clear views of the Cispus River Valley downstream, Yellow Jacket Creek, Covell Creek, and Tower Rock.

Process Prior to coming to the environmental center, read the portions of the Geology of the Cispus Area that are appropriate to your students' ages. Pay particular attention to the development of U-shaped valley formation (glaciers) and V-shaped valley formations (water).

1. Go just downstream from the confluence of the Cispus River and Yellow Jacket Creek. Have the students look downstream and observe the shape of the valley in the distance. This is a good place to make charcoal drawings of the valley and Tower Rock. Doing charcoal drawings at each of the sites tends to enhance the children's perception of the valley shapes.

2. Have the students interpret how they believe the valley was formed and provide a rationale for their belief. Have them pay particular attention to the shape of Tower Rock.

3. Go to a point upstream from the confluence, where a good view is available of the Yellow Jacket Creek Canyon. Have students repeat steps 1 & 2.

4. Go to Covell Creek to look at a stream in the early stages of valley development.