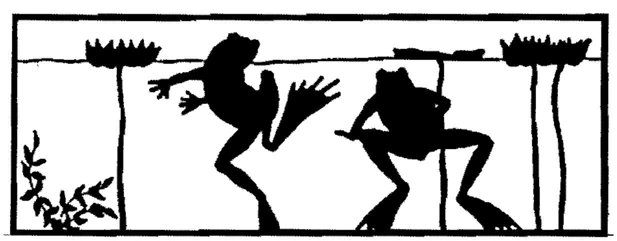
DIPPING INTO CREEKS

These activities for exploring and learning
about creeks bring your science lessons to life.

Creeks naturally attract children; they are just about the right size of water for easy exploration. With flowing water, wooded banks, a variety of wildlife—combined with ready made fascination—local creeks are an ideal resource for teaching science concepts. The material in this curriculum is designed to encourage educators of all types to use creeks as classrooms so that more people will learn about them, learn to value them—and work to protect them.



These aquatic and riparian focused activities were developed by
the **Sacramento Chapter of the Urban Creeks Council**

Updated and expanded 1998

Levels:
Grades K-8

Subjects:
Science, Language Arts

Concepts:
- Creeks contain numerous habitats that support diverse populations of organisms.
- Plant and animal populations exhibit interrelated cycles of growth and decline.

Objectives:
Students will:
1. Observe life at the creek.
2. Identify plants and animals that live in a creek ecosystem.

Skills:
Observing
Comparing
Organizing

California Science Framework Theme:
Patterns of Change
Scale and Structure
Systems and Interaction

Materials:
First Aid kit
Clip boards
Recording sheets
Simple collecting equipment
Field guides

Time Considerations:
Preparation: One to three 20 - 45 minute periods
Activity: Once a month or as many visits to the creek as possible over a year period

Getting Ready In The Classroom

A teacher or leader planning to take a group to enjoy and explore a creek should visit the area first to find the best and safest access.

*During times of heavy rainfall, creek flows can be very deep and hazardous. These are **not** good times for exploring.*

Introduce Your Creek:

What is its name?
What is the origin of the name?
Find it on a map. Where does it start? Where does it go?
What do you know about your creek now?
How is the land around it used?
Who owns the land where the creek is located?
Do storm drains flow into your creek?
Has the creek changed over time?
What might you expect to find?

Introduce The Creek Community:

Become familiar with the terms that you will be using in your activities. Define:
- organism,
- aquatic community,
- adaptations,
- riparian habitat ... and the words in the glossary.

Introduce aquatic food chains and webs:
- list the aquatic animals most likely to be found,
- explain niche and adaptation,
- discuss the niche, and adaptations to that niche for the organisms you might see.

Introduce Equipment:

Look over the equipment that you will use on your trip to the creek.
- explain how to use it and take care of it.

Establish Rules For Safe Creek-Side Behavior:

Discuss and list, this should include:
- Respect the wildlife and plants. This is their home.
- Be careful when collecting creek critters. They are fragile.
- Rocks which are moved should be gently returned to their original locations.

. . . continued next page

- Leave your creek site cleaner each time you visit.
- Be sure to have permission when entering onto privately owned land.
- Behave safely at all times.
- Listen, look and learn while visiting your creek site. Use quiet voices and walk softly.
- Take only memories, drawings, poetry, and photograph; leave only footprints.

Safety Rules

- Bring a first aid kit.
- Work with a "buddy".
- Be prepared for unpredictable weather.
- Wear sturdy footwear when wading in creeks. Try to stay at knee depth or less.
- Avoid stepping on slippery rocks or logs.
- Wear gloves when removing debris from the creek. Wash hands afterwards.
- Wear goggles when using test chemicals.
- Stay off of unstable, steep banks.

Start a Creek Notebook

Have each student keep a record or journal of what he or she saw, discovered, experienced and accomplished during the course of your creek explorations.

Review Your Plans:

✓ Plan to have facilities for washing up. Provide a way for children to wash their hands before handling any food.
✓ Go over your schedule of activities, review equipment use and safety rules.
✓ Bring a First Aid kit.

At the Creek

Watch Out For Poison Oak

Poison Oak is common along our wooded creeks. Make sure that everyone is able to identify the plant, when the leaves are out and when they have fallen, and will avoid touching any part of it.

Dress Appropriately

Exploring a creek often means getting muddy and wet, and creek beds some times have sharp cans and broken glass.

- wear old clothes that can get dirty,
- wear old shoes that can get wet and protect your feet,
- wear gloves if you are going to pick-up trash.

Take Time:

It's best to start with a quiet reflective activity to let students absorb the character of the creekside environment. A simple technique would be to supply individual students with something to write on. Have them select a quiet spot away from others, and record their observations. These observations may include plants, animals—and animal signs, the amount of shade, soil and rock types, sounds —or anything they deem interesting. Encourage them to use all of their senses and record what they hear, smell, and feel as well as see. Here are some things to look for and do:

- Watch for animal tracks in the sand, nests in the trees and holes in the ground.
- Look for aquatic life. Are there any insects in or on the water? Are there other invertebrates?
- Record the plants that you see along the creek banks by drawing their leaves and general shape.
- Is there plant life in the creek itself?
- Examine the creek channel. Are there signs of erosion along the banks?
- Is there trash and litter along the banks?
- What is the water like in your creek? Is it muddy, cloudy, clear or dark? Is it swift or slow?
- Does the water smell?
- Collect water samples in jars and observe the sediments.

These observation records, in addition to serving as an introduction to the creek environment, can serve as a basis for discussing the variety of creekside habitats and microhabitats and could lead into discussion and hypothesis as to why there is such diversity. These records can also be compared to similar observations made in a different environment, such as the school yard.

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Following Up

Observing the creek environment and its plant and animal life, learning about a creek ecosystem, investigating its water quality — all these activities will very likely elicit strong attitudes about the value of creeks in our neighborhoods. Teachers and youth leaders may wish to follow through with some activities that turn these attitudes into action.

- What did your group like best about "their" creek?
- What action might reinforce those values?
- What problems did your group find with "your" creek?
- What steps could you take to solve those problems?

Planning For Action:

- Set long range and short term goals for your creek.
  A long term goal could be to revegetate a creek.
  A short term goal would be to clear the creek of trash and litter.

- Plan specific tasks, such as:

  - Remove trash and litter from your creek —but be sure to leave logs and brush that provide habitat for aquatic creatures.

  - Make a pictorial record of the changes that you make in your adopted creek, perhaps a class or group mural or art show.

  - Help restore or revegetate your creek.
    (See the appendix for a list of agencies that can provide information.)

  - Find ways to improve wildlife habitat.
    (Contact the Department of Fish and Game.)

  - Mark the storm drains that flow to your creek with "no dumping" stencils.
    (Contact your City or County Water Resources Division for directions and stenciling kits.)

  - Visit your elected officials and tell them about your creek concerns. Find out how they can help your creek.

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EXTENSIONS:

- build a classroom aquarium,
- plan some stream-side enhancements,
- find out about sources of water pollution,
- draw or paint what you found by the creek,
- and use the other activities in this book.

Date ________________

Time ________________

Weather ________________

 ________________

Air Temperature ________________

What is your creek's name?

____

What are the land uses around your creek - homes, businesses, farms?

____

____

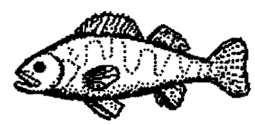
Qualitative Water Quality

Depth: __________ Color: __________

Odor: ☐ Rotten Egg ☐ Musky ☐ Acrid ☐ Chlorine ☐ None

Water Appearance: ☐ Scum ☐ Foam ☐ Muddy ☐ Milky

☐ Oil Sheen ☐ Brownish ☐ Clear



Is the creek bed gravelly, sandy or muddy?

____

Do you see anything such as an eroded bank or nearby storm drain that might influence the water condition?

____

List any plants and animals that you can identify on the back of this sheet.

Quantitative Water Quality

pH level:

1. ________________
2. ________________
3. ________________

Dissolved O_2:

1. ________________
2. ________________
3. ________________

Temperature of Water:

__________ . ______

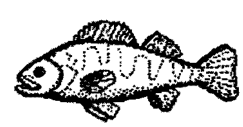
Dissolved Oxygen Saturation:

________ %

Other Tests:

1. ________________ 2. ________________

3. ________________ 4. ________________



CREEK DATA SHEET - Citter Adaptation Observation Sheet

For each critter that you find ask the following questions and fill in the table below. Don't worry if you can't answer all the questions about each organism. Just use the questions as a guide to learn more about each creature.

Name:			
	Organism #1	Organism #2	Organism #3
Where was it found? - on the surface. - in the water - on the bottom - on a plant ...			
How does it move? - crawls - paddles - darts - wriggles ...			
How does it defend itself? - hides - bites - flees - doesn't ...			
How does it react to light? - avoids it - seeks it - doesn't ...			
How does it breath? - gills - snorkel - surface - other ...			
What does it eat? - plants - animals - parasite - scavenger ...			
What eats it? - fish - turtles - spiders - people ...			
What size is it? - a period - grain of rice - pencil eraser ...			

Levels:
Grade K-8

Subjects:
Art, Math,Language Arts, Science

Concepts:
• Creeks are part of bigger systems called watersheds.
• The water that flows through a creek is subject to the water cycle.
• There are diverse plant and animal species along a creek.

Objectives:
Students will:
1. Identify plants and animals that live in a creek ecosystem.
2. Draw a watershed and define its characteristics.
3. Communicate through art and drama characteristics of a creek ecosystem.

Skills:
Observing
Communicating
Comparing

California Science Framework Theme:
Patterns of Change
Scale and Structure
Systems and Interaction

Materials:
Little or no materials needed
See specific activity

Time Considerations:
Preparation: Very little
Activity: Flexible, to fit the time at hand

Mini-Activities can be used as reinforcement following a lesson or field trip to the creek.

Activities may be related to art, math, language arts, or science.

These suggested activities require little preparation time and are useful to have on hand.

Your own experiences at a creek site or your own approach to learning about creeks will give you many more ideas.

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1. Let's Do A Show!

• Take an old, clean sock and invert the toe to form a mouth. Add other features with paper, yarn, felt scraps or pom poms.

• Also cut out animal shapes and tape them to a stick for a quick puppet.

• Put on an impromptu show, playing the roles of the creatures that live at a creek. Ask the student what would happen if a raccoon invited a crawdad to dinner?

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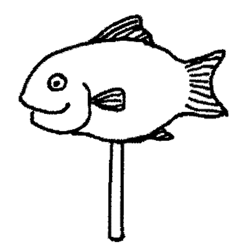


2. A Bird In The Hand

• Take an ordinary white envelope and seal it shut.

• Then cut it open along one side.

• Insert your hand and help form a mouth by pushing in the middle.

• Make sharp creases to form the edges of a beak.

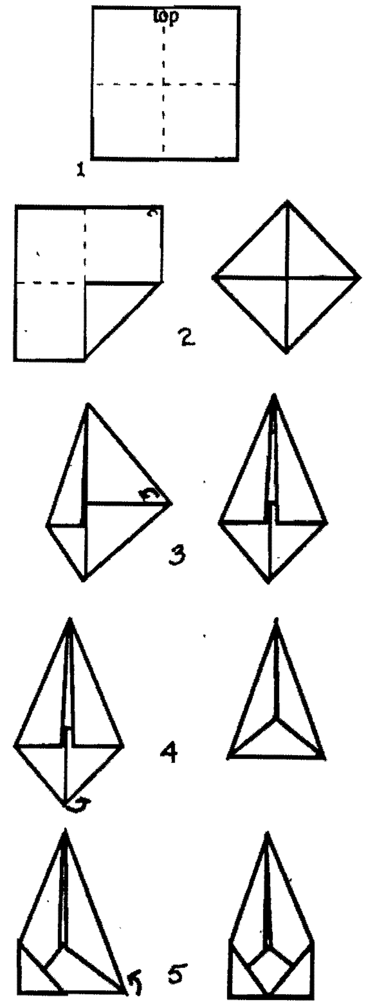
• Then fold the envelope flat again so you can color it and give it eyes.

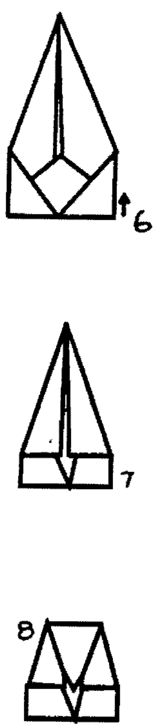
• Perhaps your bird can sing. Make up a song for it about creeks.

3. Fold A Frog!

Use a square piece of paper no larger than 6 inches across.

1. Fold in half, first one way then the other. Open again.
2. Fold each corner to the center.
3. Fold the sides in, meeting at the center.
4. Fold the bottom up.
5. Fold the sides in, with the points meeting halfway.
6. Fold the bottom up, about one third of the way up.
7. Fold the bottom down.
8. Fold the top point down.
9. Press your fingers down on the frog's back. Slide your finger off and . . . watch the frog jump!





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4. Where Are You Going?

• Review the water cycle, how water falls as rain or snow, how it flows to the ocean and returns as moisture to the sky and clouds to fall again upon the land.

• Map the creek that you are visiting or studying to find out where it starts, where it flows and where it empties.

• Ask your students to imagine that each of them is a drop of water in the creek and write a story about their travels.

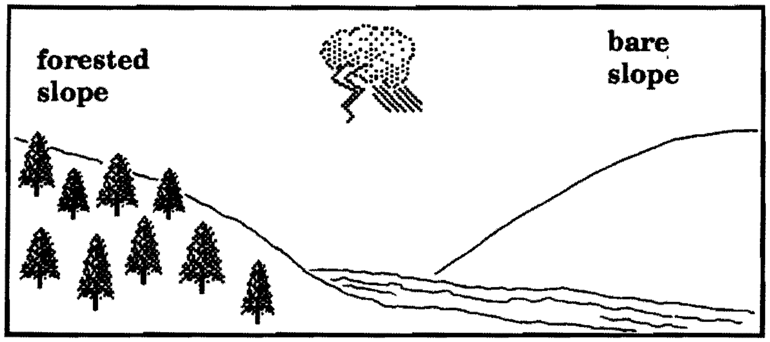
What is it like to go down a storm drain?
How does it feel to flow under trees?
Do fish tickle when they swim past?

Let your imagination flow!

Talk About...

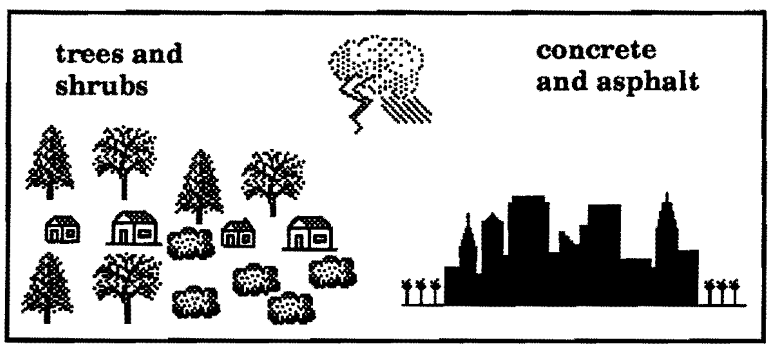
5. Which Watershed

Draw pictures like these on the board.



If 5 inches of rain falls on both watersheds, how will the different slopes affect the river?

If the same amount of rain falls in the two city areas, how will the urban runoff in each differ?



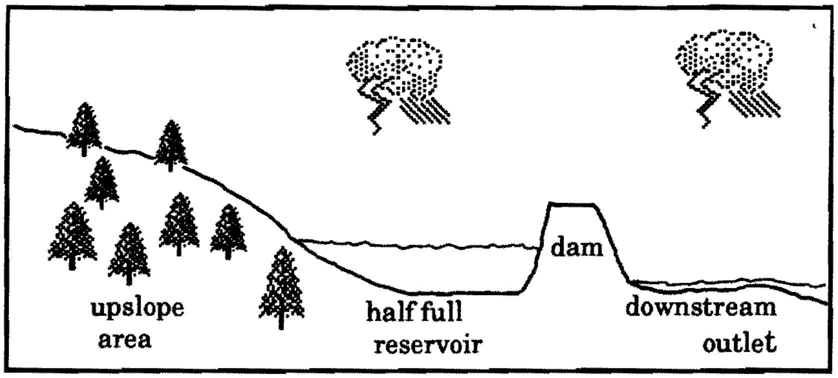
Higher runoff = more erosion
Lesser, steady runoff = less erosion
Less runoff = steadier runoff
More runoff = faster runoff

Questions About...

6. Rain and Runoff

Draw a cross section of a watershed and a reservoir on the board.

1. If the reservoir is half full and rain falls on the upslope area, what happens?



2. If the reservoir is already full and the same amount of rain falls upslope, what must the dam operators do?
3. Does it have to rain right over the reservoir for it to fill?
4. Does it have to rain right over the downstream outlet for its level to rise?

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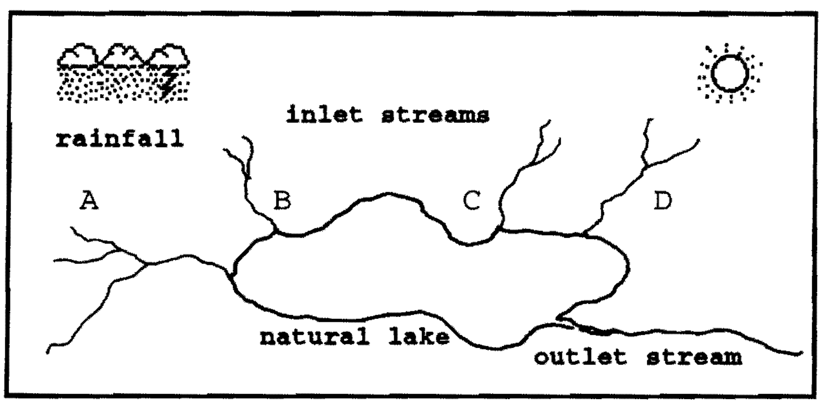
7. Looking At A Watershed

Draw a picture like this on the board and talk about how watershed and drainage areas work.



1. When it rains in the drainage area of the inlet streams what happens to the lake's water level?
2. How about the outlet streams?
3. How about the inlet streams and other streams?

8. Can You Solve My Problem?

Use data collection in the field to make up story problems to put your math to work.

For example:

• If a mosquito fish can eat 50 mosquito larvae each day, how many larvae will it eat in one week? How many would two fish, four fish or six mosquito fish eat?

• If a stick takes two minutes to float 5 feet down the creek, how long would it take to float one mile?

• If someone threw 60 cans into the creek, and it takes one person an average of 10 minutes to find a can and put it in the trash bag, how many people will it take to clean up all the cans in one hour?

• If cans are worth 2 $\frac{1}{5}$ cents each at a recycling center, how much would you receive from recycling the 60 cans?

Make up some stories of your own, trade them and solve each others problems.

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9. Draw On Your Memories

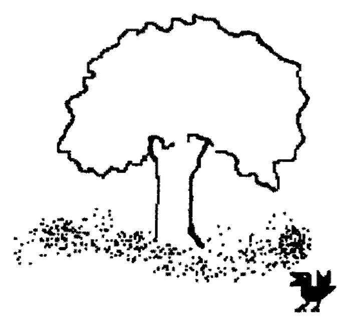
Sketch a tree or animal that you remember seeing while visiting the creek.

Use:

Charcoal
Pastels
Pencil
Crayon
Finger Paints
or...

Try colored chalk on paper sprinkled with water.

Blow drops of tempera with a straw.



10. Illustrate A Map

Make a map of your creek showing where it begins and where it empties.

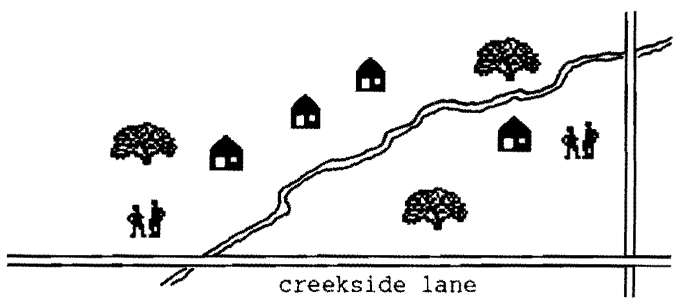
Show:

- the area that drains in to your creek.
- the creek, slough, or river, where your creek ends.
- major streets and landmarks along the way.

Make a map that shows how your creek flows through your neighborhood.

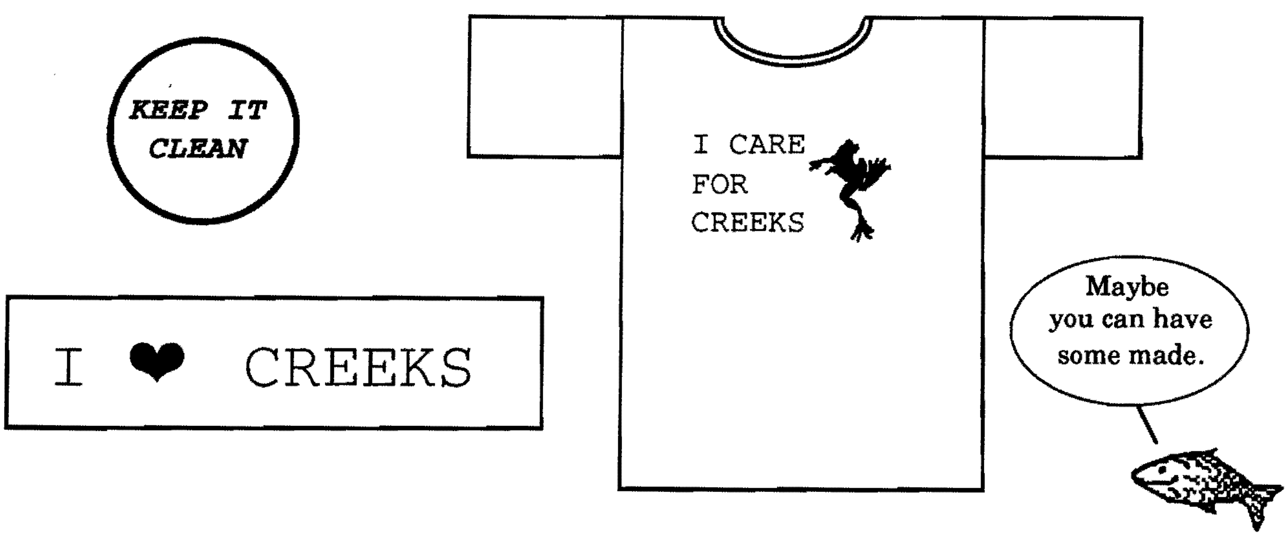
Illustrate your map with pictures of things like trees and buildings, people and wildlife.

Use your map to show others where they may go to see your creek and what to look for.



11. Designing Students

Design a T-shirt, a button or a bumper sticker that features a picture or message about creeks.



12. Bingo

Using the glossary, put a list that you chose on the board.

Ask each student to write any five words on a piece of paper.

Give them a few minutes to study the words.

Slowly call out the words, choosing them at random, and marking them off as you go.

Each student should also mark off each word as it is called.

When all five words are marked off on a student's list, he or she shouts "BINGO".

The words should be verified ... and a new person can be caller.

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13. Is There An Animal In The Creek?

Read the list of animals. Ask your students to take turns responding yes or no to the question - is this a creek animal in our area. (the underlined words are creek animals.)

<u>frog</u>
penguin
<u>dragonfly</u>
kangaroo
<u>butterfly</u>
flamingo
chicken
<u>bat</u>
<u>beaver</u>
<u>raccoon</u>
<u>hydra</u>
<u>skunk</u>
sheep
<u>daphnia</u>

<u>egret</u>
<u>shrew</u>
<u>mouse</u>
lion
<u>crayfish</u>
<u>muskrat</u>
polar bear
<u>kingfisher</u>
shark
condor
<u>turtle</u>
<u>mallard</u>
<u>clam</u>
elephant

hamster
<u>squirrel</u>
<u>ladybug</u>
whale
<u>trout</u>
antelope
tortoise
<u>caterpillar</u>
wolf
puffin
buffalo
<u>water strider</u>
<u>garter snake</u>

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14. Endless Chain

Name a broad category such a creeks. Start with a word that begins in that category, such as "water". Have students take turns adding to the list with a word that begins with the last letter of the previous word. For example:

WATER
RACCOON
NEST . . . If you get stuck, start with a new word.

15. Make A List Of

1. The kinds of trees that might be at a creek.

2. The kinds of plants that might be at a creek.

3. Animals found at the creek that have legs,—2 legs, 4 legs, more legs.

4. Things that pollute a creek.

5. Anything that might be found at a creek—in alphabetical order.

6. Predators that use the creek.

7. Creek animals that start with a vowel.

8. Features or adaptations found in water animals.

If time permits, have partners share and compare lists.

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16. Password

One student, who is to guess the password, stands facing away from the board.

The teacher or another student writes a creek related word on the board which the rest of the students can see.

The student standing may call on anyone who has a one word clue to offer and must try to guess the word on the board using that clue.

The student who provides the winning clue must provide the next password.

17. Formula Poem

(For Kids who hate poetry)

CREEKS

I like creeks,
__________ creeks, __________ creeks,
__________ creeks, __________ creeks.
Any kind of creeks.

A creek in the __________.
A creek in the __________.
A creek in the __________.

I like creeks,
__________ creeks, __________ creeks,
__________ creeks, __________ creeks.
Any kind of creeks.

A creek that __________.
A creek that __________.
A creek that __________.

Fill in the blanks!

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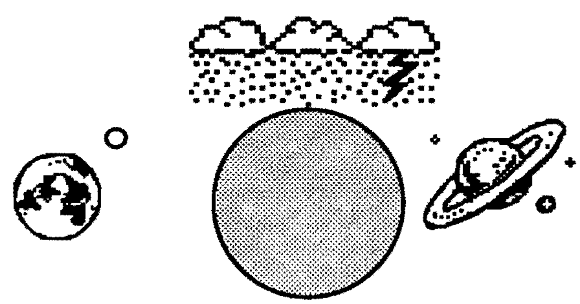
18. Life On A Watery Planet

Imagine life on another planet that is mostly covered with water.

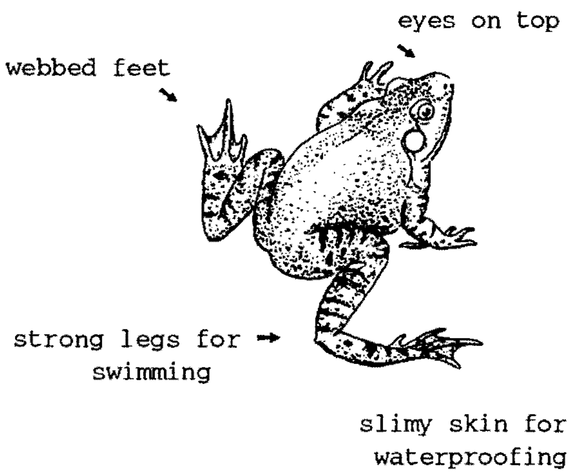
Create a plant or animal that is adapted to living in that environment.

Give it a name and describe where and how it lives.



19. Aquatic Adaptations

List the characteristics of the plants and animals that you have found that help those plants and animals live in the water.
For example:



Are there other ways bullfrogs have adapted to life in a creek?

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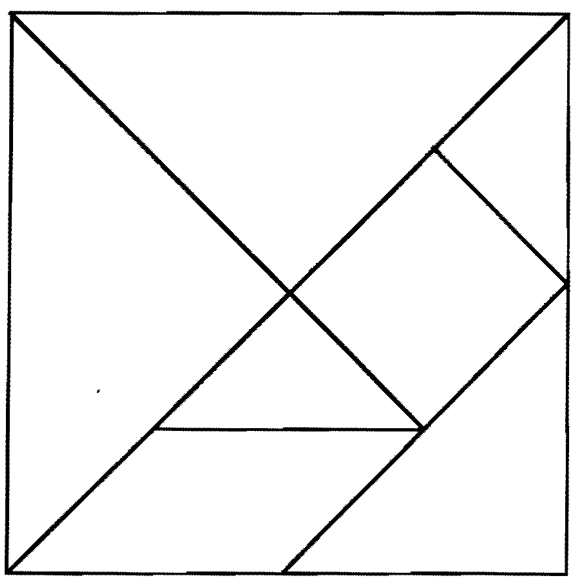
20. Tangrams



- Copy this pattern on a heavy paper.
- Have each student cut out one set of seven pieces.
- Use these pieces to create shapes of animals one might find at a creek.

21. Anagrams

"Creeks are home to animals and places where people can have fun and learn."

Copy this sentence on the board and have your students create a list of creek or water related words using the letters in the sentence.
For example:

fish
trees
water
hawk

Decide ahead of time if you can use a letter more than once and if you can use words in the sentence themselves.

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22. Build A Sentence

Provide a simple sentence such as "fish swim."

Students can then take turns making the sentence more interesting by inserting additional words for each revision.

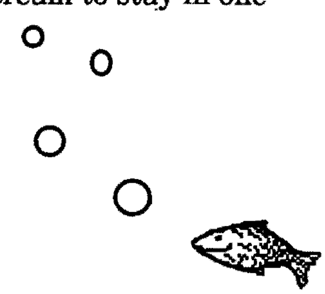
For example:

"Fish swim upstream."

"Some fish swim upstream."

"Some fish swim upstream to stay in one place."

... and so on.



23. Alphabet Hunt

On your field trip take along a clip-board, pencil, sheet of paper or form.

Find objects that begin with each letter of the alphabet.

A ________	M ________
B ________	N ________
C ________	O ________
D ________	P ________
E ________	Q ________quack!
F ________	R ________
G ________	S ________
H ________	T ________
I ________	U ________
J ________	V ________
K ________	W ________
L ________	XYZ________

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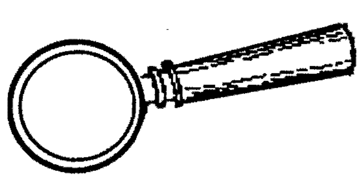
24. Nature Detectives

Using newsprint and the side of a crayon, have students make rubbings of leaves, bark, stones - any interesting textures they can find.

Collect and trade the rubbings and use them as clues.

Send "detectives" out with a rubbing, or "finger print", to find the source.

The "rubber" can give hints: "hot", "cold", "warm", to those searching until the natural pattern is discovered.



25. Meet Somebody New

Find an animal, an insect, bird, mammal, invertebrate, that is new to you.

Find out all that you can about it through careful observation.

Create a name for it.

Share that name, and the reason for it with a partner.

Using your created name, can someone else find your animal?

Try the same thing with a new plant.

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26. House Hunting

Find a home for:

- a large bird
- a small bird
- a fish
- an amphibian
- a mammal that lives in a tree
- a mammal that lives in the ground
- a flying, crawling and an aquatic insect
- a mollusk

Is there competition for the same housing?

How do creatures along the creek share space?

27. Picture That

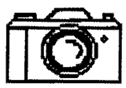
Bring an easy-to-use camera on your field trip. Choose a roll of film with about the same number of exposures as the class size.

Have each student take a picture of a part of the creek that he or she likes or wants to remember.

Keep track of the film frames and the photographers.

After developing the film, create a bulletin board with the photographs.

Add stories or poems that describe the pictures.



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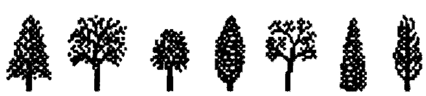
28. Paper Art

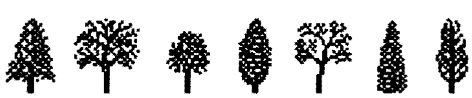


Take a piece of green construction paper on your field trip.

Look at the shape of a tree near the creek.

Begin to tear the shape of the tree's canopy as your eyes follow the outline of the tree.

Back in the classroom make a mural using these tree silhouettes.



29. Treasure Hunt

Each student is given a list of items to find or several challenge cards or sticks.
Stress finding, not picking!

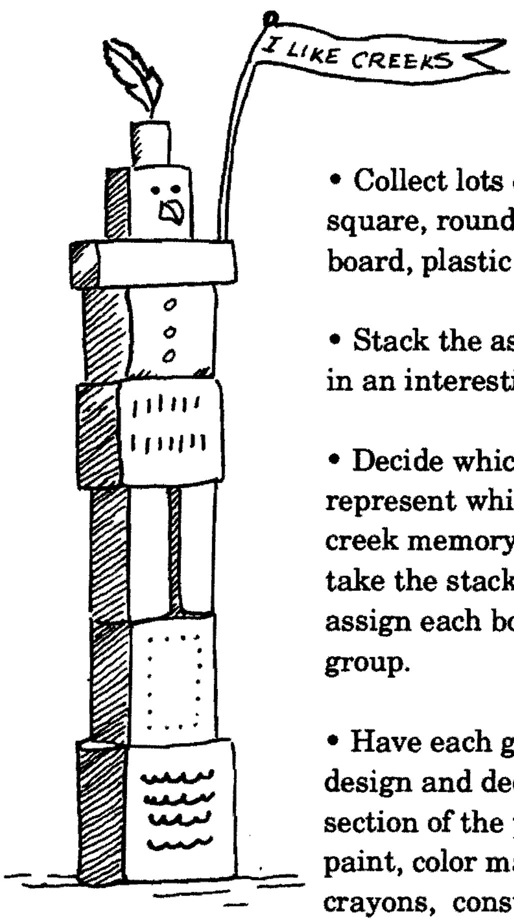
A sample list:
- a grass seed
- a hill made by animals
- a tree with limbs growing up
- a leaf with ragged edges
- a leaf with round edges
- some bark with rough surface
- a seed that sticks to fur
- a yellow flower
- a soft leaf
- a hard leaf
- five colors of green
- something you can feel but can't see
- a vine
- something with six legs
- a plant with a brown stem
- a bird perching
- a home for a bird
- an animal that gets all its food from plants.
- a leaf with many parts
- something decaying
- something that is just beginning
- a round stem and square stem
- something round
- a plant growing on a plant
- an animal track
- A hole in a tree big enough for a home.

• Some treasures will be for a specific place or season, others are general.
• Choose "treasures" that fit your time and place.
• Send students out in pairs—one finder and one witness. The teacher should be the final judge.

30. Creek Story Poles

"Capture your creek memories with a story pole."

Totem poles were used to tell a story by the native tribes of the Northwest, and these poles were a symbol of a family's importance. Create a pole to tell a story and show how important creeks are to people, plants, and animals.



- Collect lots of boxes - square, round, flat - card board, plastic - no limit!
- Stack the assorted boxes in an interesting manner.
- Decide which box should represent which special creek memory or object, take the stack apart and assign each box to a small group.
- Have each group plan, design and decorate their section of the pole using paint, color markers, crayons, construction paper, drawings, poems, photographs, cutout pictures, feathers, streamers, dry leaves, etc.

Reassemble the story pole using scissors, staplers, glue, and tape.

Show off your work!

31. Who's Who In The Creek

Fish, frogs, turtles, tadpoles, crayfish, snakes, aquatic insects, and many types of plants live in creeks. Raccoons, beavers, muskrats, ducks, etc. live near the water. The plants and animals living in and around the water provide food for each other and for many animals who live nearby.

Make simple flannel board or magnet board shapes or pictures of creek critters and plants. Look for pictures in nature magazines, use the pictures in the "Creek Habitat Webbing Activity", or draw them yourself.

Discuss with your group what lives in or around creeks. You might choose a creek nearby to talk about and actually hold the discussion outside near the creek. As the children name a plant or animal have them put it on the board. If the children name something that you don't have a picture for, have them research it and draw it to add to the collection. Talk about what each eats, where it lives, how it gets around in the water, how it gets food, etc. This would also be a good time to read a story such as *Signs Along the River* by Kayo Robertson or *Ponds And Streams* by John Stidworthy.

The children can also use the creek critter and plant cards to sort who lives in the water, who lives on land, and who lives in the water and on land.

Dipping Into Creeks

Aquatic BINGO

______ can name three macroinvertebrates found in the creek.	______ knows the name of the nearest creek.	______ knows what DO means.	______ enjoys visiting creeks.	______ can name two trees found along the creek.
______ knows what a riffle is.	______ can name one reason for an algal bloom.	FREE	______ has participated in Creek Clean-Up Day.	______ knows a song about water.
______ can describe what a food chain is.	______ can name three birds found near a creek.	______ has picked up litter at a creek.	______ knows what non-point source pollution is.	______ has written a poem about a creek.
______ knows what a water penny is.	______ stays on trails to avoid creek bank erosion.	______ can name three plants that grow along a creek.	______ has taught a lesson about creeks.	______ can name four mammals that live along a creek.

TIPS FOR PLAYING

The object of this game is to assess a group's knowledge of aquatic biology and water quality monitoring . . . and to have fun!

Each person in the group gets a copy of the bingo card. Each person then goes to someone else in the group and, one at a time, asks them a bingo question. If that person can answer with a correct defintion or a "yes" his or her name is written in the square.

When the group has had time to intereact with one another, stop the game and go over the answers.

- Did anyone fill their card?
- Did anyone mark a bingo?
- Did anyone learn something new?

Extra Ideas and Personal Notes:

Levels:
Grades K- 3

Subjects:
Science, Language Arts, Visual Arts, Performing Arts

Concepts:
• Creeks contain numerous niches that support diverse populations of organisms.
• Plant and animal populations exhibit interrelated cycles of growth and decline.

Objectives:
Students will:
1. Observe life at the creek
2. Identify plants and animals that live in a creek ecosystem.

Skills:
Observing
Comparing
Communicating

California Science Framework Theme:
Systems and Interaction
Energy
Evolution

Materials:
Creek scavenger hunt
Activity sheet
Clip board
Pencils or crayons

Time Considerations:
Preparation: 30 min. or more
Activity: Variable amounts of time over several months

HABITATS AND INHABITANTS

Critter Count Scavenger Hunt – for younger children

Take a creek-side walk to see what plants and animals you can identify. Start in the classroom by talking about what plants grow by the creek at certain seasons, what animals you might see and what signs of animals to look for. You may come up with other ideas, too, that should be included. Develop your own activity sheet with words or pictures. Here is a sample:

CRITTER COUNT SCAVENGER HUNT

Scrub Jay	Minnows
Magpie	Crayfish
A nest hole in a tree	An empty shell
Valley Oak	An animal track
An acorn	A white flower
A flying insect	A water insect
A duck	A bird's nest
Tadpoles	Frogs
Cattails	Pussy willows

Identify what you see and put a check by the name or picture.

• • •

EXTENSIONS:

1. After taking your walk, have your students illustrate an original poem or story describing your excursion.

2. Create a classroom mural illustrating what you saw at the creek.

3. What's for dinner? Discuss the role each plant or animal plays within the creek's community, e.g., producer, herbivore, carnivore, scavenger, decomposer.

4. Create simple cards with drawings or words of creek critters and plants. Give each child a card and some yarn and have them create a complex web of interconnections.

5. Produce a show using simple puppets playing the roles of producer, herbivore, etc.

Levels:
Grades 4-6

Subjects:
Science, Visual Arts

Concepts:
• Creeks contain numerous habitats that support diverse populations of organisms.
• The quantity and quality of resources and their use- or misuse- by humans affect the standard of living of societies.

Objectives:
Students will:
1. Observe life at the creek and recognize interconnections.
2. Identify adaptations by plants and animals in a creek ecosystem.

Skills:
Observing
Comparing
Communicating
Relating

California Science Framework Theme:
Systems and Interaction
Energy
Evolution

Materials:
Clip Board
Pencils
Data sheet
"Creek Guide" booklet

Time Considerations:
Preparation: 30 min.
Activity: Variable amounts of time over several weeks

"Who Lives Here?"

Take a creek-side walk. Start in the classroom by discussing what you might see. Divide into small groups to work in teams recording observations of the variety and diversity of creek life. A team might consist of: a team leader who guides the group's movement and reports back in class, a research specialist who is responsible for guide books and charts, and the recorder who fills in the data sheet, takes notes and makes drawings.

Sample Data Sheet for plants or animals

					(make it bigger!)

or "Plant Patrol"

Survey the numbers and types of plants at your creek. Using student groups of three, record your observations.

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EXTENSIONS:

1. Discuss how plants and animals living at the creek are adapted for survival. The "Creek Guide" booklet will provide good background.

2."Sugar-making Green Machines" Find out how algae and larger plants produce their own food. Discuss the role of "producers". Who depends upon these "producers"?

3. Make leaf rubbings of the plants you find along a creek. *Don't rub poison oak!*

4. Plant a "producer". Check the list of native plants in the booklet on creek life.

Levels:
Grades 4 - 6

Subjects:
Science; Social Studies; Visual Arts

Concepts:
- Biological diversity results from the interaction of living and nonliving environmental components such as air, water, sunshine, soil.
- Creeks contain numerous habitats that support diverse populations of organisms.
- Human societies affect natural systems on which they depend.
- In biological systems, energy flows and materials continually cycle in predictable and measurable patterns.

Objectives:
Students will:
1. Observe life at the creek
2. Recognize interconnections through classification
3. Compare surveys for differences and similarities

Skills:
Observing
Comparing
Communicating
Relating

California Science Framework Theme:
Systems and Interaction

Materials:
Recording sheet
Clip boards
Guide books

Time Considerations:
Preparation: 30 minutes
Activity: Variable amounts of time over several weeks.

"What is It?"

- As a group, discuss the names of different divisions used to classify organisms, moving from the broadest categories to the most specific: kingdom, phylum, class, order, family, genus, and species.

- Divide into teams and survey and record the organisms found at a creek site. *Use the Dipping Into Creeks data sheet.*

- Have teams record in a variety of locations and note any factors adjacent to that location that might influence the number of organisms, e.g., storm drains, heavy traffic, limited access, domestic animals.

- Compare records of several surveys for differences and similarities. What factors could account for the differences? Similarities?

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EXTENSIONS:

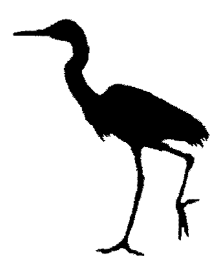
1. Using the list of organisms recorded by the teams, classify some according to their scientific order.

    - Classify these according to their role in the community, i.e., producer, herbivore, carnivore, etc.

    - How are all these organisms interconnected?

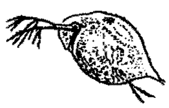
2. Draw a webbing chart of these organisms.

    - If any, what links are missing?

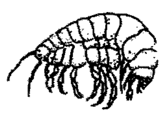


Some little things you might find:

Copepod

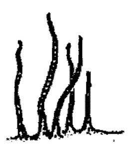


Daphnia



Scud

Water Mite



Worms

Clams

Snails

Use the "Creek Guide" and the Golden Guide to "Pond Life" to find out about aquatic creatures.

DIP INTO A CREEK

When you visit a creek you can almost always find riparian plants and some of the larger animals that live there, such as, squirrels and birds. But in a healthy aquatic environment the "real action" is under the water. Algae are burgeoning, macroscopic organisms are scurrying around eating algae and each other, and larger invertebrates are eating it all. It is a world full of action and drama—and a rich opportunity for exploration and observation. This underwater scene is also important because it contains the organisms that form the base of the aquatic food chain and contribute to the quantity and diversity of creatures in the whole riparian environment.

Many creeks may not be healthy enough to support a diverse aquatic community, but these creeks, too, present a lesson. The lack of small aquatic organisms in a creek indicates problems. Learning about these problems and seeking solutions are an important aspect of creek studies.

Don't miss the opportunity to explore the underwater world!

The best way to let students discover the variety of creatures living in the creek is to collect some for closer observation. Select a safe spot along the creek where one can use a dip net from the bank—or where it is shallow enough to wade. If students are going into the water, first establish safety rules. Wear protective footwear and wade only where there is a smooth flat bottom. Watch for slippery rocks and deep holes!

Tiny insects and other invertebrates are best caught by gently sweeping nets along the tops of plants. Empty the debris gathered in the nets into a bucket to take back to the classroom for careful examination, or empty into a shallow white pan for observing at creek-side.

Larger invertebrates such as water beetles and bugs, snails, and crayfish can be observed at the creek and released when everyone has had a chance to look.

Levels:
Grades K- 3

Subjects:
Science, Math

Concepts:
- Organisms change throughout their lifetimes.
- Populations exhibit variations in size and structure over time.

Objectives:
Students will:
1. Survey and census aquatic invertebrates
2. Compare surveys over time

Skills:
Observing
Recording
Comparing
Inferring

California Science Framework Theme:
Change
Energy
Systems and Interactions
Evolution
Scale and Structure

Materials:
Two-way viewers
Hand nets
Shallow pans
Buckets
Clip board
Census card
"Creek Guide" books

Time Considerations:
Preparation: 30 min. or more
Activity: Variable amounts of time over several weeks

"Checking the Action" ... for younger children

Make a census card with pictures or names of the water animals you hope to discover when you dip into a creek. Go over the cards in the classroom to become familiar with some of the creatures you will be observing.
Divide into teams. Each team should have a person who will be responsible for each piece of equipment — the dip nets, buckets and two way viewers — and a census taker.

Collect and observe, using the technique described on page 24. Have each group collectively record what they find by having the census taker put a tally mark in the number box each time a specimen is discovered and identified. At the conclusion of your creek visit, combine the tallies of each team to reach a final census.

If you can, visit the creek and take a census in two week intervals, or at different seasons and note the changes. Did new specimens appear? Did old ones disappear? Did some get more plentiful?

If you cannot repeat your visits, discuss what changes might occur, e.g., tadpoles become frogs, wigglers become mosquitoes.

Sample Census Card

Date__________	Name of census taker ________________
name	**number**
snail	
mosquito larva	
water strider	
tadpole	
dragon fly adult dragon fly nymph	

• • •

EXTENSIONS:

Set up an aquarium in the classroom to observe over a period of time some of the smaller invertebrates that you collect. If you fail to find the smaller aquatic creatures in your creek, try to bring some in from another healthier aquatic environment.

Levels:
Grades 4 -6

Subjects:
Science, Language Arts, Visual Arts, Performing Arts

Concepts:
• Organisms are interdependent, and dependent on nonliving components of Earth.
• Organisms change throughout their lifetimes. Species of organisms change over long periods of time.
• Populations of organisms exhibit variations in size and structure as a result of their adaptations to their habitats.

Objectives:
Students will:
1. Survey and census aquatic organisms
2. Review metamorphosis and life cycles

Skills:
Observing
Comparing
Inferring

California Science Framework Theme:
Change
Energy
Systems and Interactions
Evolution
Scale and Structure

Materials:
Two-way viewers
Hand nets
Shallow pans
Buckets
Thermometer
Clipboard
Census card
"Creek Guide" books

Time Considerations:
Preparation: 30 minutes
Activity: Variable amounts of time over several weeks

"Changing Times?"

In the classroom, review metamorphosis.

Select some aquatic creatures that you might find at your creek and review their life cycles. You might find frog eggs, tadpoles and frogs. You are likely to find mosquito egg rafts, mosquito larvae and hear a mosquito buzz. Think, too, about dragonflies and snails. What about mosquito fish? Do they change form during their lifetimes

When you visit the creek, use the same strategy described in the activity on page 25, but in addition to recording the number of organisms and their life cycle stage (i.e. adult, larva, immature), record other observations, such as, water level, amount of sunshine, leaf cover, temperature in the water and air. Challenge your students to find correlations between those environmental factors, which often change as the seasons change, and the stages of life cycles of the organisms they found.

If you can, plan to visit the creek to collect and observe in one or two week intervals to develop an idea of the changes and cycles of several creek organisms.

Back in the class room, discuss how each stage of an organism's life cycle reflects it adaptation to its environment, i.e., how does a beetle's shape help it move through the water. How does a tadpole live and feed underwater and a frog live and feed above water? What adaptations make their survival possible? How long does such an adaptation take to evolve. How does the process work? Which organisms that you observed possess a life stage that fills a different niche than the one before it?

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EXTENSIONS:

In teams or individually, create an aquatic animal:

- Give it a name,
- tell about its niche,
- explain the adaptations it uses to fill its niche,
- tell about its life cycle.

Do this either in an oral presentation to the class or as a bit of creative writing.

Create the animal as a drawing or by using other art media such as clay. For 3-D animals use recyclables such as egg cartons, corks, tooth picks, cardboard. Add pipe cleaners, styrofoam balls—or whatever your imagination inspires.

Levels:
Grades 4 -6

Subjects:
Science, Math

Concepts:
- In biological systems, energy flows and materials continually cycle in predictable and measurable patterns.
- Plant and animal populations exhibit interrelated cycles of growth and decline.
- Altering the environment affects all life-forms, including humans, and the interrelationships that connect them.

Objectives:
Students will:
1. Investigate adaptations forsurvival, niches and food webs

Skills:
Observing
Comparing
Inferring

California Science Framework Theme:
Systems and Interaction
Change
Stability

Materials:
Dip net
Bucket
Two-way viewers
Magnifiers
"Creek Guide" booklet
Record cards
plastic buckets
Microscopes

Time Considerations:
Preparation: 30 minutes
Activity: Variable amounts of time over several weeks

"Dinner Time!"

Introduce your class to the variety of organisms that can be found in an aquatic environment and the food chains that make up this riparian community. The *Quick Guide to Creek Life and Creek Ecosystems* provides this information.

Collect a wide assortment of the micro and macro-organisms that form the base of a food pyramid. Observe all you can at the creek site, then take some samples back to the classroom for detailed observation. (You may have to visit several different aquatic communities for a good assortment for on-going study.)

Inventory what you have collected, make a note of each organisms niche in the community. Does it produce food? Where does it get its energy? When it is eaten or dies, where does that energy go? Place a different assortment of organisms in several different aquariums and record what each contains. Create a card where you can record the date and daily observations of population changes.

- Do some species of organisms increase in numbers?
- Do some species disappear?
- Who is the dinner and who is the diner?

• • •

EXTENSIONS:

Try introducing a predaceous insect, such as, a water bug or dragon fly nymph, into one of the aquariums and observe what happens to the population of smaller organisms.

The opportunity to observe aquatic organisms in a classroom aquarium opens up many more possibilities for learning.

What about collecting?

When you collect aquatic organisms and bring them into the classroom are you disrupting an ecosystem? In a healthy environment with little disturbance, removal of the smaller species will not greatly affect the food web. But in an urban setting, no matter where you collect, you are entering an already stressed environment. Be judicious whenever you explore a creek and adjust your activities to leave as little impact as possible on its aquatic life. Encourage your students to consider and discuss the ramifications of collecting.

Levels:
Grades K- 6

Subjects:
Science, Language Arts, Visual Arts

Concepts:
• Altering the environment affects all life-forms, including humans, and the interrelationships that connect them.
• Biological diversity results from the interaction of living and nonliving environmental components.
• Ecosystems change over time through patterns of growth and succession.

Objectives:
Students will:
1. Observe the water in a creek over a period of time
2. Experiment with evaporation

Skills:
Observing
Comparing
Communicating

California Science Framework Theme:
Energy
Change

Materials:
Clip boards
Drawing paper
Pencils, colored pens, crayons
Shallow dish

Time Considerations:
Preparation: 30 minutes
Activity: Variable amounts of time over several weeks

WATER CYCLES

"Riding the Water Cycle"

Talk about the water cycle and how a creek becomes part of that cycle. "Pool" the group's knowledge and create a picture or word diagram of the water cycle.

Plan several walks at a creek to observe how the level and appearance of the water changes. Can any factors you observe be attributed directly to human activity, in the water, at the water's edge, and in the riparian zone.

- What is the weather like when the water is high?
- What is the weather like when the water is low?
- Where does water come from when it is not raining?

On your walk, can you find signs of changing water levels? Look at the banks for erosion, or debris left in creek-side plants.

What does the water look like when the water level is high? What does it look like when it is low?

In the classroom, experiment with a shallow dish of water outside on a sunny day and on an overcast day. What happens to the water? Where does it go?

What would happen to the creek inhabitants if their water evaporated? What happens to them when it rains? How do some animals change in order to survive hard times, such as no rain or too much rain?

• • •

EXTENSIONS:

1. Locate your creek on a map and trace its course. Where does it start? What is the source of the water? Where does the creek go? Does it go into a river? Where does the river go? Does it get to the ocean?

2. Write or tell a story about a drop of water landing in your creek. Who would it meet? How would it feel to splash and roll down a creek and float back up into the air to become part of a cloud?

3. Take a cloud walk and observe the different kinds of clouds. What do rain clouds look like?

Levels:
Grades 4 - 6

Subjects:
Science, Math

Concepts:
• Ecosystems possess measurable indicators of environmental health.
• Organisms are interdependent, and depend on nonliving components of Earth.
• Pollutants are harmful byproducts of human and natural systems which can enter ecosystems in various ways.

Objectives:
Students will:
1. Discuss the water cycle
2. Explore the factors affecting the quality of water in a creek

Skills:
Observing
Comparing
Communicating
Relating

California Science Framework Theme:
Energy
Change
Stability
Systems and Interactions

Materials:
Clipboards
Paper and pencil
Wood dowels
String
Ruler
Thermometer
Large jar

Time Considerations:
Preparation: 20 minutes
Activity: Variable amounts of time over several weeks.

Water Ways

Introduce the topic of water quality to your students and survey their knowledge and notions. Then, survey the water in your creek. Divide into small groups and have each group choose a site at the edge of the water. Mark the area with string or other objects that can later be removed.

- Record the air temperature: in the shade - in the sun.
- Record the water temperature: in the shade - in the sun.
- Record the water depth. Measure in three places and record the average. (Guess if it is very deep).
- Record the rate of water flow. Measure the distance between two points and count the time it takes a stick or leaf to float between them.

What is the creek bed like? soft? hard? squishy? sandy?

What does the water look like? clear? muddy? foamy? milky? oily? brownish? other?

How does the water smell? musky? fresh? rotten egg smell?

Note the amount of plant and animal life at this site.

Note any nearby storm drains that could affect creek water .

What conclusions can be drawn from the condition of the water and the amount of plant and animal life?

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EXTENSIONS

1. Find out what is in a creek bed. Take a sample of the creek bottom and place it in a large jar. Fill the jar with water until it is three quarters full. Let the jar stand for several minutes to several days. The mixture will separate into layers, with the coarser material on the bottom, sand and silt next, with organic matter usually floating on the top. Did you find any animals living in the sample?

Levels:
Grades 4 - 6

Subjects:
Science, Math, Social Studies

Concepts:
- Organisms are interdependent, and depend on nonliving components of Earth.
- Pollutants are harmful by-products of human and natural systems which can enter ecosystems in various ways.
- By reducing waste and recycling materials, individuals and societies can extend the value and utility of resources and also promote environmental quality.

Skills:
Observing
Comparing
Communicating
Relating
Inferring

Objectives:
Students will:
Experiment with the effects of urban runoff on the creek environment.

California Science Framework Theme:
Systems and Interactions
Stability

Materials:
Algae samples
Three one gallon jars
Non-chlorinated water
Eyedropper
Plant food
A chlorinated cleanser*
A petroleum based oil*
Observation sheet
**Use the safest substitute for toxic materials that you can find*

Time Considerations:
Preparation: 60 minutes
Activity: Variable amounts of time over several days

Urban Runoff

Experiment to see how chemicals such as fertilizers, pesticides, oil and paint can pollute creek water and affect plant growth. Algae, the simple green plants that are "producers" in the aquatic ecosystem, proliferate in the presence of a large number of nutrients and can have a negative impact on other aquatic life. They will also die when subjected to toxic chemicals. Because algae are at the beginning of the food chain, changes affecting algae affect the entire ecosystem.

Gather some algae from your creek. In the classroom, place equal amounts in each of three jars filled with non-chlorinated water. (One eyedropper of algae should be sufficient.) All three jars should be placed where they receive the same exposure to light.

Let the algae cultures incubate four to eight days. This interval will let them adjust to the jar environment and ensure approximately equal growth in each jar. Then add the plant food and chemicals

Jar A should contain water and algae only . This is the control jar.

Jar B should contain water, algae and plant food. This represents the creek polluted by fertilizer runoff.

Jar C should contain water, algae and oil or cleanser. This represents the creek polluted by toxic urban runoff.

Observe the jars for a week and record any changes. Using a chart like the one below rank the growth of algae in each with a numbering system: 1 = much growth, 3 = little growth

Date							
Jar A							
Jar B							
Jar C							

Working with an illustration of a food chain, predict how the change in the growth of algae will affect the creek's ecosystem.

Discuss what students might do to keep creeks free of chemicals in urban runoff water.

What have you learned?

As students, or children from other groups, dip into creeks and carry out some of the activities suggested here, they should consider keeping a record or a journal of notes and impressions of what they have seen and accomplished. A creek notebook is a simple and valuable way to record this information—and it can be done in pictures and in words. Such a notebook, too, can serve to stimulate individuals to continue the process of observation and exploration after the class or group experience. Teachers can evaluate their students' participation and understanding of the creek activities by reviewing the notebooks. Students can review their own progress as well.

What comes next?

Observing the creek's environment and its plant and animal life, learning about a creek's ecosystem, investigating its water quality — all these activities will very likely bring about some strong attitudes about the value of creeks in our neighborhoods. Teachers and youth leaders may wish to follow through with some activities that turn these attitudes into action.

- What did your group like best about "their" creek?
- What action might reinforce those values?
- What problems did your group find with "your" creek?
- What steps could you take to solve those problems?

• • •

The exercise that follows demonstrates how attitudes towards creeks influence land use decisions.

Other follow-up activity may include:

- Adopting a creek
- Writing an article about your creek study for your school newspaper or local newspaper.
- Working with other groups, neighborhood associations, and governmental bodies to improve the creek environment.

Levels:
Grades 4-8

Subjects:
Science, Language Arts

Concepts:
• Creek ecosystems mean many things to many people.
• Land use issues are important and complex and important to everyone.

Objectives:
Students will:
1. Identify social and ecological considerations of land use decisions.
2. Describe the importance of land use planning.

Skills:
Communicating
Comparing
Organizing
Relating

California Science Framework Theme:
Patterns of Change
Stability
Systems and Interaction

Materials:
Copies of background and role cards

Time Considerations:
Preparation: 30 minutes
Activity: Two or more sessions of 20 to 45 minutes.

Creek Or Houses?

Background

This activity uses a role playing strategy for studying the importance of land use planning. It emphasizes the complexities of decision making where people of different points of view are involved. The major purpose of this activity is for students to understand the importance and complexity of land use planning and decision making.

Background for students:

Land use decisions affecting creeks have become a familiar issue where housing developments are concerned. This is an imaginative conflict that corresponds to some real life dilemmas.

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Metropolis is a big city and a center of business and industry. It is surrounded by several small but growing communities. Just five miles north of Metropolis is one of those communities called Pleasantville. There are a few small businesses here but most of the people living here work in nearby Metropolis. Pleasantville used to be made up of ranches, farms and houses surrounded by open land. Lately as the area grows new houses have been built in subdivisions in Pleasantville. This is to the advantage of Metropolis because new homes and new development means more property tax revenue to help fund Metropolis' budget.

Babbling Creek and Little Creek run through the northern section of Pleasantville before they join Sally River. When people first began building homes here, the creeks were an attraction and not much of a worry because there was lots of open space where water could go if the creeks flooded in the rainy season. There are grasslands between the two creeks and at times of high water the two creeks join to make one big waterway covering the grasslands. Many years ago ranchers built low levees on the outside boundaries of the creeks to protect nearby houses. When the creeks and rivers were full the levees were high enough and wide enough to keep water from flooding surrounding areas. Lately however, as more houses are built, and more heavy rains are occurring over a short period of time the creeks have flooded some houses.

Engineers and city planners say the cause of the increase in flooding is from the many new homes and businesses which have been built upstream in other communities. Rain water that used to soak into the ground or be held back by plants now runs straight off new roads, parking lots and roof tops into storm drains that lead into the creeks. This causes more water to flow through the creeks all at once. Also in recent year there have bee more heavy rainstorms than in past years. To help solve this problem, the Metropolis Flood Control Agency plans to make the levees higher to keep flood water from spilling into nearby neighborhoods.

Meanwhile, a developer has noticed that if could just move the south levee into the floodplain to gain another 80 acres, this combined with some land outside the floodplain, would give him room for a big project. He has proposed that a thousand apartments and houses be built on the undeveloped grassland. He has studies which show that by excavating a deep large hole and changing the course of Little Creek he can create a lake. He claims this means the land he needs for his project can be reclaimed from the floodplain without any additional risk of flooding. He is promising to build the new south levee for the Metropolis Flood Control Agency if he can build it where he wants it to be. He is also promising to create wetlands, plant trees, and make other improvements to the floodplain to make it a better habitat for animals.

Cattle now graze on the grasslands. The have trampled and eroded the banks of the creeks and eat or trample any new trees that might start to grow. Even so, many wild animals live and find food here. Many species of birds have been sighted in the area. Dozens of herons and egrets nest in large trees on the western edge of this property. After the first heavy rains of the fall, rare salmon and steelhead trout migrate upstream from the Sally River on their way to spawn further up on Babbling Creek. The 80-acre plot is currently zoned for agriculture and would have to be rezoned as residential by a vote of the City Commissioners if the proposed development were to take place.

What should the commissioners do?
How should they vote?

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ROLE PLAYING CARDS

Jason or Jenna Jones

Realtor & City Commissioner

You work for a local real estate company on the other side of Big City, and business is going well. Your company is not developing this property. You have some questions about the promises that the developer is making. Can he keep them?

Lewis or Linda Wong

Teacher & City Commissioner

You teach at the elementary school in Pleasant Valley. You know that the school is overcrowded and that a new one needs to be built. The school district doesn't have the money but if a new subdivision is built development money will help pay for a new school.

Manuel or Maria Garcia

Rancher

You own and operate a ranch near the north edge of the village and next to the 80 acre plot in question. You have been interested in buying the land to add to your family ranch.

Rahiim or Taneika Bixton

Apartment Manager

You manage an apartment complex in Pleasantville. Not all the apartments are rented and you worry that if people move to newer apartments and more of your apartments become vacant you might lose your job.

Tanya or Tom Avilla

Developer

You are the developer in the area who can afford to buy the land. You will make a big profit if the houses and apartments are built. You are successful, but you have been criticized more than once for developing areas that later flood.

Lee or Ann Vang

Kayaker

You are the recently elected president of the kayaker club, and feel you should represent the club's interests. The lake would be a perfect place to practice kayaking, but you know that the development also means the loss of valuable creeks and grassland.

Tyler or Summer Simpkins

President of Chamber of Commerce

This is your tenth year as president of the Chamber of Commerce. You are a developer and a landowner. Three of the buildings that you own in the village are vacant. Profits of businesses are steadily going down. New development would mean new customers.

Vladimir or Natalia Borisenko

Homeowner

You have lived in your home in a nearby subdivision for three years. Your two children take a bus to a school four miles away because there isn't room at the neighborhood school. You don't want more traffic, but maybe 1,000 more homes would mean money for a new school.

Jared or Nalice Johnson

Homeowner

You have lived near Babbling Creek for 30 years. Your house was flooded for the first time 10 years age. Since then it has flooded twice more. You have spent a lot to repair your house and you don't think that it wise to narrow the floodplain. You think new development will raise flood levels.

Leah or Nate Williams

Urban Creeks Council President

You know that the land near Babbling and Little Creeks is one of the last places near an urban area in the county next to open space. Once the land is lost to development it is gone forever.

Darnell or Joshua Becker
School Board Member

You ran for school board promising to build a new school. The assessments on the new development could provide money to build the much needed school. You believe that the lake and new wetland will make up for the loss of creek and grasslands.

Pablo or Rosio Martinez
Engineer

You are a young engineer working for Metropolis. You graduated with top grades and are respected in your profession. You agree the development plan will not make flooding any worse. You also know that the city needs to attract more building to increase tax revenue.

Bea or William Klemper
Disaster Worker

You work for the Federal government to help victims of natural disasters get loans to repair their homes. You know that the best policy, as communities develop in flood-prone areas, is not to narrow the floodplain.

Alexandra or Andrew Graves
Park Planner

You are designing a recreational trail for the city. It would follow Babbling Creek to Hill Town upstream. If the houses and apartments are built, a mile of the trail will be along busy streets instead of along a tranquil creek.

Jason or Jenna Jones
City Commissioner

You are a 65 year-old rancher. Your children all live in the city and none of them want to take over the family ranch. You want to sell your land and move to a place with less people.

Rita or Randy Smith
Carpenter

You depend upon construction projects for employment. The prospect of a new large development means you would have work for a long time. You like the idea of a subdivision on the grasslands. Jobs are more important than habitat for animals.

Rachel or Ryan O'Donnell
Restaurateur & City Commissioner

You opened your fast food restaurant in Pleasantville five years ago. The new homeowners and their families would mean more customers. You might be able to open a second restaurant if the open grasslands were developed.

Melanie or Michael Ikemoto
Retired Lawyer & City Commissioner

You retired seven years ago and moved to a small ranch in Pleasantville. You moved to get away from traffic and crowds in the city. You like the open space and enjoy fishing in the creek. After the last subdivision was built you noticed strangers trespassing on your land.

More Ideas and Personal Notes:

Levels:
Grades 4-6

Subjects:
Science

Concepts:
- Creeks are parts of larger watersheds.
- Topographic maps show changes in elevation and delineate watersheds.

Objectives:
Students will:
1. Design and build a model mountain;
2. Draw a contour map;
3. Determine which three-dimensional model corresponds to a specific contour map; and
4. Interpret contour lines on topographic maps as three-dimensional features.

Skills:
Observing
Communicating
Organizing
Comparing

California Science Framework Theme:
Scale and Structure
Systems and Interaction
Energy

Materials:
Topographic maps
(See appendices under Equipment Suppliers or call 1-800-USA-MAPS)
Water-based clay
Clear container
Large rock

Time Considerations:
Preparation: 30 - 60 minutes
Activity: 45 minutes

WHAT ABOUT WATER?

Watershed Runoff

Overview

Students analyze and interpret a model watershed made out of clay.

Background

Water is dynamic. Water moves through Earth's surface, interior and atmosphere in different forms: as a liquid, a gas or a frozen solid. The pathways followed by water through and around Earth are known as the hydrologic cycle. Water flows through rivers to bays and oceans and flows into the ground, recharging underground aquifers.

A watershed is an area of land on which rain or snow ultimately drains down into an individual creek or river system. As water moves down hill, its energy carves out and shapes creek and river courses within a watershed. The area of land that drains into a creek is determined by the topography or "lay" of the land.

Getting Started

1. Using a compass, have students determine which direction in a classroom or play yard is north, south, east and west. Have the students draw a rough map, indicating directional symbols including objects and landmarks.

2. Topographic maps show shape and elevation of land forms with contour lines. Demonstrate the concept of a topographic map. Place a large rock into a see-through container. Mark one inch (2.54 cm) intervals on the outside of the container. Pour water into the container to the one inch mark. Using a grease pencil, draw a line around the rock at the water line. Continue to pour more water into the container one inch at a time, marking the water level at one inch intervals. The resulting set of parallel lines around the rock are representative of the contour lines on a topographic map. Hold the rock with the top facing towards the students, showing them what the contour lines would look like from above. This view of the rock is identical to a topographic map's two-dimensional representation of the rock.

Procedure

1. Have each group model a mountain out of clay. Be sure that they include a steep cliff, flat plain, and gradual incline. When the group is finished, "key" the model by running two wooden dowels near highest point straight down through the clay mountain. The resulting holes will be used when the students overlay their contour clay slices and trace around them. Using fishing line or dental floss cut the clay mountain into equally spaced horizontal pieces. Trace each piece one at a time to illustrate a contour line. Be sure to line up the holes. The completed illustration will represent a topographic map. When the map is finished stack the clay slices back together using the hole made by the dowel to remake the clay mountain.

2. Group all the models together. Exchange the groups' topographic maps. Ask the groups to determine which model corresponds to the map that they have.

Summary

Discuss the following with your students:

- Using two clay mountain models, identify water shed boundaries between the two peaks.
- What features are indicated on each map and model?
- Where would be a good location for a town? Why?

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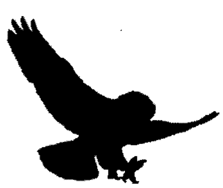


EXTENSIONS:

The Lay of the Hand

Contour maps can be difficult to understand. It is a challenge to mentally translate a flat map into a three-dimensional area filled with plains, valleys, hills and mountains.

Contour lines represent points of equal elevation. To understand how contour lines work, make a fist with one hand. Rest your hand on a flat surface and using a water soluble pen, mark a level circle around the highest knuckle. Mark a second and third circle below. Notice how your pen moves across the slope of the back of the hand and through finger valleys. After all the lines are marked, spread your hand flat. With a little practice you can "see" the shape of your fist even when its flat.

Levels:
Grades 2-6

Subjects:
Science, Language Arts

Concepts:
• Creeks are home to diverse life that interacts with each other.

Objectives:
Students will:
1. Be able to recognize the interdependency of physical and biological components in a creek habitat.
2. Be able to describe relationships between creek inhabitants.
3. Be able to describe the special roles creek inhabitants perform.

Skills:
Comparing
Organizing
Communicating

California Science Framework Theme:
Energy
Systems and Interaction

Materials:
Creek webbing cards
Yarn for webbing

Time Considerations:
Preparation: 60 minutes to copy and cut cards
Activity: 10 to 20 minutes

Creek Habitat Webbing

"Everything's connected to everything else."

Background

A creek habitat includes the plant and animal communities living along its banks and within its water as well as non living components such as soil, air and sunlight. "Creek Habitat Webbing" highlights the roles that different creek inhabitants perform as they live out their lives as well as their interdependency.

Getting Started

Enlarge the "Creek Inhabitants" pictures, laminate, punch two holes at the top and string with yarn so the cards can be worn easily around the neck. Roll a skein of yarn into a ball to use as the webbing between the cards.

Give each student a card to wear around their neck and group everyone in a circle. Start with the picture of the sun. Introduce it by asking, "What is the source of all the energy on Earth?" The student having the sun card starts the webbing by holding the end of the ball of yarn. Then ask, "What living things are able to make their own food using the sun's energy along with minerals and water?" Stretch the yarn from the sun to one of the plant cards, for example the cattail card. Facilitate a discussion about the role of the cattail and what it needs to live as well as what it provides for other creek dwellers. There are many connections that can be made, for example the muskrat eats cattail. In this case the yarn would then go from the cattail card to the muskrat card. What else does the muskrat eat? Where do they make their burrow? Who would eat a muskrat? There is no **one** way to web the creek habitat. Each time you and your students play the "Creek Habitat Webbing" game it can turn out differently.

Summary

When all the cards are connected, introduce different situations such as stating; "A pesticide has been poured into the creek to kill the mosquitoes." Ask the students what effect this will have on the creek and its inhabitants? After the discussion, ask the student with the mosquito card to start giving a continuous gentle tug on their yarn. Then ask every student who feels the tug to start gently pulling on their yarn also, until everyone in the circle is included. This demonstrates that every component in a habitat is connected to everything else, no matter how small.

EXTENSION:
Make a creekside concentration game. Make two copies of each "Creekside Inhabitants" cards and use as a concentration game by matching pairs.

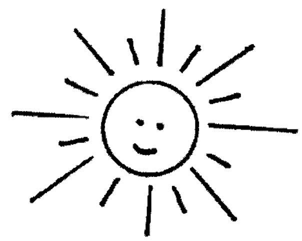
Creek Webbing Habitat Activity Cards

Dipping Into Creeks Webbing Card

Cloud

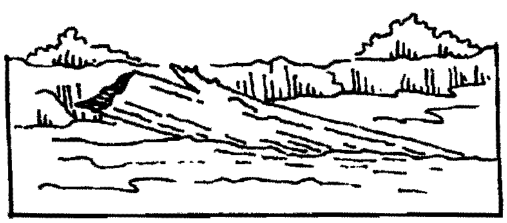
Dipping Into Creeks Webbing Card

Sun



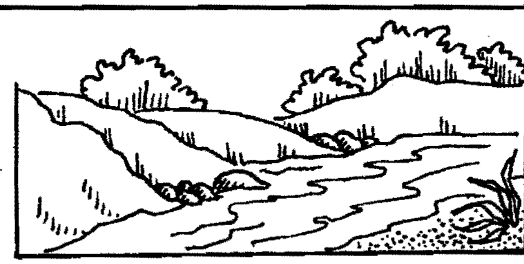
Dipping Into Creeks Webbing Card

River and Log



Dipping Into Creeks Webbing Card

River

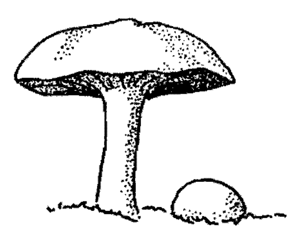


Dipping Into Creeks Webbing Card

Worm

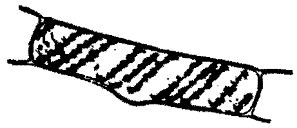
Dipping Into Creeks Webbing Card

Mushroom



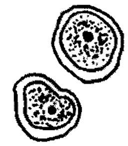
Dipping Into Creeks Webbing Card

Spirogyra



Dipping Into Creeks Webbing Card

Algae



Dipping Into Creeks Webbing Card

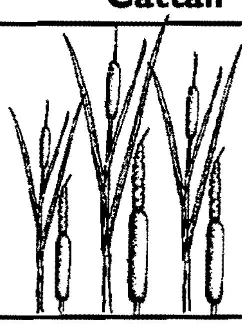
Duck Weed

Dipping Into Creeks Webbing Card

Water Weed

Dipping Into Creeks Webbing Card

Cattail



Dipping Into Creeks Webbing Card

Wild Grape

Dipping Into Creeks Webbing Card

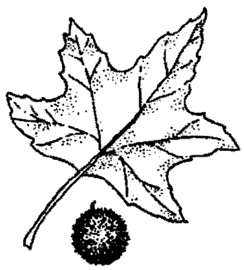
Poison Oak

Dipping Into Creeks Webbing Card

Willow

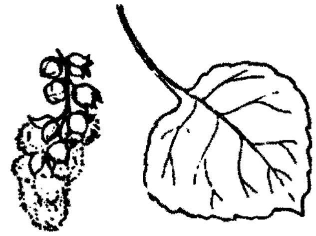
Dipping Into Creeks Webbing Card

Sycamore



Dipping Into Creeks Webbing Card

Cottonwood

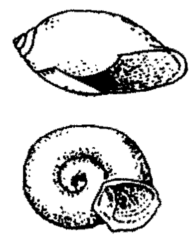


Dipping Into Creeks Webbing Card

Blackberry

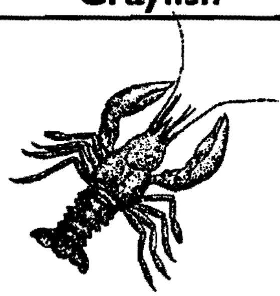
Dipping Into Creeks Webbing Card

Fresh-water Snail



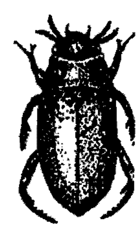
Dipping Into Creeks Webbing Card

Crayfish



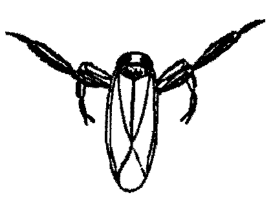
Dipping Into Creeks Webbing Card

Water Beetle



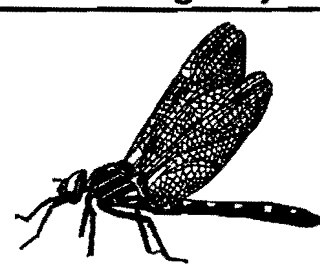
Dipping Into Creeks Webbing Card

Water Boatman



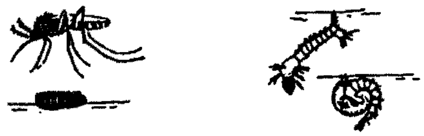
Dipping Into Creeks Webbing Card

Dragonfly



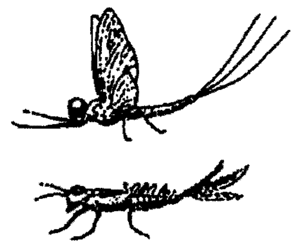
Dipping Into Creeks Webbing Card

Mosquito



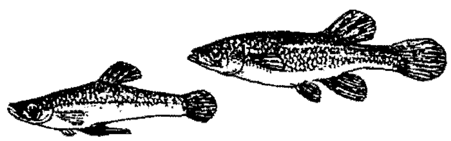
Dipping Into Creeks Webbing Card

Mayfly



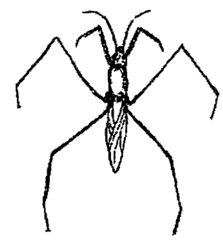
Dipping Into Creeks Webbing Card

Mosquito Fish



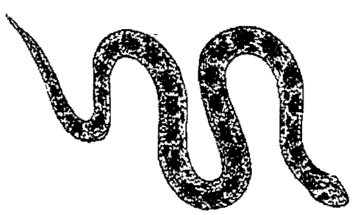
Dipping Into Creeks Webbing Card

Strider



Dipping Into Creeks Webbing Card

Gopher Snake

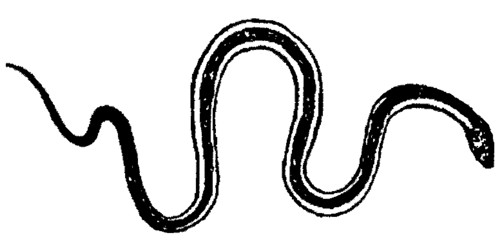


Dipping Into Creeks Webbing Card

Toad

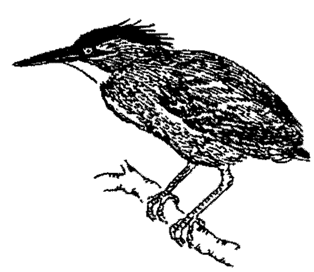
Dipping Into Creeks Webbing Card

Garter Snake



Dipping Into Creeks Webbing Card

Green Heron

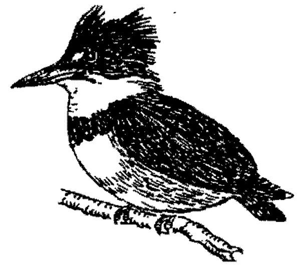


Dipping Into Creeks Webbing Card

Muskrat

Dipping Into Creeks Webbing Card

Kingfisher



Dipping Into Creeks Webbing Card

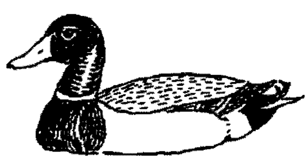
Opossum

Dipping Into Creeks Webbing Card

Red-shouldered Hawk

Dipping Into Creeks Webbing Card

Mallard



Dipping Into Creeks Webbing Card

Raccoon

Dipping Into Creeks Webbing Card

Beaver

Dipping Into Creeks Webbing Card

Skunk

Levels:
Grades 4-8

Subjects:
Science

Concepts:
• Erosion is a natural process.
• Erosion is compounded when natural vegetation is removed from creek banks.

Objectives:
Students will:
1. Model a watershed
2. Simulate rain on their watershed
3. Infer what aids and slows erosion

Skills:
Observing
Communicating
Comparing
Relating

California Science Framework Theme:
Patterns of Change
Scale and Structure
Stability
Energy

Materials:
Diatomaceous earth
Sand
Plastic dish pans
Wooden cubes or dice
Straw or grass clippings

Time Considerations:
Preparation: One hour or more to gather materials.
10 to 20 minutes to discuss erosion.
Activity: 30 to 60 minutes

Waterway Erosion

Background

As a creek meanders and flows, the shape of the creek banks is important to the health of the creek habitat. Erosion occurs on the outside bend of the creek where the water velocity and energy is the greatest. On creek banks with little or no vegetation, there is a greater chance that the banks may collapse, threatening creek inhabitants with excessive silt and debris. Erosion may be slowed down when concrete or rocks are used to hold an eroding creek bank. However the force of the water is only deflected downstream, causing more extensive problems there. The best solution to protecting creek banks is to leave the vegetation intact and, where necessary, replanting.

Procedure

• Fill the dish pans half full with $^{2}/_{3}$ diatomaceous earth (found at pool supply stores) $^{1}/_{3}$ sand and enough water to mix to the consistency of soft clay. Pour Diatomaceous earth slowly and carefully from the bag into the trays to avoid creating any dust.

• Prop up one end of the pan and push the diatomaceous earth towards the lower end to create a sloped surface. Part of the pan will be bare.

• Create "rain" by spraying water over the diatomaceous earth for 8-10 seconds. You should see small "creeks" forming. Notice that after you stop spraying, the water will keep flowing. You will start to see erosion occur.

• Scatter a few pinches of straw or grass on the surface along a creek, and then make it rain again for another 8-10 seconds. What happens?

• Next, sprinkle more straw or grass clippings along the creek but press them down into the earth to represent plants rooted in the soil along the banks. This represents healthy creek banks with lots of vegetation. Make it rain again. What happens this time?

• Create a concrete playing field on the banks of the creek, using a 2" x 4" square of waxed paper. Make it rain again. Compare the amount of erosion downstream before and after.

• Build a housing tract on the creekbanks using small dice. Make it rain again. What happens to the homes?

• Channelize your creek using long, thin strips of waxed paper. Observe how this affects the speed of runoff.

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EXTENSIONS:

Non-Point Source Pollution

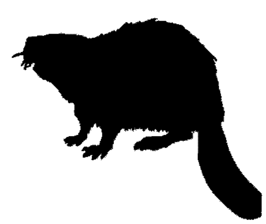
Not all forms of water pollution are point-of-source pollution. Non-point sources are pollutants that are typically generated by human activities all over a watershed, not just poured into the water itself, and are carried to creeks, rivers, lakes, and eventually the ocean. During storms, runoff can wash large quantities of the toxic by-products of our daily lives into our creeks.

Fertilizer/Pesticide

Sprinkle powdered drink mix on the surface to represent pesticides or fertilizer on a field. Spray water over the surface to simulate rain, Observe, and discuss the results.

Landfill/Abandoned Waste Site

Roll a 1 inch piece of paper towel into a ball and saturate it with food coloring. Place it beneath the surface to represent an improperly designed abandoned waste site or old (dump) landfill. Spray water on the surface and observe the results.



Levels:
Grades 3-8

Subjects:
Science

Concepts:
• Wetlands help to neutralize and breakdown toxic runoff.

Objectives:
Students will:
1. Make a model of a wetland
2. Perform experiments using the model wetland

Skills:
Observing
Organizing
Relating

California Science Framework Theme:
Scale and Structure
Stability
Systems and Interaction

Materials:
Plastic soda bottles
Gravel, sand, soil
Plant
Food coloring

Time Considerations:
Preparation: 60 minutes
Activity: 20 to 45 minutes

Wetland Purifiers

Background

Wetlands areas like freshwater and saltwater marshes, delta areas, bogs, and wet meadows are uniquely important to plants, animals, humans, and the total environment. Because wetlands contain an abundance of food, cover, and water they support a multitude of diverse wildlife. Wetlands also have the ability to purify the environment by acting as natural filtering systems. They can trap and neutralize sewage waste, allow silt to settle, and promote the decomposition of many toxic substances. Plants help keep nutrient concentrations from reaching toxic levels, and slow down water flow causing silt to settle out.

Procedure

1. Cut the tops off of two large 2 liter size plastic pop bottles, just where the curve stops. Carefully poke a few holes in the bottom of one of the plastic bottles with a hammer and nail.

2. Put about a cup of gravel and a layer of sand in the bottle with the holes. Put in a little soil and a plant with a thick root system. Grass that comes with sod or weeds will work. Inset the bottle with the plant into the empty bottle. This is a model of a wetland environment.

3. Prepare a cup of water with some food coloring in it and a pinch of sand. The sand and the food coloring will be your pollution in the water.

4. Pour some of the water onto the model wetland, a little at a time.

5. Look at the water that percolates down through the wetland and into the sand and gravel. The sand may have some color in it, but not the gravel. Why? The plants in a wetland can only take so much up into their root and leaf systems. Wetlands can be overburdened by pollution.

Nature's Plant Purifiers

A Demonstration of How Plants Take Up Fluids Into Their Tissues

Levels:
Grades K-4

Subjects:
Science, Language Arts

Concepts:
- Plants are important in removing pollutants from a wetland.

Objectives:
Students will:
1. Describe how plants remove pollutants from the water.
2. Understanding the limitations of cleaning the water when it is overburdened with pollutants.

Skills:
Observing
Communicating
Relating

California Science Framework Theme:
Systems and Interaction

Materials:
A celery stalk with leaves on
Jar or glass cup
Food coloring
Water
Paring knife
Cutting board

Time Considerations:
Preparation: set up the day before. 10 to 30 minute discussion of wetlands.
Activity: small amounts of time over 2 or 3 days

Background

The plants growing in a wetland help filter pollutants out of the water flowing into it. The mass of stems, leaves, and roots in a densely vegetated wetland trap particles of sediment and take up excess nutrients and toxic pollutants. It is important to maintain and add to our wetland areas.

Procedure

1. Put a few drops of food coloring into a jar of water. The food coloring will represent pollution.

2. Slice off the bottom of a celery stalk. Notice the big tubes that run through the plant. The celery stalk is like many wetland plants that have their roots in water and have tubes running up inside the plant.

3. Put the celery inside the colored water and watch it over a few days. The dye will eventually be drawn up, even into the leaves. After a few days cut the stalk and see the water- and dye–filled channels in the celery cross section.

Questions to consider:

1. Where does the water go after it goes up the plant? The water goes up into the pores of the plant and eventually evaporates.

2. What happens to the pollutants? Some are used by the plant's metabolic systems just as nutrients are. The plant can also store some of the pollutants inside its tissues. Plants can also detoxify some pollutants.

3. Why can't we dump all our pollutants into the wetlands? Plants can only handle so much, and too many pollutants will kill plants.

Levels:
Grades 6-8 (Requires some chemistry skills for pH testing.)

Subjects:
Science, Language Arts

Concepts:
- The health of a creek is measured in many ways.
- pH, DO and temperature parameters are used to measure the health of a creek.

Objectives:
Students will:
1. Understand the relationship of the pH scale to acidity and alkalinity.
2. Understand the relationship of DO to diversity of creek life,
3. Understand the relationship of temperature to the life cycle of creek life.
4. Gain insight into the sources and problems of acid rain.

Skills:
Observing; Communicating; Comparing; Organizing

California Science Framework Theme:
Patterns and Change
Systems and Interaction

Materials:
A local map
Wide-mouthed glass containers which can be capped
Test tubes if available
pH test kit
Tweezers
Water samples from rain, local creeks, ponds, etc.
Containers of various substances, such as: ammonia, baking soda solution, distilled water, tap water, lemon juice, cranberry juice, milk, milk of magnesia, vinegar, and shampoo

Time Considerations:
Preparation: Set up a day ahead; an hour for testing and discussion
Activity: Various times over the year

WATER QUALITY

pH Testing

Background

pH is a common indicator of water quality. pH measures the hydrogen ions (H+) in the water. The more hydrogen ions the more acidic the water. A pH test will also tell if the water has a higher concentration of hydroxyl ions (OH-) and is alkaline. The pH concentration of water is extremely important to aquatic life. Most creek critters are adapted to living in neutral conditions.

Human activities influence the level of acidity in a creek. Acid rain is a result of air pollution from car exhaust and other fossil fuel burning which become part of the water cycle and fall back to earth, with rain, as weak sulfuric acid and nitric acid. Since most fish species have pH tolerance ranges from 6 to 8.5, when acid rain lowers the pH to below 5 it can be lethal.

The pH (acidity or alkalinity) of water is measured according to a scale which ranges from 0-14. Distilled water has a pH of 7.0, which is considered neutral. Readings above pH 7.0 are alkaline, and below 7.0 are acidic. The scale is a base-10 logarithmic progression which means that a solution with a pH of 4.0 is 10 times as acidic as a solution with a pH or 5.0, and 100 times as acidic as a solution with a pH of 6.0 Therefore, the lower the pH number, the stronger the acidity; the higher the pH number, the stronger the alkalinity. Rainwater is slightly acidic, with a pH of 5.7.

Classroom Procedure

Divide students into groups of four so they can test the pH of various acid and alkaline solutions using a pH test kit. Students can test common household substances such as vinegar, ammonia, cranberry juice, lemon juice, baking soda solution, milk of magnesia, tap water, distilled water, and soft drinks. Groups can record their findings on the pH data sheet.

Creekside Procedure

Collect small water samples from several different places and measure the pH. Compare the pH of the creek water to the solutions tested in the classroom. Discuss ways that people can help keep the pH levels at an optimal level for creek life.

Dissolved Oxygen (DO) Testing

Background

Oxygen is present in water in a dissolved form. Almost all plants and animals need oxygen for growth and metabolism. Aquatic organisms have special adaptations that allow them to extract and store oxygen. Oxygen is mixed into the water at the surface, with the help of currents, wind and rain and as a by product of photosynthesis from aquatic plants and algae.

Dissolved Oxygen content is affected by temperature, salinity, altitude and flow. Cold water holds more oxygen than warm or salty water, and is more easily dissolved into water at low altitudes. Each creek organism has a specific oxygen requirement. Most require DO in the range of 8 mg/l to sustain life. Creeks with low dissolved oxygen, less than 3 mg/l are considered oxygen poor. Most fish are stressed at this level, and many species may be absent.

The amount of DO in water is expressed as a concentration. A concentration is the amount in weight (mass) of a particular substance per a given volume of liquid. The DO in a creek is the mass of the oxygen gas present, in milligrams (mg) per liter (l) of water.

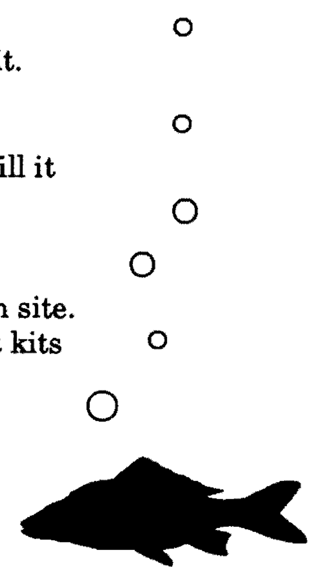
Classroom Procedure:

Obtain a dissolved oxygen test kit from a chemical supply company, (see listing in the appendices under equipment sources.) Read the instructions that accompany your dissolved oxygen test kit, including safety and material handling considerations.
Test using samples of tap water, rainwater, and creek water.
Clean all containers/tubes thoroughly and rinse with distilled water.

Creekside Procedure:

Follow the directions that accompany your dissolved oxygen test kit.
Rinse testing containers/tubes a few times with the water you will sample.
Submerge the sample bottle into the water, allowing the water to fill it slowly. If any bubbles are present, try again.
Continue with the DO testing.
If possible, conduct three tests at each sampling site.
Be sure to carry out all waste products when you leave your stream site.
Refer to the material handling information provided with your test kits to find out about proper disposal.

What was the average DO concentration in your stream?
Compare the DO level to the number of species present.



Water Temperature Testing

Background

Water temperature is a controlling factor for aquatic life: it controls the rate of metabolic activities, reproductive activities and therefore life cycles. Heat reduces the ability of water to hold dissolved oxygen. Heated water is often returned to creeks, streams, rivers, and lakes. With less oxygen in the water, fish and other aquatic life can be harmed. Water temperatures that are much lower than normal can also cause habitat damage.

Classroom Procedure

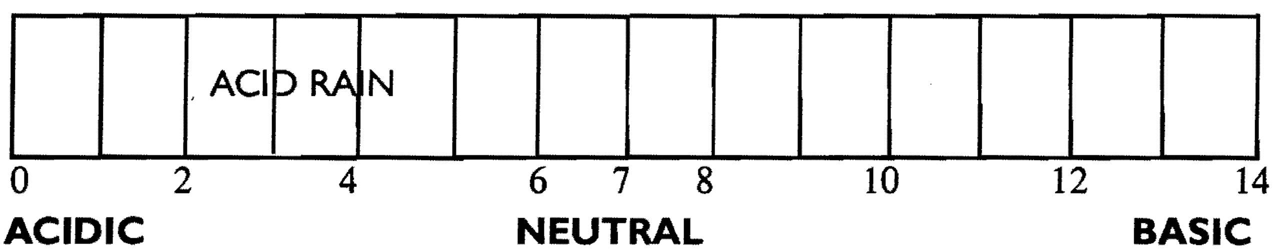
- Measure the temperature of the samples of tapwater, rainwater, and creekwater that were used to test for dissolved oxygen,
- Keep the thermometer in the water for approximately two minutes.
- Record your data.

Creekside Procedure

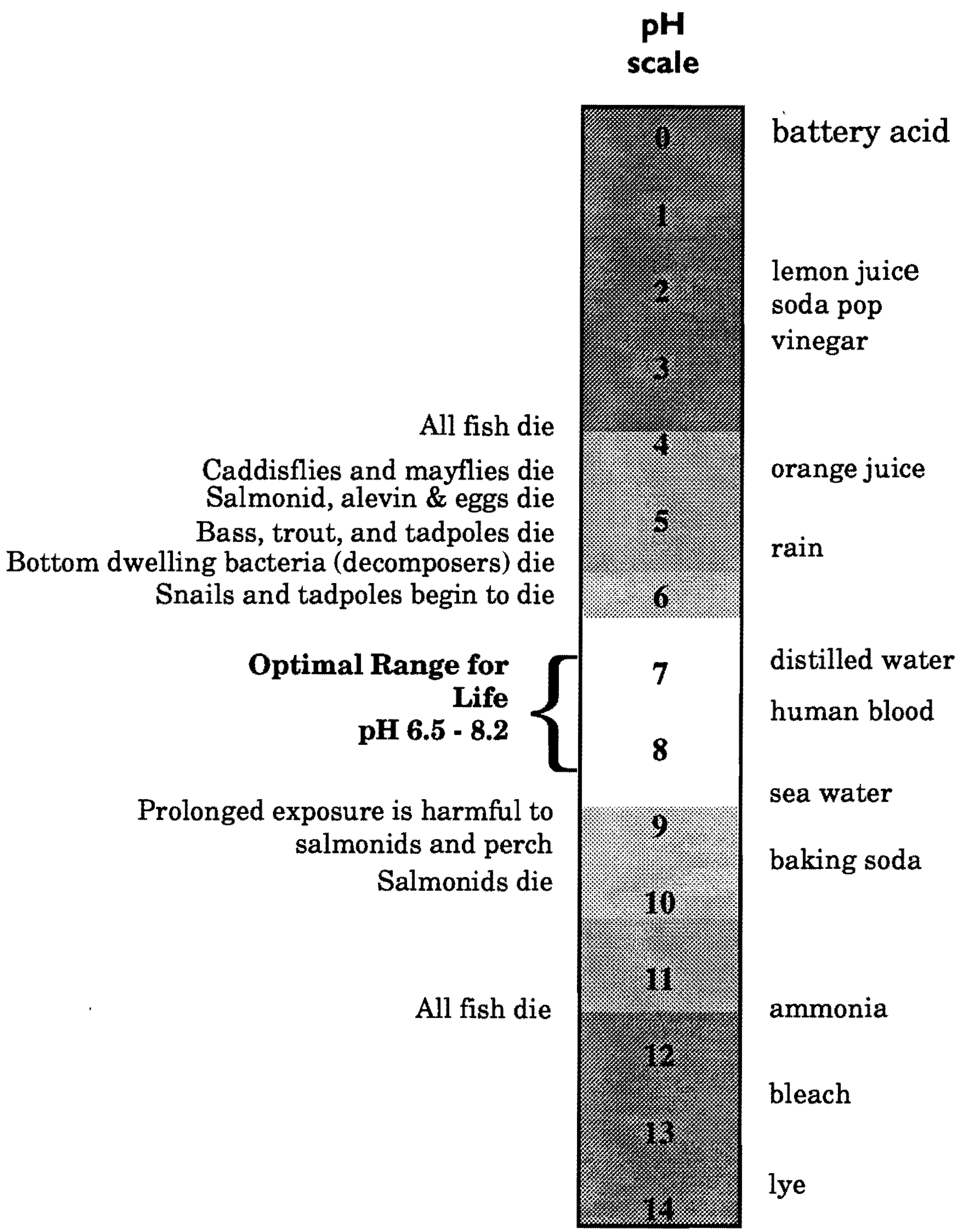
- Measure temperature at the same locations where you measure pH and dissolved oxygen.
- Monitor temperature on a monthly basis, at the same time each day.
- Lower the thermometer by a string approximately four inches below the surface.
- Leave the thermometer in the water for approximately two minutes.
- Record your data.
- Compare your results to the state and federal standards for aquatic life.
- Find the percent saturation of oxygen by comparing your temperature reading with your dissolved oxygen test results.

Dipping Into Creeks pH Rating Scale

Liquid	Column A Predicted results: Acid, Neutral or Basic	Column B Actual pH	Column C Acidic, Neutral, or Basic
Ammonia			
Baking Soda Solution			
Distilled Water			
Lemon Juice			
Milk			
Milk of Magnesia			
Saliva			
Shampoo			
Tap Water			
Vinegar			
Other			
Rain Water			



Dipping Into Creeks pH Scale of Common Substances



Parameters for Dissolved Oxygen Concentration and Optimum Temperature

Temperature

F°	C°	O_2 mg/l
32	0	14.6
35	1.67	13.81
40	4.44	13.09
41	5	12.75
45	7.22	12.12
50	10	11.27
55	12.78	10.52
59	15	10.07
60	15.56	9.85
65	18.33	9.45
68	20	9.07
70	21.11	8.90
75	23.89	8.40
77	25	8.24
80	26.67	7.95
85	29.44	7.54
86	30	7.54
90	32.22	7.28
95	35	6.93

Cold Range
(41–55 F°)
steelhead, salmon (pink, chum, coho, sockeye, chinook, kokanee), cutthroat, rainbow, brown trout, brook trout, dolly varden, arctic grayling, smelt, cal roach, speckled dace
mayflies, caddisflies, stoneflies

Cool Range
(59–68 F°)
salmon (coho, chinook), cutthroat, lamprey, sturgeon, shad, dace, shiners, stickleback, walleye, sculpins
mayflies, caddisflies, stoneflies, beetles

Warm Range
(68–77 F°)
bass, shiners, bluegills, bullheads, carp, catfish, suckers, squawfish, dragonflies, trueflies, and some caddisflies

Finding Percent Saturation Of Your Solution

1. Find the maximum saturation value for the temperature in your creek using this chart.
2. Divide your test value by the maximum value found. For example, if the creek temperature is 8°C the maximum saturation value would be approximately 11.80 mg/l. If your creek reading was 8.50 then:

    8.50 / 11.80 = 72.03%

3. A healthy stream is considered to be 90-100% saturated. If your percent is lower then something other than temperature is affecting oxygen levels adversely.

LET CREEK STUDIES BRING YOUR SCIENCE LESSONS TO LIFE

An overview of science curriculum areas where aquatic ecology principles may be substituted for, or used in conjunction with, science text lessons.

TOPIC IN SCIENCE TEXT	CREEK ACTIVITIES AND STUDY IDEAS
I. Classification of Living Organisms	**Look for and identify the living things associated with creeks and streams.** (Use the "Creek Guide" and other suggested creek activities.)
A. Invertebrates	**Identify and list the types of invertebrates** found living in a creek or aquatic environment. (You will need a microscope for the simple protists.) **Record the number of species.**
B. Vertebrates	**List and/or research the types of vertebrates** you might find on ariparian hike, i.e., amphibians, fish, reptiles, (pond turtles and garter snakes), birds and mammals. (Use the "Creek Guide") **Take a riparian walk and look and listen for animals or look for their signs**, e.g., songs of birds, footprints in the mud, scat (droppings). Did you find the animals you expected?
C. Animal Populations	**Observe and record the animals or signs found. Was any group more abundant? Did you see plants in groups or interspersed?** In the classroom, **discuss the role each organism plays within the riparian community**, e.g., carnivore, herbivore, scavenger, decomposer.
II. Web of Life and Energy Flow	**Read your science materials and then study the web of life and energy flow within the framework of the aquatic community.**
A. Aquatic Plants	**Collect and study algae and survey larger plants.** Discuss "producers". *Plants are called producers because they "produce" their own food via photosynthesis. The number and variety of plant species will determine the number and variety of animals in any given community. Riparian communities are especially rich in plant life from single-cell algae in the water to the vertical and horizontal layers of trees and shrubs along the creeks.*
B. Consumers	**Inventory and identify:** **Primary consumers** — Protists and other invertebrates that eat plants, e.g., daphnia, copepods, scuds, mayflynymphs, water boatmen, tadpoles. **Secondary consumers** —Insects, small fish and amphibians that consume smaller animals. **Tertiary consumers** — larger fish, birds, and mammal predators at the top of the food web (including us).

TOPIC IN SCIENCE TEXT	CREEK ACTIVITIES AND STUDY IDEAS
	Construct a food pyramid showing how the number (mass) and diversity of primary consumers is greater than the secondary consumers, which in turn outnumber the tertiary. Use nested cannisters to further illustrate this concept of biomass.
C. Decomposers	**Look for and discuss decomposers.** Most decomposers are unseen bacteria and fungi but seek out some of the larger ones and their signs. Look for crawdads, mushrooms, snails, earthworms and others. How do they perform their roles of decomposers?
III. Relationships among Organisms in the Community and Survival	**Discuss who are the predators? Prey? How is each adapted to eat and not be eaten. What is each organism's contribution to the whole community? Remember, all organisms cycle nutrients within the community.**
IV. Physical Properties of Aquatic Communities	**Examine the water cycle.** **Measure the size and shape of your aquatic habitat.** **Estimate water flow and volume.** **Measure nutrients and pollutants** (an activity best for older children). **Examine an area devoid of plants and record erosion.** **Examine horizontal and vertical zonation** typical of riparian systems.
V. Health, Conservation and Ethics	**Discuss the values of aquatic habitats.** **List the values of aquatic habitats** — watersheds, fisheries, drinking water, recreation, wildlife habitats, etc. **Discuss the importance of responsible decision making.** **Brainstorm ways for students to help keep aquatic environments "healthy".**

Adaptation: an inherited structural, functional or behavioral characteristic that improves an organism's chances for survival in its chosen habitat, i.e., something that makes an animal or plant more fit for survival in its environment. For example, a fish's fins and body shape help it to move easily through the water.

Adapted: how an organism is modified for survival in its environment. For example, a snake's coloring matching its particular habitat to provide camouflage.

Aquatic: living in water.

Carnivore: a meat eating animal. A secondary or tertiary consumer.

Cell: a single mass of protoplasm (a jelly-like life-giving substance) surrounded by a membrane or wall which holds it together. Cells are living organisms which carry on all life processes such as reproduction, respiration and digestion while being contained in a single microscopic unit. They are among the smallest units of life. Cells usually have a nucleus which is the center that controls its life processes.

Consumer: organisms (living things) that eat or consume plant material and/or other animals. They are not organisms that manufacture food from non-living substances, as plants do.

Decomposers: organisms, principally bacteria and fungi, that live by extracting nutrients and energy from decaying plants and animals, While doing this, they release chemicals stored in the dead organisms into the environment where they become available to other living, growing things.

Diatom: a microscopic, single-cell, yellow-green alga. The two halves of the cell overlap and fit together like the halves of a pill box.

Ecosystem: a natural unit that includes living and non-living parts interacting to produce a stable system in which the exchange of materials between the living and non-living parts follows closed paths.

Energy Cycle: the process by which energy from the sun is passed from one organism to another. Green plants capture the sun's energy through the process of photosynthesis; they are eaten by herbivores who are consumed by carnivores who are, in turn, consumed by the decomposers that release nutrients for green plants. (A great deal of energy, mainly in the form of heat, is lost at each interchange.) Nutrients cycle within a system; energy flows through a system.

Erosion: the removal or wearing away of soil or rock by water, wind or other forces or processes.

Evaporation: the process in which a substance changes from a liquid to a gas by exposure to air and/or heat.

Food Web: an interlinking system of food chains.

Habitat: the immediate surroundings (living place or home) of a plant or animal. It contains everything necessary for life in a particular location.

Herbivore: an animal that eats only plant material.

Hydrology: the science which deals with the study of the waters of Earth and its atmosphere.

Metamorphosis: a process through which an organism changes from one form to another- usually that change becomes a new life stage, i.e. egg, tadpole, adult frog; egg, larva (mosquito wiggler), pupa, adult (flying mosquito).

Niche: the function or role played by an organism in a biological community. An animal's niche includes its requirement for food, shelter and space and its adaptation to secure these needs, for example, a predator with sharp senses, stealth and camouflage.

Omnivore: an animal that eats both plants and animals.

Organism: any living thing.

- **Microorganism**: any living thing so small it must be observed through a microscope.
- **Macroorganism**: a tiny living thing that can be seen with the unaided eye, but is more easily observed with magnification.

Photosynthesis: the process by which green plants, using energy from the sun, convert carbon dioxide and water into simple sugar and oxygen gas. **Chlorophyll** - the green plant pigment - is essential to the process.

Phytoplankton: microscopic and near microscopic plants which freely float in marine and fresh water systems. They are single-cell or colonies of single-sell organisms, and may also be called protists.

Population: a group of similar, interacting individuals of the same kind.

Producer: a term referring to plants as "producers" of food or stored energy in the form of simple sugars. A green plant with the ability to combine carbon dioxide and water, in the presence of chlorophyll and sunlight, and manufacture or "produce" sugar and free oxygen.

Protista: a term used to describe the Kingdom designation containing all one-cell organisms, These include protozoans (one-cell animals), algae (one-cell plants) and diatoms.

Protozoa: simple one-cell animals such as amoebae and paramecia.

Raw Materials: simple non-living organic and inorganic substances taken up and used directly by plants and the more primitive animals, fungi, bacteria, etc., for growth and maintenance. Raw materials are generally recycled in the environment.

Riparian: relating to or living on the bank of a natural watercourse; the habitat immediately adjacent to a creek, river or other body of water.

Runoff: water that drains or flows off the surface of the land.

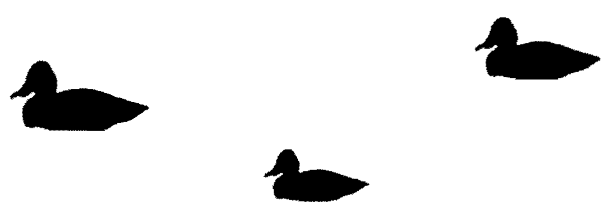
Sediment: earthy or organic debris suspended in or deposited by water.

Single-cell organism: an animal or plant made up of a single cell.

Storm Drain: a constructed drain designed to capture rain water and surface runoff and direct the flow to the natural drainage of the landscape, such as a creek or other waterway.

Watershed: the area drained by a river or stream and all its tributaries.

Zooplankton: floating microscopic and near-microscopic animals. Zooplankton feed upon phytoplankton and are in turn fed upon by larger animals in aquatic food chains.



EDUCATOR GUIDES AND CURRICULUM MATERIALS

Clean Water, Streams and Fish - A Holistic View of Watersheds: Curriculum guides which include a series of lessons and resources on salmonids, emphasizing freshwater habitat specific to Washington State, but applicable to northern California. Contact Washington State Office of Environmental Education, c/o Shoreline District Office, NE 195th and 20th Avenue NE, Seattle, WA 98155. (Elementary and Secondary)

Habitat Fun Pack: Wetland activities for teachers. California Central Valley Joint Venture, U.S. Department of the Interior, Fish & Wildlife Service. 911 N.E. 11th Avenue, Portland OR 97232-4181. (K-3, 4-6, Jr. & Sr. High School)

Investigating Streams and Rivers, an Interdisciplinary Curriculum for use with Mitchell and Stapp's Field Manual for Water Quality Monitoring. 1991. Includes suggestions for using computer networks to enhance student understanding. G.R.E.E.N., School of Natural Resources, University of Michigan, Ann Arbor, MI 48109-1115 (313) 764-5171.

Learning Activities for Youth Groups, Age 10-15: "Water Inspectors", "Fresh Water Guardians", "Creek Watchers", etc. published by the California Aquatic Science Education Consortium. This series of curriculum guides help youth leaders and other non-traditional educators to involve their charges in learning experiences which lead to aquatic action projects. Also in Spanish. Contact: C.A.S.E.C., Graduate School of Education, Univ. of Calif., Santa Barbara, CA 93106 (805) 893-2739. (Ages 10 - 15)

O.B.I.S. - Outdoor Biology Instruction Strategies: Water activities lesson plans presented on small cards for easy use. Delta Education, Inc., P.O. Box 915, Hudson, NH 03051, 1-800-258-1302. (Elementary)

Project Learning Tree: Tree related activities to develop environmental awareness. Contact Project Learning Tree, California Department of Forestry and Fire Protection, 1416 9th Street, Sacramento, CA 95814. (916) 653-7958. (Elementary and Secondary)

Project WILD Aquatic Activities: Environmental education activities focus on marine and fresh water habitats. Contact the California Department of Fish and Game, Project WILD, 1416 9th Street, Sacramento, CA 95814. Project WILD and WILD Aquatic Workshops are prerequisites. Call for a workshop schedule (916) 653-7958. (Elementary and Secondary)

The Stream Scene - Watersheds, Wildlife, and People: The Stream Scene is a comprehensive curriculum package designed to bring watershed awareness into schools and communities. The book's format will guide the user from awareness to action as the study of watersheds proceeds. $15.00. Send order and payment to: Oregon Department Fish & Wildlife, Office of Public Affairs, P.O. Box 59, Portland, OR 97207. (503) 229-5400 Ext 432

Wading Into Wetlands: Ranger Rick Nature Scope, National Wildlife Federation, 1400 16th Street N.W., Washington, D.C. 20036. Wonderful, interactive lesson plans and ideas centered around aquatic organisms and their habitats. (Elementary)

Water Precious Water: Water activities and experiments with emphasis on the physical properties of water and soil. Project AIMS Education Foundation, P.O. Box 8120, Fresno, CA 93747. (209) 255-4094. Publication # 1301, $14.95. (Elementary)

WOW!! The Wonders of Wetlands: an Educator's Guide by Britt E. Slattery. 1991. The Guide contains comprehensive classroom and outdoor wetland activities. Contact Project WET Fund-RDI, The Watercourse, Culbertson Hall, Montana St. Univ., Bozeman, MT 59717-0057. (406) 994-1917 (Elementary and Secondary)

ECOLOGICAL PRINCIPALS

Ecology of the San Francisco Estuary, An Introduction to the San Francisco Estuary Project, P.O. Box 2050, Oakland, CA 94604-7990. This booklet examines the physical, biological and social processes affecting the San Francisco Estuary which drains an area of nearly 60,000 square miles, about 40 percent of the state. Good background material.

Refuge in an Urbanizing Land THE SANTA MARGARITA RIVER; Cultural and Natural Resource Value. The Friends of the Santa Margarita River, P.O. Box 923, Fallbrook, CA 92928. Written to educate a broad audience in the cultural history and special biodiversity of the Santa Margarita drainage basin. Excellent resource for activists and educators wishing to move learners from understanding to action.

AGENCIES AND FACILITIES WITH EDUCATIONAL PROGRAMS

California Department of Fish and Game: Publications and price list - contact DFG, P.O. Box 944290, Sacramento, CA 94244-2090, or call (916) 324-3812. All ages.

California Department of Water Resources, Water Education Office: 1416 9th Street, 95814. Informational booklets, coloring books, maps and other water related materials. (Elementary)

San Francisco Estuary Project, c/o RWQCB, 2101 Webster Street, Suite 500, Oakland, CA 94612 (510) 286-0460. A variety of public information and educational materials including resources, conflicting interests, water quality issues, etc., available free or for a small charge. Write or call for a Publication List.

Water Education Foundation, 717 "K" Street, Suite 517, Sacramento, CA 95814. Publishes and distributes a wide variety of water related educational materials having to do with western water issues including: **Western Water,** a bimonthly magazine presenting non-biased, in-depth coverage of western water issues; posters; maps; and educational packets. For a complete catalog write to the above address or call (916) 444-6240. (Elementary and Secondary)

WATER QUALITY

Field Manual for Water Quality Monitoring - An Environmental Education Program for Schools. 6th Edition. Mark K. Mitchell and William B. Stapp. 1992. Order: Wm. Stapp, 2050 Delaware Avenue, Ann Arbor, MI 48103

Global Rivers Environmental Education Network: is an international network of students, teachers, and other interested persons who seek to study and improve water quality in their regions. By linking schools around the globe with newsletters, a pilot computer conference, sister watersheds and other forums, GREEN involves students in an exciting, hands-on approach to education. Contact the University of Michigan, School of Natural Resources, 430 E. University, Dana Bldg., Ann Arbor, MI 48901-1115. (313) 764-5171. (Elementary and Secondary)

Project Mayfly - Guide to the Determination of Water Pollution in Local Waterways by Katherine Widmer. National Audubon Society, Mid-Atlantic Regional Office, 1104 Fernwood Avenue, #300, Camp Hill, PA 17011. The Guide contains study units which allow high school students to monitor the health of streams, rivers, and lakes in their own areas. Cost $10.00. (Secondary)

Stream Quality Monitoring, A Citizen Action Program: Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Scenic Rivers Program. This booklet demonstrates a simplified approach to stream water quality examination through the collection and analysis of key indicator species of aquatic insects and other macro-invertebrates. Organisms and associations easily relate to California ecosystems.

BOOKS

Adopting A Stream, A Northwest Handbook. Steve Yates. University of Washington Press, Seattle. 1988. The Adopt-A-Stream Foundation, 600 128th Street SE, Everett, WA 98208. The Foundation also publishes other related publications.

Adventures with Freshwater Animals. Richard Headstrom. (A small paperback with essays on individual pond and stream animals. Good for webbing, science and reading.) Dover Publications, N.Y.C. 1964.

Common Riparian Plants of California - A Field Guide for the Layman. Phyllis Faber and Robert Holland. Pickleweed Press. 1988.

Pond Life - A Golden Nature Guide. George K. Reid. (The single best field guide for elementary classes. Contains introductory sections on geology, hydrology, and ecological associations within aquatic habitats as well as the most common insect, fish, amphibian, reptile, mammal, and bird inhabitants.) Golden Press. New York 1987.

Pond and River - Eyewitness Books. Steve Parker. (A British publication with elaborate and informative photographs. Organisms are similar to those in the U.S.) Alfred A. Knopf, Inc. 1988.

Ponds and Streams - Nature Club. John Stidworthy. Troll Associates. 1990.

****Check with your local library for new titles**

PUBLICATIONS

California's Rivers and Streams - Working Toward Solutions. The booklet contains separate chapters on types of threats to our water resources such as mine drainage, agricultural pesticides, toxicity, etc. Final chapters on watershed management with a region-by-region summary. State Water Resources Control Board, Office of Legislative and Public Affairs, P.O. Box 100, Sacramento, CA 95812-0100. (916) 657-1247

Environmental Education Compendium for Water Resources: A Cooperative presentation by the California Department of Education, the California Department of Water Resources, and Sonoma State University. Printed in 1992, this Compendium evaluates state-wide water education environmental ed. materials available at the time. Most are still current. Additional water curricula not evaluated are listed in the back of the Compendium. Contact the State Department of Education for a copy.

Puddler - A Wetland Wildlife Magazine for Children. Published by Ducks Unlimited Inc. four times a year. Must be a member to receive publication. Send inquiries to Ducks Unlimited, One Waterfowl Way, Memphis, TN 38120, (901) 758-3825

San Francisco Estuary Project: Newsletter. Focuses on issues directly related to San Francisco Bay and Estuary. For Current Issues or to get on their mailing list, call (510) 464-7990

Volunteer Monitor - The national newsletter of Volunteer Water Quality Monitoring. For free copies or to get on their mailing list, write: Eleanor Ely, editor, 1318 Masonic Ave., San Francisco, CA 94117 or call (415) 255-8049

Western Water - Focuses on state water issues. Published bimonthly by the Water Education Foundation, 717 K Street, Suite 517, Sacramento, CA 95814 (916) 444-6240

ACTION IDEAS

Saving the Wetlands, A Guide for Audubon Chapters, Government Agencies, and Educators. National Audubon Society, Education Division, 950 Third Avenue, N.Y., NY 10022

Saving Wetlands: A Citizens' Guide for Action in California. The Guide contains strategies for saving wetlands at the local level and contains chapters on: locating wetland sites, identifying wetland types and threats to each site, ideas for working with owners of wetlands, etc. National Audubon Society Regional Office, 555 Audubon Place, Sacramento, CA 95825 (916) 481-5332

Urban Stream Restoration Program. Program Manager, Stream Restoration Program, California Department of Water Resources, 1416 Ninth Street, Sacramento, California 95814 (916) 445-9248

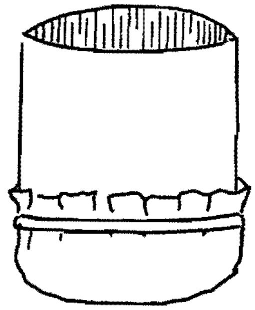
EQUIPMENT SUPPLIERS

Carolina Biological Supply Company
Powell Laboratories
19355 McLoughlin Boulevard
Gladstone, OR 97027
800 547-1733
FAX (503) 656-4208

Hatch Company
P.O. Box 389
Loveland, CO 80539
800-227-4224
FAX (303) 669-2932

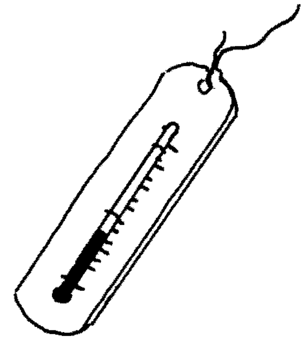
LaMotte Chemical Products
P.O. Box 329
Chestertown, MD 21620
800-344-3100
FAX (301) 778-6394

Simple Equipment Helpful For Exploring



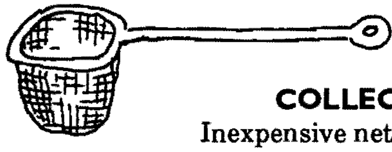
PONDSCOPE

A large coffee can, opened at both ends, may be painted black inside. Cover one end with a clear plastic bag and attach with a large rubber band or waterproof tape.



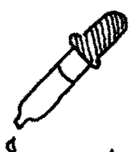
THERMOMETER

With a string attached, it can be used to measure water temperatures at different depths.



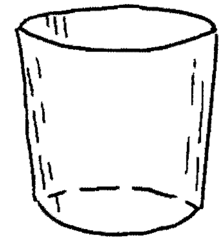
COLLECTING NET

Inexpensive nets can be purchased at pet and aquarium supply stores, or create one from a kitchen sieve.

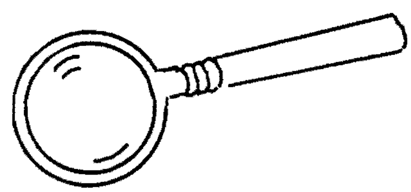


EYE DROPPER

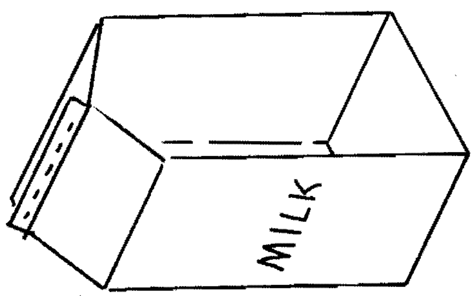
An eye dropper is useful for getting water samples and for sucking up small aquatic insects.

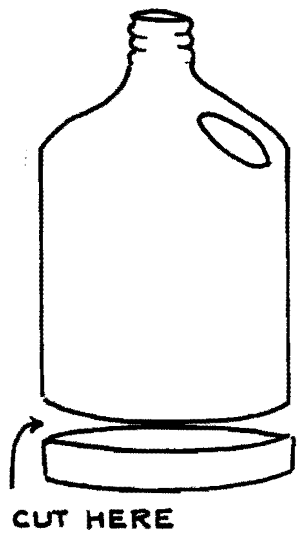


PLASTIC CUP



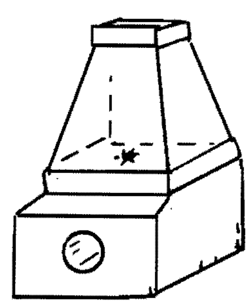
MAGNIFYING GLASS



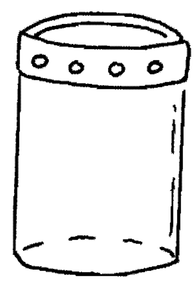


OBSERVATION PAN

The bottom of a bleach bottle, a milk carton with the side cut off, or a light-colored plastic pan make a good background for viewing aquatic creatures.



BUG VIEWER



TWO-WAY VIEWER