

# *North, South, East and West*

*orienteering and trails*

# MAPPING MADNESS

<b>Focus</b>	To design a trail guide employing collaborative decision making and skill application.
<b>Group Size</b>	Entire class
<b>Time Required</b>	1-2 hours
<b>Materials</b>	Wooden popsicle sticks Lap board ( <i>one per team</i> ) Pencil
<b>Physical Setting</b>	Standard classroom ( <i>discussion</i> ) Braille Trail, Covell Creek Trail ( <i>activity</i> )
<b>Process</b>	<ol style="list-style-type: none"><li>1. Facilitator leads a discussion focusing on the various skills needed to make an accurate map. Points highlighted might include: gauging distances (pacing, highly visible landmarks), producing a map scale, inclusion of a map key for frequently encountered sites, using all the senses (as opposed to sight only), noticeable elevation changes, and colors that would not be subject to seasonal changes.</li><li>2. Following the discussion, break the group into small teams of 4-5. Based upon their mapping plan, each team member is given a specific job to do as part of making their map. For example: a team might consist of a recorder who charts the map, a pacer who marks distances, a graphics person who makes margin drawings, and a visual/sensory spotter who captures specific peripheral details for the map.</li></ol> <p><b>Large Group Applications:</b> Divide groups according to the criteria cited above, but disperse them to different starting locations on the trail. Two groups may be given a five minute head-start into a trail, and begin writing their map from a location more central to the trail.</p>

### **Extension Activities:**

#### *Popsicle Sticks*

1. Participants are issued five sticks per team (sticks are numbered 1-5). When teams encounter a prominent location they note it on their map. Then hide a numbered stick in an inconspicuous spot in the immediate location and note the location on their map.
2. When teams return to the starting point, they exchange maps and set off to find the sticks, as indicated on the maps. Decide upon a prize and basis for awarding prizes to the teams (most found, how quickly, etc.).
3. Sticks not discovered should be retrieved by the team who planted them. In the unlikely event that a stick is not retrieved, it will eventually decompose.

#### *Poetry*

1. Using the completed map as their guide, group members design a memory poem to implant useful landmarks, smells or sounds.
2. The groups then recite their poem to other groups, who try to use the poem as a guide for a successful tour of the trail.

#### *Compasses*

1. Map the key highlights of the trail using compass headings as the direction indicators. Participants can measure distances to be traversed using pacing or clock time.

## ***WHERE AM I?***

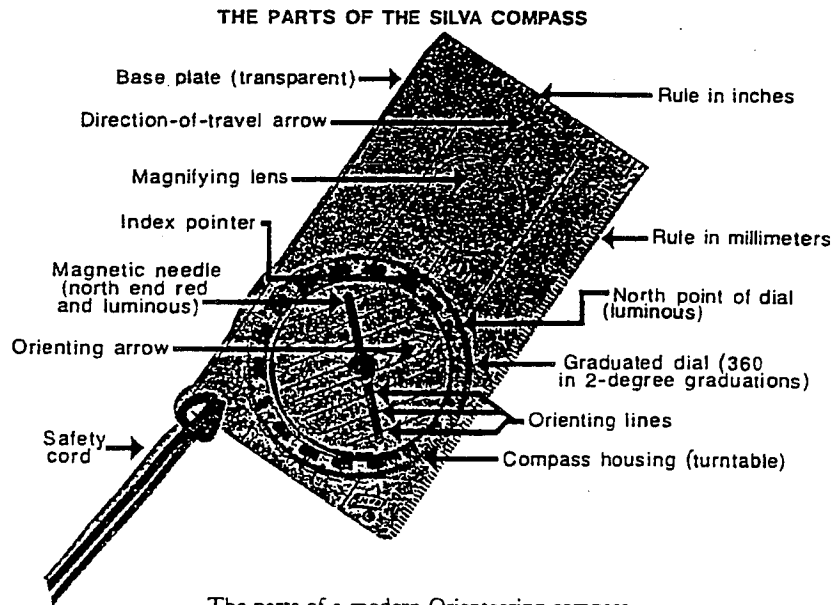
<b>Focus</b>	To learn the parts of a compass, how to find a given direction, pacing, and following a compass course ( <i>instructors must be fluent with a compass</i> ).
<b>Group Size</b>	Entire class
<b>Time Required</b>	2 hours
<b>Materials</b>	A compass for each student and instructor Pre-made compass courses on 5x7 cards
<b>Physical Setting</b>	Field or forest
<b>Process</b>	<p><b>Activity 1: PARTS OF THE COMPASS</b> Divide into groups of six, with one instructor/counselor for each group. Then, begin to describe each of the parts of the compass, checking to see that everyone is using it correctly. The parts described should include: base plate, 360 degree dial/bezel, index line, direction of travel arrow, alignment arrow, and magnetic needle. After describing all of the parts, review by asking the students to name and describe the uses of the parts.</p> <p><b>Activity 2: FINDING A GIVEN DIRECTION</b> Explain to the students that to find a "given direction" they must align the direction they want to go with the index line, then align the magnetic arrow with the alignment arrow. Now the direction of the travel arrow is pointing in the direction they want to go. Ask the students to find a specific heading (North), and name an object in line with that heading. Check to make sure all the students have it correct, then ask them to find a more difficult bearing (275 degrees).</p> <p><b>Activity 3: PACING</b> The next step is pacing. Mark-off a 5 meter area and have the students walk between the two points, counting their steps. Now they will be able to figure out distances by pacing. Ask them how many paces they would take to go 20 meters, or 35 meters, etc. (Divide the number of meters by 5, then multiply that number by the amount of paces in 5 meters.)</p>

#### Activity 4: COMPASS COURSES

The next exercise is to have the students do a small course. This course should be written on 5x7 cards and consist of three different directions--equal distances, forming an equilateral triangle. Have the students place something on the ground where they start from and then see where they end up. After completing the triangle correctly, give them another 5x7 card with a more complex course on it. Markers can be used to keep each leg of the course fairly accurate. There is a wide variety of difficulties you can achieve by making different courses, so use your imagination!

**NOTE:**

*This orienteering exercise does not include declination or map use. These subjects could be covered in a following exercise.*



The parts of a modern Orienteering compass.

## ***LOOKIN' SOUTH***

<b>Focus</b>	To illustrate use of the sun's position in determining direction. ( <i>Basic knowledge of compass use necessary; refer to <b>WHERE AM I?</b></i> )
<b>Group Size</b>	Entire class, divided into groups of 6
<b>Time Required</b>	40 minutes, divided into 4 - 10 minute segments approximately 2 hours apart ( <i>i.e. 9:30am, 11:30am, 1:30pm, 3:30pm</i> )
<b>Materials</b>	One compass for each group Field journal Pen/pencil
<b>Physical Setting</b>	Any outdoor setting in the sunlight
<b>Process</b>	<b>Activity 1: TAKING BEARINGS</b> 1. Team members select their jobs: each team needs 1 sighter/reader, 1 recorder, and 4 shadow line members. 2. In direct sunshine, have shadow-line members of team line up on each other's shadows, about 4 feet apart. 3. Sighter/reader stands about 10 feet from shadow-line members in line with the shadow. 4. Sighter/reader then lines up compass north to magnetic north as indicated by compass needle. 5. Sighter/reader then sights down the shadow-line and reads out the bearing (in degrees) to the shadow-line. 6. The recorder then notes the time and relative bearing. 7. All members write down these notations in their field journal.  <b>ACTIVITY 1 IS THEN REPEATED 2 TO 3 MORE TIMES AT APPROXIMATELY 2 HOUR INTERVALS.</b>

## Activity 2: FINDING YOUR DIRECTION

1. Subtract 21 & 1/2 degrees from each of your relative bearing readings and note these new (true) bearings on a compass rose with the time of observation.

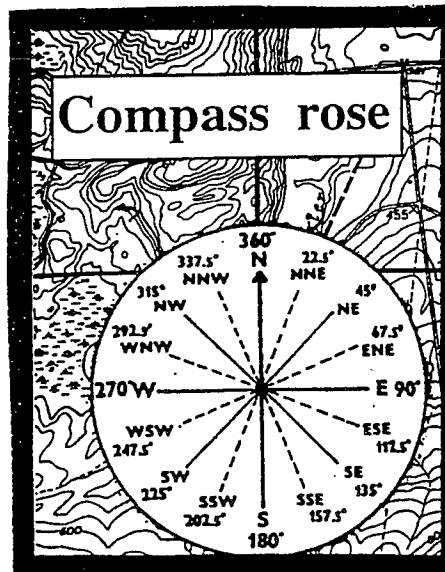
**Note: Compass readings are based on magnetic north and 21 & 1/2 degree east of true north. A correction must be made for the difference between *true* and *magnetic* north.**

2. Answer the following questions:

- What do you estimate the position of the sun was at noon?
- Before noon, was the position of the sun closer to the Southeast or Southwest?
- If you face the sun at Noon, in which direction will your shadow point?

### EXTENSION OF LESSON:

An ordinary analog wrist or pocket watch can help find true north. In the North Temperate Zone (from latitude 23 & 1/2 to 66 & 1/2 degrees) point the hour hand toward the sun. A line halfway between the hour hand and 12 o'clock (standard time) or halfway between hour hand and one o'clock (daylight time) is a north-south line. On cloudy days, hold a small stick at the center of the watch so its shadow falls along the hour hand. A line halfway between the shadow and 12 o'clock (standard time) points north.



# *Take A Dip*

*water and wetlands*



# ***BENDS BOULDERS, SWIRLS, AND EDDIES***

<b>Focus</b>	To use field investigations and problem solving skills in determining the importance of streams to the plants and animals which live around it.
<b>Group Size</b>	Entire class
<b>Time Required</b>	1 hour
<b>Materials</b>	<i>Per group:</i> 6" stick Yard stick Clipboard Wet gear ( <i>boots</i> ) Handout: <i>A Determination of Streamflow</i> 50' measuring tape Watch with sweep hand Pencils
<b>Physical Setting</b>	Covel Creek
<b>Process</b>	<ol style="list-style-type: none"><li>1. Begin this activity by discussing with the class the importance of water, and its many uses. Water in streams such as Covel Creek provide a valuable resource to people who live near it. It is also important for the plants and animals which live in this area. Covel Creek is home to many aquatic creatures and plants. Have the students discuss this aspect and come up with guidelines that will enable them to take their measurements, while doing the least damage to this aquatic habitat.</li><li>2. Each group will select a member to be the official group recorder. This person will be responsible for writing down the information that their group collects.</li><li>3. Follow the Covel Creek Trail until you reach Covel Creek. Once there, each small group will select a fairly straight area of the creek to take their data from. Using the handout, take the required field measurements. Return to camp and complete the final calculations.</li><li>4. Follow-up the activity by completing the discussion questions, discussing the results from each group's calculations (using a chart of class results), drawing some conclusions on the impact of Covel Creek on the ecology of the area, and on man's impact on the ecology through water use.</li></ol>

## A Determination Of Streamflow

*Water is needed for many purposes. Streams such as this one can provide a valuable resource to people who live near it. It is also important for the plants and animals which live in this area.*

A. Using a tape measure, mark off a 50 ft. distance along your chosen section of Covell Creek. Then, have two students stand in the stream, one at each end of the 50 ft. distance. These two are your markers. Find out how fast the creek is flowing. Using the 6" stick, have a member of your team set the stick in the water, upstream from your first marker. Release the stick and time the number of seconds it takes the stick to float between the two markers. Repeat the procedure two more times. Record the times below and average them.

First measurement \_\_\_\_\_ seconds

Second measurement \_\_\_\_\_ seconds

Third measurement \_\_\_\_\_ seconds

Total \_\_\_\_\_  $\div$  3 = \_\_\_\_\_ average seconds

B. To find out the feet per second the stick made, divide the 50 ft. distance by the average seconds it took the stick to float between the markers

50 ft.  $\div$  average seconds = \_\_\_\_\_ ft. per second

C. Find the average width of your section of the creek. Measure the width of the stream at 3 places within the 50 ft. area. Record the measurements below and average them.

First measurement \_\_\_\_\_ ft.

Second measurement \_\_\_\_\_ ft.

Third measurement \_\_\_\_\_ ft.

Total \_\_\_\_\_  $\div$  3 = \_\_\_\_\_ ft.  
(average width)

D. Find the average depth of your section of the stream. Wade across the stream in a straight line. Measure the depth of the stream in 3 places (near bank, middle, far bank) to get the average depth of the stream.

First measurement \_\_\_\_\_ ft.

Second measurement \_\_\_\_\_ ft.

Third measurement \_\_\_\_\_ ft.

Total \_\_\_\_\_ ÷ 3 = \_\_\_\_\_ ft.  
(average depth)

E. Find the cubic feet of water per second. Multiply the average depth, average width, and the number of feet the stick floated each second. This will tell you the number of cubic feet of water flowing in the stream every second.

\_\_\_\_\_ X \_\_\_\_\_ X \_\_\_\_\_ = \_\_\_\_\_  
(average width) (average depth) (No. of ft. per sec) (cubic ft. of water flowing per sec)

Note: A cubic foot of water is the amount that will fill a container 1 ft. wide x 1 ft. high x 1 ft. long, or 7.48 gallons.

Use this table of water measurements to answer the questions below

<p><i>A waterflow of 1 cubic ft. per second = 449 gallons per minute</i></p> <p>One cubic foot of water = 7.48 gallons</p> <p>One cubic foot of water = 62.5 pounds</p>
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F. How many gallons of water flow in this stream every second?

\_\_\_\_\_ X \_\_\_\_\_ = \_\_\_\_\_  
(stream flow in cu. ft./sec) (gallons/cu. ft. of water) (gallons of water/sec)

G. How many gallons of water flow in this stream every minute?

\_\_\_\_\_ X  $\frac{60}{\text{seconds/minute}}$  = \_\_\_\_\_  
(gallons water/sec) (seconds/minute) (gallons of water/minute)

H. Each person uses about 150 gallons of water a day. What is the total number of people who could live from the water in this stream?

$$\begin{array}{ccccccc}
 \underline{\hspace{2cm}} & \times & \underline{\hspace{2cm}} & = & \underline{\hspace{2cm}} & \div & \underline{\hspace{2cm}} = \\
 \text{(gal water/min)} & & \text{(No. of} & & \text{(total gal of} & & \text{(amt. water} \\
 & & \text{min/day)} & & \text{water/day)} & & \text{1 person} \\
 & & & & & & \text{uses/day)} \\
 & & & & \underline{\hspace{2cm}} & & \\
 & & & & \text{(total No. of people} & & \\
 & & & & \text{who could live from} & & \\
 & & & & \text{the water in this stream)} & & 
 \end{array}$$

**Discussion:**

1. How many people in your community could live off of the water in this stream?
  
2. What would happen to this environment if we piped all the water out of the stream at this point and into your community?
  
3. If we were going to use this water, how much water should be left to flow down stream?
  
4. Does this stream always have the same amount of water in it? Why?
  
5. What are some problems you have encountered during this task?

## ***ROCKS + WATER***

<b>Focus</b>	To understand the forces that created and shaped the Cispus area using lecture, guided inquiry, reading and field study.
<b>Group Size</b>	12 students
<b>Time Required</b>	1.5 hours
<b>Materials</b>	Writing tools 3 or 4 copies of the USGS Tower Rock, Washington, quadrangle maps ( <i>available at Cispus</i> ) Handout: <b><i>ROCKS + WATER Questions</i></b>
<b>Physical Setting</b>	Cispus Road ( <i>adjacent to the local Volunteer Fire Station</i> ) Cispus Center service roads and trails Gravel bars at the edge of Yellowjacket Creek and the Cispus River
<b>Process</b>	<ol style="list-style-type: none"><li>1. Walk your group to the main entrance of the center. Review with them safe walking rules for country roads. Turn right and walk, on the left side of the road facing on-coming traffic, about .25 miles to the parking lot of the volunteer fire station. At this point you have a great view of Tower Rock.</li><li>2. Have the students answer the first few questions. Pass out the maps and help the students get oriented. By examining the map they should be able to answer the next few questions. (Tower Rock is 3335 ft. high, the vertical face is about 550 ft, and it is 2000 ft. from the valley floor to the top of the rock). After the "Talus slope" question, return to the Cispus Center.</li><li>3. Take the group out to a gravel bar on the Cispus River, it will give them a good vantage point to complete the rest of the questions ( the questions can be completed back at the center if you are running out of time).</li></ol>

## ROCKS + WATER Questions

The geology and geography of the area around Cispus is as interesting as any in Washington State. We are just south of an old volcano and the largest mountain in the Cascade Range--Mt. Rainier. There are two other volcanoes sitting atop the Cascade Range even closer to Cispus. **NAME** these other two volcanoes:

Mt. \_\_\_\_\_, and Mt. \_\_\_\_\_

A material known as pumice can be found all over the area from past eruptions of mostly Mt. \_\_\_\_\_, whose last eruption was in (date) \_\_\_\_\_.

**WHAT** is the test you can run to see if it really is pumice?

**HOW** do you suppose pumice was formed?

**HOW** did it get here?

Very visible throughout much of this valley is Tower Rock. **LOOKING** at the USGS Tower Rock quadrangle map, find the Cispus Center. Nearby is Tower Rock. At its peak, **WHAT** is the elevation of Tower Rock? (The contour interval between the brown contour lines on the map is 40 ft. That means that the contour line on either side of a single line shows a spot 40 ft. higher or lower. If these lines are spaced wide, an inch or so, apart then the land is fairly flat.)  
\_\_\_\_\_ft.

Tower Rock is a lacolith--an intrusion of molten rock under the surface of the earth. With the advance of the Ice Age large glaciers lifted many valleys and abraded away the face of the mountain, leaving a new vertical cliff. **DRAW** in the space below what you think this creation process looks like:

**IF** the contour lines are placed close together then the slope is \_\_\_\_\_.  
Compare these kinds of areas on the map.

**IF** the contour lines are spaced so close together that they seem to merge, you have a \_\_\_\_\_. The vertical face of Tower Rock measures about \_\_\_\_\_ feet, and is about \_\_\_\_\_ feet from the valley floor to the top of Tower Rock.

At the base of the vertical face of Tower Rock is a slope of loose boulders. This is called a *talus slope*. **HOW** do you suppose it got there?

**WHAT** is this weathering process called?

The Cispus River Valley was formed by two entirely different forces of nature (both involve water). **NAME** these two forces: \_\_\_\_\_, and \_\_\_\_\_

These forces create two distinct types of valley formations:

V-shaped valleys are formed by \_\_\_\_\_.

U-shaped valleys are formed by \_\_\_\_\_.

The forces of nature have altered the landscape in many ways in this region. **NAME** at least 3 ways in which this might happen: \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

**WHAT** evidence do you see of past flooding in the area between the upper Cispus Center buildings and the Cispus River?

**DRAW A PROFILE** from the Cispus Center flagpole to the Cispus River:  
Flagpole X

X  
Cispus River

**WHAT** natural force is still at work in this beautiful river valley?

# **WATER INGREDIENTS**

**Focus** To develop some skills in collecting and interpreting data about the water environment and applying that data in discussion.  
*Adapted from the Investigating Your Environment Series, U.S. Forest Service.*

**Group Size** Maximum 30

**Time Required** 1-5 hours

**Materials** Writing instruments  
Blank sheets of paper (*recording answers & observations*)  
Clipboard (*writing surface*)  
Handouts:  
*Describing a Watershed*  
*Observing the Water Environment*  
*Observing and Collecting Aquatic Life*  
*Predicting Water Characteristics*  
*Testing Your Predictions*  
*Determining Water Amounts*  
*(streamflow, lake & pond volume)*  
*Discussion Questions*

**Physical Setting** Yellowjacket Ponds and Yellowjacket Creek

**Process** 1. Follow the instructions on the **WATER INGREDIENTS** handouts. Additional materials for each exercise are listed on the individual handouts--they all require the materials listed on this page. If your time is limited you may want to select only a few of the exercises to complete.

2. Answer the discussion questions for **WATER INGREDIENTS** that pertain to each exercise you choose.



## *Observing the Water Environment*

**Materials:** Handout: *Discussion Questions*

*As you approach the water, record your observations (10-15 minutes).*

**Plants:**

**Animals:**

**Air:**

**Rocks:**

**Water:**

## *Discussion Questions*

### *Describing a Watershed*

1. What activities could change the characteristics of the water?
2. What would be some reasons for having people look at watershed boundaries on a map before investigating a stream in that watershed?

### *Observing the Water Environment*

1. What did you notice about the stream or pond environment?
2. What plants were growing along the gravel bar or banks?
3. Why are/are not large trees growing on the gravel bar or banks?
4. What did you notice about the rocks?
5. Where did you see the bigger rocks, and where did you see the smaller ones? Why do think they were there?

### *Observing and Collecting Aquatic Life*

1. What animals did you find? Compile a class list (preferably on a chart), recording the information collected by each student or group of students.
2. Where did you find most of the specimens?
3. What similarities are there among the specimens?
4. What differences did you find?
5. What classification system could you use to classify the aquatic animals you found?
6. What other life would you expect to find in this stream?
7. Would you be likely to find the same specimens in a different aquatic environment? Why or why not?

## ***Predicting Water Characteristics based on aquatic life***

1. As a group, discuss the range of predictions.
2. What criteria did you use to arrive at your predictions?
3. How can you test out our predictions?

## ***Testing Your Predictions***

1. How did the test results compare with your predictions?
2. What might account for any differences in the results from each group?
3. Under what conditions might you expect to get different results than you did today?
4. What can you say about the quality of the water in this pond/stream so far?
5. What would you need to know to decide whether or not this water is potable?

## ***Determining Water Amounts***

1. What results did you get? Compare group results.
2. How did your prediction compare with your calculations?
3. What would happen to this environment if we piped all the water at this location into a community?
4. If you were going to use some of this water, how would you determine the amount to be left to maintain the environment?
5. What things might affect the amount of water needed to maintain the environment?
6. What else would you need to do, if you wanted a more accurate result, to determine the adequacy for a community water supply?

## ***Summary Questions***

1. What did you find out about water from our investigations today?
2. Why is water important to the ecosystem?
3. How can you summarize our discussions and investigations?
4. What methods and processes did we use in our investigations today?

5. Describe in writing how you feel about man's effect on the aquatic environment at this site.
6. Describe at least one action you can take in your everyday life to help improve the way water is managed.

in your home: \_\_\_\_\_

in your community: \_\_\_\_\_

in your consumer habits: \_\_\_\_\_

7. Describe the benefits of each action in question 6.

## *Observing and Collecting Aquatic Life*

**Materials:** Collecting equipment (*screens, jelly cups, nets, etc.*)  
White dishpans  
Glass observation jars  
Identification book(*lets*) for aquatic organisms  
Handout: *Some Sub-surface Freshwater Organisms & Some Aquatic Insects I.D. sheet*  
*Discussion Questions*

1. As a class, or in smaller groups, discuss these questions before you begin collecting specimens. Write down the answers to compare with your actual findings.

What kind of life would you expect to find in this water?

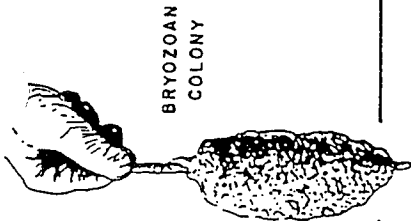
Where would you expect to find animals in this water environment?

What are some guidelines that you need to consider in collecting aquatic life to cause the least impact on the environment? ( consider: keeping animals for observation, overturned rocks, what to do with specimens after the exercise, vegetation, etc.)

2. Using collecting equipment, collect as many kinds of aquatic animals as possible with minimal disturbance to the aquatic habitat. Place the organisms into the white dishpans and glass jars for observation (keep in a cool place). Using the identification guides, spend the next 20-30 minutes identifying what you have found. List or sketch your findings below:

Where was it found?	Name or Sketch	No. Found

SOME SUB-SURFACE FRESH WATER ORGANISMS



BRYOZOAN COLONY



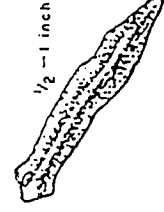
LEECH



1/2 - 2 inches

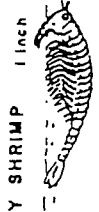


FRESH WATER SHRIMP



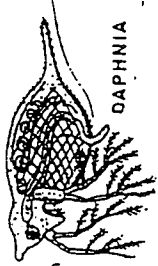
PLANARIA

1/2 - 1 inch



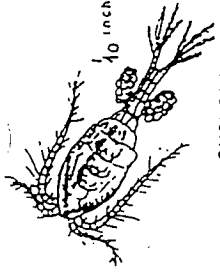
FAIRY SHRIMP

1 inch



DAPHNIA

1/16 inch



CYCLOPS

1/10 inch

SOME AQUATIC INSECTS

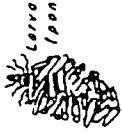


Larva (stream form)

9/10 inch



Adult

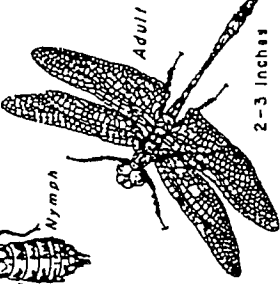


Larva (pond form)

CADDISFLY



Nymph



Adult

2-3 inches

DRAGONFLY



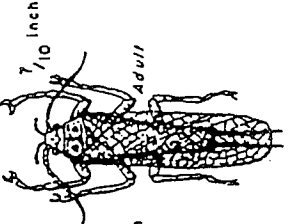
4/10 inch

WATER STRIDER



4/10 inch

WATER BOATMAN



Nymph

7/10 inch

STONEFLY



6/10 inch

WHIRLIGIG BEETLE



Nymph



Adult

1 1/10 inches

MAYFLY

MOSQUITO



Larva

3/10 inch

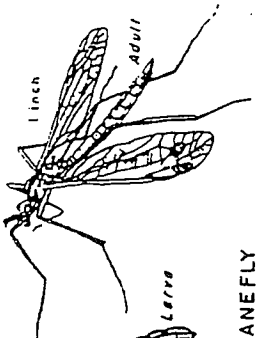


Adult

DRAGONFLY

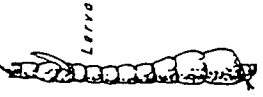


Larva



1 inch

CRANEFLY



Larva



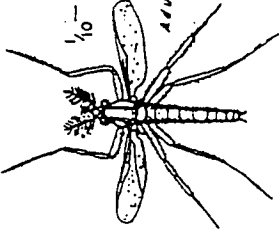
3/10 inch

Adult

BLACK FLY



Larva



1/10 - 9/10 inch

Adult

MIDGE

## *Predicting Water Characteristics based on aquatic life*

**Materials:** Results from *Observing and Collecting Aquatic Life*  
**Handout:** *Discussion Questions*

1. Based on the aquatic organisms you found, and the charts below in Analyzing Data, predict the following characteristics of this creek/pond:

The water temperature will be \_\_\_\_\_, because \_\_\_\_\_

The air temperature will be \_\_\_\_\_, because \_\_\_\_\_

The pH will be \_\_\_\_\_, because \_\_\_\_\_

The dissolved O<sub>2</sub> count will be \_\_\_\_\_, because \_\_\_\_\_

I can see about \_\_\_\_\_ feet down into the water.

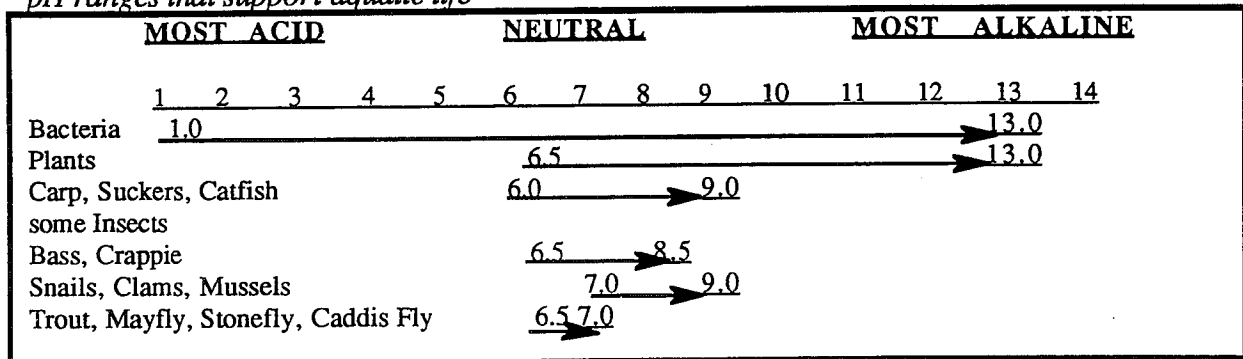
The color of the water is \_\_\_\_\_

### **ANALYZING DATA:**

*Approximate temperature ranges required for certain organisms*

Temperature (Fahrenheit)	Examples of Life
Greater than 68 degrees (high range)	much plant life, many fish diseases most bass, crappie, bluegill, carp, catfish, caddis fly
55-68 degrees (middle range)	some plant life, some fish diseases; salmon, trout, stone fly, mayfly, caddis fly, water beetle
less than 55 degrees (low range)	trout, caddis fly, stone fly, mayfly

### *pH ranges that support aquatic life*



### *dissolved oxygen requirements for native fish and other aquatic life*

Examples of Life	D.O. in parts/million or milligrams/liter
Cold-water organisms, including salmon and trout (below 68 degrees F); spawning, growth and well-being (caddisfly, stone fly, mayfly).....	6 p/m and above
Warm-water organisms, including game fish : bass, crappie catfish and some carp (above 68 degrees F). Growth and well-being (some caddisfly).....	5 p/m and above 45

## *Testing Your Predictions*

**Materials:** Hach O<sub>2</sub> pH Testing Kit (*or equivalent*)  
 Secchi disk  
 Results from *Predicting Water Characteristics*  
 Handouts: Table A  
 Table B  
 Table C  
*Discussion Questions*

1. We can test out the predictions we just made, using O<sub>2</sub> pH testing kits. Instructions are inside the lid. Work in groups of 5-6. Each group will have one kit to use. There are a lot of jobs to be done in testing (clipping, squirting, swirling, dipping, counting, reading, etc.), so make sure that everyone in the group has a job to do.
2. Using the water test kit, determine the water and air temperature, dissolved oxygen count, and pH of the stream or pond. Record data below.

Name of stream or pond:

Location of water sample (edge, middle, bottom, bank, etc)	Time Taken	Temperature		pH		Useable Oxygen (ppm) (mg/liter)	
		water/air my pred.	water/air actual test	my pred.	actual test	my pred.	actual test

3. Refer to your data from *Predicting Water Characteristics* and Table a. Based on this information, what can you say about this water (water productivity and color)?
  
4. Transparency of lake and pond waters can be roughly determined by the use of a Secchi disk (a plate 8" in diameter, painted white and black in alternate quadrants), which is lowered on a line into the water until it can no longer be seen. Very little sunlight penetrates below the point at which the disk disappears. Lower the Secchi disk into the water until it can no longer be seen. Measure depth from the surface of the water to the disk: \_\_\_\_\_ ft. Compare this measurement to your prediction: \_\_\_\_\_ ft. Based on the depth of the Secchi disk and Table b, what can you say about the water?
  
6. Based on the temperatures you recorded for your pond, the season of year and the information in Table c, describe what you think is happening in the water now:



**Table a: Relationships of water color to productivity:**

The quantity of life that may be present in any given body of water at any given time is often referred to as the "productivity." A water of low productivity is a poor water, biologically speaking, but is a clean water and desirable as a water supply or for recreational use. A productive water may be either a nuisance to man or it may be highly desirable. Foul odors and weed-choked waterways are usually branded a nuisance; however, bumper crops of bass, catfish or sunfish may be the result and are highly desirable.

Color of Water	Probable Cause	Fish Food Productivity
Clear	Absence of algae and microorganisms	Low
Greenish hue	Blue-green algae	Moderate
Yellow to yellow-brown	Diatoms (microscopic, one-celled algae)	Moderately high
Red	Micro-crustaceans	High
Dark Brown	Peat, Humus	Low

**GEOLOGICAL FACTORS HAVING BEARING ON COLOR**

In limestone geology- Green	Abundant calcium	Moderate
In volcanic geology- Yellow-green, Red	Abundant sulfur Abundant iron	Low Moderate

**Table b: Relationship of Water Clarity to Fish Food Production and Watershed Condition**

Depth you can see into water (Secchi disk reading)	Interpretations of Depth Readings	
	Fish Food Production (If reasons for degree of clarity are biological- (algae, etc.)	Condition of Watershed above Water Readings (If reasons for degree of clarity are physical- soil siltation, etc.)
0" - 6"	Most productive waters for fish food Maximum oxygen from photosynthesis (greatest diurnal variation) Maximum algae growth	Poor condition due to soil runoff, slides, etc.
24"	Least productive for fish food Minimum oxygen from photosynthesis (least diurnal variation) Minimum algae growth	May indicate better condition because of vegetation cover - more stable soil, etc..

**Table c: Temperature Layering in Ponds - Lakes**

In summer, the surface water absorbs the sun's heat and warms faster than the water below. The warmed water is lighter than the cold water, so it floats on the cool layers. By midsummer there are three distinct layers.

During the summer, mixing or circulation is prevented by these stratified layers of water which act as a barrier.

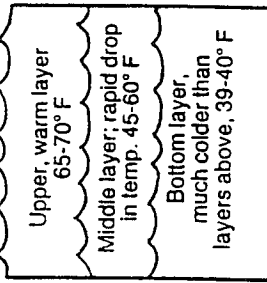
The upper layer of water cools in autumn until it approaches the temperature of the water in the middle and lower layers. Aided by winds, the surface water sinks causing circulation from top-to bottom.

In winter, the cold surface water continues to sink and the water becomes stagnated, photosynthesis slows, and oxygen levels drop.

In the spring, aided by winds, another circulation and mixing occurs, called the "Spring Overturn."

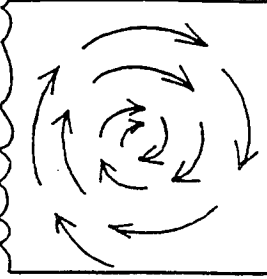
**1. Seasonal Change Diagram**

Summer



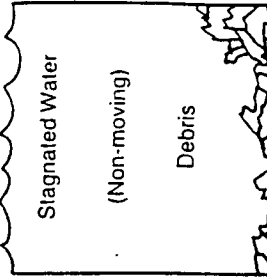
During the summer, fish and aquatic life are most active.

Spring and Fall



During spring and fall overturns the temperature of the water is equalized throughout the lake. Fishes and other animals are more active than in winter but less active than in summer.

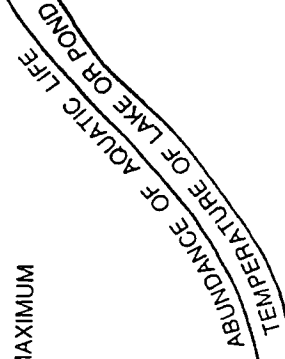
Winter



Activity is greatly reduced during the winter. Many animals hibernate in the mud or debris at the bottom.

**2. Seasonal Change Chart**

MAXIMUM



MINIMUM

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

## Determining Water Amounts Streamflow

**Materials:** Measuring tape  
 2 stakes (*distance markers*)  
 5-6" stick  
 Handout: *Discussion Questions*

*Before beginning this exercise, discuss these questions as a class or in groups:*

How many people do you think could live off the water in this stream (domestic water use only)?

What measurements do we need to know in order to determine the amount of water in this stream? Discuss how you would make the different measurements.

1. Measure and mark a 100' distance along a straight section of your stream. If you can't find a 100' section, use 25' or 50' (and multiply the results by 4 or 2). Throw your stick in the water above the upstream marker. Record below the number of seconds it takes to float downstream between the markers. Now divide the 100' distance by the total seconds it took the stick to float between the stakes. Repeat the stick exercise three times and use the average time.

First measurement    100 ft ÷ (total seconds to float 100 ft) =  $\frac{\text{ft}}{\text{(# of feet stick floated each second)}}$  ft/second

Second measurement    100 ft ÷ (total seconds to float 100 ft) =  $\frac{\text{ft}}{\text{(# of feet stick floated each second)}}$  ft/second

Third measurement    100 ft ÷ (total seconds to float 100 ft) =  $\frac{\text{ft}}{\text{(# of feet stick floated each second)}}$  ft/second

Total    (ft/second) ÷ 3 = \_\_\_\_\_ ft/second average

2. Find the average width of your section of the stream. Measure the width of the stream at 3 places within the 100' area. Divide the total by 3 to get the average width of the stream.

First measurement \_\_\_\_\_ ft

Second measurement \_\_\_\_\_ ft

Third measurement \_\_\_\_\_ ft

Total \_\_\_\_\_ ft. ÷ 3 =  $\frac{\text{ft}}{\text{(average width)}}$

3. Find the average depth of your section of the stream. Measure the depth of the stream in 3 places, going across in a straight line (near bank, middle, far bank). Divide the total by 4 to get the average depth of the stream (the reason you take 3 depth measurements then divide by 4, is to take into account the shallow areas of the stream).

*First measurement* \_\_\_\_\_ ft

*Second measurement* \_\_\_\_\_ ft

*Third measurement* \_\_\_\_\_ ft

*Total* \_\_\_\_\_ ft = \_\_\_\_\_ ft (average depth)  
4

4. Find the cubic feet of water (enough water to fill a container 1' x 1' x 1', or 7.48 gallons) per second. Multiply the average width, average depth, and the number of feet the stick floated each second.

\_\_\_\_\_ ft X \_\_\_\_\_ ft X \_\_\_\_\_ = \_\_\_\_\_  
(Average width) (Average depth) (# of ft/second) (Cubic ft water/second)

5. In order to find out how many people could live from the water in this stream, complete the following calculations.

(A) \_\_\_\_\_ X 7.48 = \_\_\_\_\_  
(Stream flow in cu. ft/sec) (Gallons in 1 cu. ft of water) (Gallons of water/second)

(B) \_\_\_\_\_ X 60 = \_\_\_\_\_  
(Gallons of water/second) (seconds in a minute) (Gallons of water/minute)

(C) \_\_\_\_\_ X \_\_\_\_\_ = \_\_\_\_\_  
(Gallons of water/minute) (# minutes in a day) (Total gallons of water/day)

(D) (Total gallons of water/day) = \_\_\_\_\_  
\*200 gallons (Total # of people who could live from water in this stream)

*\*The average person uses about 200 gallons of water a day for home use. This does not reflect each person's share of water used for industrial, public services, and commercial. (U.S. Office of Education figures.)*

## Determining Water Amounts Volume of Lake or Pond

**Materials:** Measuring tape  
Handout: *Discussion Questions*

*Before beginning this exercise, discuss these questions as a class or in groups:*

How many people do you think could live off the water in this pond (domestic water use only)?

What measurements do we need to know in order to determine the amount of water in this pond? Discuss how you would make the different measurements.

1. Find the average diameter of the pond by measuring the length and width. You may have to take several length and width measurements and average them.

Pond width \_\_\_\_\_ ft

Pond length \_\_\_\_\_ ft

$$\text{Total} \frac{\text{_____ ft}}{\text{_____}} + 2 = \frac{\text{_____}}{\text{(average diameter)}} \text{ ft.}$$

$$\frac{\text{_____ ft}}{\text{(average diameter)}} + 2 = \frac{\text{_____}}{\text{(radius)}} \text{ ft}$$

$$\frac{\text{_____}}{\text{(radius)}} \text{ ft} \times \frac{\text{_____}}{\text{(radius)}} \text{ ft} \times 3.14 = \frac{\text{_____}}{\text{(surface area)}} \text{ sq. ft.}$$

2. Find the average depth of the pond or lake. Measure the depth in 3 places in a line (transect) across the body of water, as near the middle as possible. Add these depths and divide by 4 to get the average depth. The reason you take 3 depth measurements then divide by 4 is to take into account the shallow areas of the pond. If additional accuracy is desired, repeat this process along additional transects and average the results.

First measurement \_\_\_\_\_ ft

Second measurement \_\_\_\_\_ ft

Third measurement \_\_\_\_\_ ft

$$\text{Total} \text{_____ ft} \div 4 = \frac{\text{_____}}{\text{(average depth)}} \text{ ft}$$

3. Compute the number of gallons of water in the pond or lake.

*Method I*

$$(A) \frac{\text{_____ sq ft}}{\text{(surface area of pond/lake)}} \times \frac{\text{_____ ft}}{\text{(average depth)}} = \frac{\text{_____ cu. ft.}}{\text{(volume in cubic feet)}}$$

$$(B) \frac{\text{_____ cu. ft.}}{\text{(volume in cubic feet)}} \times 7.48 = \frac{\text{_____ gallons}}{\text{(gallons of water)}}$$

*Method II*

$$(A) \frac{\text{_____ sq ft}}{\text{(surface area of pond/lake)}} \times \frac{\text{_____ ft}}{\text{(average depth)}} = \frac{\text{_____ cu. ft.}}{\text{(volume in cubic feet)}}$$

$$(B) \frac{\text{(volume) cu.ft.}}{\text{_____}} \div \frac{43,560 \text{ sq.ft.}}{\text{in an acre}} = \frac{\text{_____}}{\text{acre-feet of water}}$$

$$(C) \frac{\text{_____}}{\text{(acre-feet)}} \times \frac{395,900}{\text{(gal/acre-feet)}} = \frac{\text{_____}}{\text{(gallons of pond water)}}$$

5. In order to find out how many people could get their domestic needs for one day from the water in the pond, complete the following calculations:

$$\frac{\text{(gallons of water in the lake/pond)}}{\text{**200}} = \frac{\text{_____}}{\text{(total \# of people who could live one day from this water)}}$$

*\*A cubic foot of water is the water that can be held in a 1' x 1' x 1' container--or 7.48 gallons.*

*\*\*The average person uses about 200 gallons of water a day for home use. This does not reflect each person's share of water used for industrial, public, and commercial services. (U.S. Office of Education figures.)*

## *Describing a Watershed*

**Materials:** Topographic maps (*of Yellowjacket Ponds/Yellowjacket Creek area*)  
Aerial photos (*optional*)  
Handout: ***What is a Watershed?***

1. Describe what you think a watershed is:

2. In small groups of 5-6, use the maps and photos to determine the location where we will be collecting our water information. Find your location on the creek/pond/lake on the map. Where does the water come from (trace upstream to its source)? Where does it go?

3. Draw a line around the watershed boundaries. We're in the \_\_\_\_\_  
creek/lake/pond watershed.

4. What activities in this watershed might change the characteristics of this water?

Activity	Ways the activity might change the characteristics of the water

## What is a watershed?

"Watershed" is a new term to many people. The increasing use of soil and water conservation measures for watershed protection and flood prevention is bringing the term into more common use. Its definition is almost as simple as the well-known phrase "water runs downhill." The drainboard that carries rinse water into your kitchen sink can be compared to a watershed. On land, water that does not evaporate or soak into the soil usually drains into ditches, streams, marshes, or lakes. The land area from which the water drains down to a given point is a watershed.

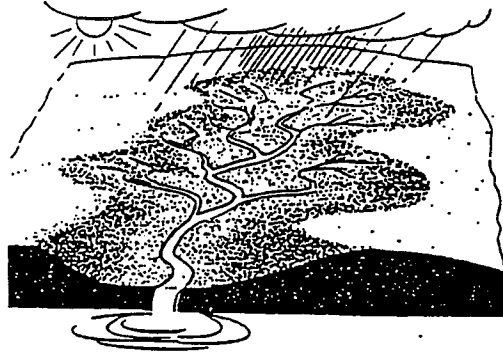


Diagram of a watershed showing the drainage pattern.

When you were a small child, you probably had a favorite mud puddle in which you liked to play. The part of the yard from which the water drained into the puddle was its watershed. Possibly a small stream ran by your house. It may have been dry most of the year, or it may have flowed continuously. Water from a few acres drained into that little stream. Those few acres were its watershed. That small stream and others like it ran into a larger one. The land areas drained by the small streams made up the watershed of the larger stream into which they flowed. Small watersheds make up the larger ones. The Mississippi River, for example, drains a watershed of about 1,243,000 square miles.

### **Vocabulary:**

Can you define these terms?

*Precipitation:*

*Runoff:*

*Streamflow:*

*Wetland:*

*Watershed boundaries:*

*Potable:*

*Coliform:*

# WETSID E STORY

- Focus** To understand human impacts on an ecosystem that is dominated by animals and plants. To relate and see issues from another point of view, by playing a character.
- Group Size** 5 primary characters, up to 20 additional character "extras"
- Time Required** 30 minutes (*plus time to construct puppets/costumes, stage, and practice*)
- Materials** Script Paper bags (*puppets, costumes*)  
Six-pack ring (*Dudley*) Fish (*Harry*)  
Scarf and hat (*Gilbert*) Buck teeth (*Bucky*)
- Physical Setting** Indoors (*with the primary characters in front of the group*), or outdoors in good weather.
- Process** *The script can be followed as a role play, or hand puppets can be made from bags and materials. Besides the five primary characters (Patty the Presenter, Harry the Heron, Dudley the Duck, Bucky the Beaver, and Gilbert the Goose), students can also be trees, reeds, background animals, and members of the stage crew.*
1. The play begins with an introduction to the wetland by Patty the Presenter about the wetland and her animal friends that live there. This is a story about their struggles with human impacts on their home.
- Discussion:**  
*Patty also wraps up with a discussion about the plight of her friends and efforts we can make to have less impact on their homes.*
1. After the play or puppet show brainstorm about other animal homes, the ways that human behavior impacts them, and how we can lessen those impacts.
  2. Compare human impacts on animal homes to the destruction of student's homes.
  3. Discuss lower impact behaviors such as packing out garbage when you return home from hiking or camping, staying on trails, and respecting animals and their habitats.



# Wetside Story

**CHARACTERS:**

Harry, the Heron

Dudley, the Duck

Bucky, the Beaver

Gilbert, the Goose

Patty, the Presenter

**PLAYED BY:**

PATTY: A visiting goose is talking to some other animals about what a great place their home is to visit. He wishes he could stay but he is compelled to fly south each winter and north each summer.

HARRY (*stretching his long neck high*): What a beautiful day!!

GILBERT: Morning Harry!! I bet every day is beautiful in your marsh!

HARRY: Oh yes, but it's very fragile and threatened by human impacts such as pollution, and construction.

GILBERT: Well, I bet it's not as dangerous as migrating twice a year, dodging airplanes and buildings. At least you get to stay at home!

HARRY: You should ask Dudley about that! Yesterday I thought he had a new necklace but it turns out that he was diving for food and came up with this plastic ring around his neck. Bucky was going to try to chew it off today.

*(Harry sees a fish and goes for it with his beak. Gilbert floats away and sees Dudley.)*

GILBERT: Dudley, how are you? I heard about your new neckwear, have you seen Bucky about getting it off?

DUDLEY: He went to sharpen his teeth on a log. What a horrible feeling to have this thing wrapped around my neck, I was afraid I wasn't going to be able to eat or breathe! I hope Bucky can chew through it.

GILBERT: Do you know what it is or how it got here?

DUDLEY: Well Bucky said he had seen them before by piles of other materials like cans and bottles and that it's human pollution!

GILBERT: Oh! I bet they didn't mean to hurt anybody.

DUDLEY: Yeah well, they shouldn't have left their garbage to cause problems for others!! Great! Here comes Bucky!

BUCKY: Hi Gilbert! Okay Dudley are you ready?

DUDLEY: Yes, I'm very ready!!

*(Bucky leans toward Dudley's neck and nibbles on the plastic ring until he chews through. Dudley shakes his head and rolls his neck.)*

DUDLEY: I'm free, I'm free!!! Thank you so much Bucky, I must go show my family!

*(Dudley swims off happily)*

GILBERT: That was great Bucky, you're such a great friend! That makes this beautiful day even brighter!

BUCKY: I'm always glad to help a friend. I wish everyone was as considerate. This morning I found one of my dams destroyed and there was a large hiking boot print next to it!

GILBERT: Oh no! They didn't leave more garbage did they? Dudley told me about what happened last time.

BUCKY: Well, not too much this time! I sure felt bad for Dudley with that plastic ring stuck around his neck. I've heard of birds who died because they couldn't breathe with one of those things stuck on their neck. I was sure glad to help him out. I still remember our worst tragedy, when Harry lost his family, what a shame!

GILBERT: How did that happen?

BUCKY: Well, Harry and his wife had a nest set up and they had laid two eggs in it. Only one egg hatched, and then the weak baby Heron only lived for a week. Soon after Mrs. Heron died too. Harry sat by the nest for days. Then he noticed a smell and followed it to a flow of water trickling into the marsh. It turns out it was heavily polluted water coming from town businesses. I built a strong dam to filter the water before it comes into our marsh.

GILBERT: Oh my gosh, that's horrible!!

BUCKY: Yeah, it's not like it used to be. We used to all have bigger families and there was much more food.

GILBERT: Well, how can you teach these humans about the harm they're doing to your home?

BUCKY: Well, some humans are very gentle to our home. They just stop by to see birds, and don't leave garbage or break up my dams. Other humans come out to test our waters and count the different species. I think these people will have to educate their fellow humans about their influence on our home. Teaching humans not to pollute, damage, or take away our home is the only way we will be able to continue sharing this planet.

GILBERT: Wow, I didn't realize that humans had an impact on our homes, although there seem to be many more of them around than there used to be. I guess there are so many of them that they don't all know much about our homes yet.

BUCKY: No, many of the humans don't know about their impacts on our homes, but the ones that do are trying to help by educating others so we can all live in harmony.

GILBERT: Here come Harry and Dudley!

ALL: Good-bye everyone! Remember us the next time you visit wetlands!

PATTY: Let's brainstorm about animal homes, and ways we can lessen our impact on them!

## ***WHAT KIND OF SHED DO YOU PUT WATER IN?***

- Focus** To develop the concept of a watershed using guided inquiry.
- Group Size** Entire class
- Time Required** 15-30 minutes
- Materials** Topographical map of the Cispus area  
Pencil  
Clipboard  
Crayons
- Physical Setting** The Cispus Learning Center's Water Room, and Yellowjacket Creek or the Cispus River bank
- Process**
1. Students will look at the relief map in the Water Room and, through guided inquiry, develop the concept that water runs down hill and gathers at the low spots. A watershed is the area which feeds that low spot.
  2. Go out to Yellowjacket Creek or Cispus River bed, in an area where students can see the surrounding hills. Using a topographical map, color in the watershed for Yellowjacket Creek and/or the Cispus River.

# ***YELLOWJACKET POND DEVELOPMENT, INC.***

<b>Focus</b>	To use creative problem solving and simulation in commercializing a wetland area.
<b>Group Size</b>	Entire class
<b>Time Required</b>	30-60 minutes
<b>Materials</b>	<i>Per group:</i> Map Building and road icons sheet Paste/glue Yellowjacket Ponds cut-out sheet Construction paper Scissors Pencil
<b>Physical Setting</b>	Main room in the education building
<b>Process</b>	<ol style="list-style-type: none"><li>1. Brief the counselors before beginning this activity.</li><li>2. Set the stage by giving general directions: each group is an interest group (groups should be made up of one or two cabin groups (6-12 students). The group decides where to place all of the components of a community, where materials are, what to do with the materials and where to put the finished product. The students will cut and paste the components of Yellowjacket Creek Development onto a sheet of construction paper according to their decisions.</li><li>3. Each group will be lead by a high school counselor who gathers the materials and <i>facilitates</i> the discussion about where everything should go.</li><li>4. When everyone is finished planning, tape the posters up. Have a spokesperson for each group tell where they put things and why.</li></ol>

**Extensions:**

*The only limiting factors on extensions are time and imagination. A couple of possible extensions are:*

1. A representative from each interest group meet to arrive at a compromise solution, which they then present to the entire group.
2. Who, or what, lives downstream from Yellowjacket Ponds? What effect does the outflow from the pond have on their lives?

Interest groups:

Farmers (field crops and dairy farms)  
Small businesses (filling station, cafe, store)  
Loggers and log storage areas  
Utilities (power, sewage, water, fuel, garbage)  
Parks department  
Highways department  
Home owners  
Emergency facilities (medical, fire, police)

Possible Pros and Cons for Interest Groups:

**PROS**

**CONS**

**Farms**

production of food  
part of the local economy

fertilizers and insecticides  
pollution, cause of erosion

**Businesses**

part of the local economy

uses extra water, produces extra  
waste--creating water pollution

**Homes**

provide protection and  
a sense of roots

produce additional water usage  
and waste production

