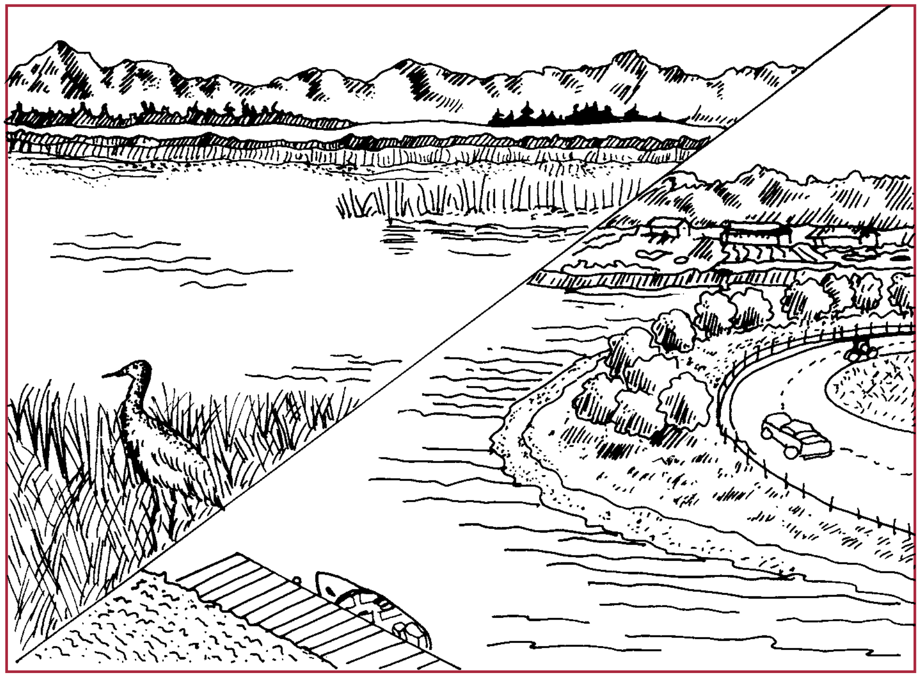
Create and Destroy

3 EXTENSIONS



Section 4
ECOLOGY ACTIVITIES

Grade: 4 - 12

State Standards: S A-14, Geo E-5
NGSS: MS-ESS3-3, MS-ESS3-4., HS-ESS3-3.,MS-ESS3-4HS-ESS3-4

Subjects: Social studies, science, art

Skills: Analyzing, classifying, interpreting, drawing

Duration: 45-90 minutes

Group Size: 2-4 and whole class

Setting: Indoors

Vocabulary: Conservation, create, destroy, habitat, nonrenewable resources, rehabilitate, renewable resources

Objectives:

1. Students will define and give examples of **conservation**.

2. Students identify and describe factors that change or destroy **habitat**.

3. Students will recommend methods for easing habitat destruction and rehabilitating destroyed habitat.

Teaching Strategy:

Students create an image of a beautiful environment, destroy it, put it back together, and discuss the relative time that it takes to **create**, **destroy**, and **rehabilitate**.

Complementary Activities:

This is applicable to all activities in this book.

Materials:

For each group: large sheets of newsprint or butcher paper, colorful drawing implements (markers, crayons, pastels, etc.), roll of masking or transparent tape.

Background:

See INSIGHTS, *Section 1, Elements of Ecosystems;* INSIGHTS, *Section 2, Ecosystems – Community Connections;* INSIGHTS, *Section 3, Living Things in their Habitats;* and INSIGHTS, *Section 4, Human Impacts.*

Procedure:

1. Divide your class into groups and distribute the art supplies *(but not the tape)*. Tell students they will make group pictures of the most beautiful place they can imagine.

2. Brainstorm some items they might draw – things like rainbows, lakes, colorful sunsets, tundra, mountains, or forests. You may want to direct them to draw only natural objects instead of man-made items. Encourage them to include wildlife.

3. Tell the students that you will be timing the class as they **create** their pictures.

4. After 20 minutes or when the students are finished *(whichever comes first),* collect the markers and have a spokesperson from each group describe their picture to the entire class.

5. Ask the groups to exchange drawings so that each group ends up with another group's creation.

6. Tell the students that they will have *5 seconds* to **destroy** the creation in front of them. Do not give them tools such as scissors. *Most kids figure out how to destroy the drawings without help!* Students may not touch the paper until you give the signal.

7. When the ripping frenzy is over, distribute a roll of masking or transparent tape to each group. Return the originals to their creators. Ask each group to re-construct its creation *as close to its original form as is possible*. Tell the groups that you will time this process, too.

8. As the groups finish, display their reconstructed drawings at the front of the room.

9. Draw a chart on the board with the times needed to **create**, **destroy**, and **rehabilitate** each drawing.

10. Ask students to compare the times in each of the columns. Were students able to restore any of these destroyed habitats perfectly?

11. Ask the class the following questions.
- What were your feelings when you were creating your beautiful place?
- How did you feel when you saw it destroyed?
- Did you have difficulty getting your creations back together perfectly?
- Are the drawings the same as they were before destruction?
- Is it possible for humans to live in this world without destroying some habitat?
- Do we ever destroy habitat needlessly?
- How can we prevent habitat destruction?

12. Brainstorm a list of beautiful natural habitats and add them to the class chart. Discuss human actions or natural phenomena that affect their list of habitats. *For example, road-building and forest fires*. Students will have to estimate the time it takes to create and destroy each habitat unless they've already done some research.

13. Discuss **renewable** and **nonrenewable** resources. *A renewable resource is a naturally occurring raw material or form of energy which has the capacity of replenishing itself through ecological cycles and sound management practices. The sun, wind, falling water, plants, and many animals are renewable resources. Nonrenewable resources such as oil, coal, copper, and gold can only be replaced in geologic time, not human time.*

14.Discuss the word **conservation** — the use of mineral, plant and animal resources in a way that assures their continuing availability to future generations.

How can habitat conservation reduce habitat destruction? What are some current examples of (a) **habitat destruction** (*clearing a forest for a school or mall, fishing on unprotected river banks, etc.*), (b) **conservation** (*prescribed burns, planning for human access, etc.*) and (c) **rehabilitation** (*river bank improvement projects, rehabilitation following mining and logging*)?

Evaluation:
1. Write a paragraph or poem describing your feelings about environmental destruction and rehabilitation.

2. Name five types of environmental destruction and five ways that humans can rehabilitate a habitat following this destruction.

EXTENSIONS:
A. **Schoolyard rehabilitation project.** Students consider how they can rehabilitate the environment around their neighborhood or school and develop a class project based on class suggestions.

B. **Research, design, present solution to dilemma.** Students write to a local, state, or national government official or governing body presenting a position, solution, and defense to a real conservation dilemma. The students will need to research an area which is being affected, design a plan to conserve the area, estimate costs of the rehabilitation plan, and defend his/her idea in writing.

View points should come from the students' values, interest, and knowledge gained through research. Opinions may vary from student to student on how lands should be conserved. Create an acceptable environment for students to have differing viewpoints.

C. **Turn thoughts into poetry.** Share the following poem with students. Students may want to write their own poetry following a discussion of the poem.

The Peace of Wild Things
by Wendell Berry

When despair for the world grows in me
and I wake in the night at the least sound
in fear of what my life and my children's lives may be,
I go and lie down where the wood drake
rests in his beauty on the water, and the great heron feeds.
I come into the peace of wild things who do not tax their
lives with forethought of grief.
I come into the presence of still water.
And I feel above me the day-blind stars
waiting with their light. For a time
I rest in the grace of the world, and am free.

From *Collected Poems, 1957-1982*, Berkeley, California North Point Press, 1985.

Credit:

Contributed by Colleen Matt, Alaska Department of Fish and Game, Division of Wildlife Conservation.

Curriculum Connections:

(See appendix for full citations)

Books:

Farewell to Shady Glade (Peet)

Kid's Guide to Social Action (Lewis)

Little House (Burton)

Miss Rumphius (Cooney)

Sign of the Sea Horse (Base)

Window (Baker)

The Wump World (Peet)

Website:

Preventing Waste for Schools
http://www.stopwaste.org/preventing-waste/schools
Recycling in Alaska
http://dec.alaska.gov/eh/solid-waste/recycling-in-alaska.aspx

Teacher Resources:

(See appendix)

Watching Your Waste

3 EXTENSIONS

Section 4
ECOLOGY ACTIVITIES

Grade Level: 2 - 9

State Standards: S B-1, Gov E-6
NGSS:K-2-ETS1-1,5-ESS3-, MS-ESS3-3, MS-ESS3-4, HS-. ESS3-3,HS-ESS3-4

Subject: Social studies, science, math, language arts, art

Skills: Observing, recording, analyzing, applying

Group Size: Small or Individual

Duration: Teacher determines

Setting: Indoors

Vocabulary: Decomposers, detritivores, limited resources, nonrenewable, recycle, renewable, synthetic

Objectives:

1. Students will measure, describe, and evaluate their household's or school's output of waste materials.
2. Students will make a waste reduction plan for home or school.

Complementary Activities:

"Create and Destroy" *in this section; and* "Mineral Cycling through an Ecosystem" *and* "Create a Classroom Compost Box" *in Section 2, Ecosystems – Community Connections.*

Materials:

Pencil and paper, bathroom scale, containers for separating and weighing trash.

Background:

See INSIGHTS, *Section 4, Human Impacts* and INSIGHTS, *Section 2, Ecosystems – Community Connections.*

Procedure:

1. Ask students to think about things that are thrown away in our homes and schools everyday. Generate a class list of categories that make up our garbage at school or at home *(i.e. food waste, paper waste, plastics, aluminum, etc.).* Ask students to predict the percentage of their home garbage that falls into each category.

2. Ask students to inventory the waste materials produced by the class or the school, their households or community:

- ***At home***, students and their families separate their waste by category for a day or a week, weighing each on a bathroom scale. Students can record their daily waste production by category. These data can be presented in a chart, with category percentages.

- ***At school,*** classes monitor waste produced by the lunchroom or office as well as in a classroom.

- ***In the community***, a study of waste produced by the town could include a trip to the dump or to the sewage treatment plant.

3. As a class, evaluate the origin of the largest percentage of household or school trash. Choose a common item from this category and follow its cycle from its basic elements to its eventual disposal. Where does this item go after we use it? What is it made from? Is that material recyclable?

See if your item is a part of a cycle, or reaches a dead end for years at a landfill.

4. To set the stage for the discussion stage of this activity, show "The Rotten Truth" or "Its Gotten Rotten" or share a resource book with students from the list of references to focus students on the need to reduce dead-end waste.

5. How does your community deal with waste? How long will waste materials last? Will they ever decay? Are any recycled? Which waste materials will decompose quickly in nature?

6. Discuss the concept of **limited resources** and list some examples that students or others in the community frequently use *(old-growth timber, fresh water, and products that rely on a lot of agricultural land)*.

7. Contrast these with **nonrenewable resources** such as oil and metals such as gold and aluminum. Nonrenewable resources are also limited. *They will only be replaced naturally within geologic time, not human time.*

8. What changes can people make to become less reliant on nonrenewable resources and conserve them for the future? Focus the discussion on ideas relating to reducing use, reusing old materials, recycling, or rethinking ways to conserve our limited resources.

9. You might want to incorporate a discussion of **renewable resources** here. *(Resources that replace themselves over time such as trees or that are inexhaustible such as sunshine and wind).* Discuss what might make Alaska unique in terms of waste disposal.

10. Working in small groups, students design a plan to recycle either all or one of the waste elements that currently are discarded by their home, school, or community. Encourage them to think of ways to recycle both the organic and inorganic wastes.

11. Each student (or group of students) writes up a proposal that includes how the plan would work, what would be recycled (also what could not be recycled), and how much implementation of the plan would cost. Include a statement of advantages and disadvantages of each plan.

12. If possible, set up a compost box either in the classroom or at the lunchroom. *See Section 2 activity "Create a Classroom Compost Box" for instructions and suggestions.*

Evaluation:

1. Present recycling and waste reduction ideas to others in the class. The class decides the best system considering feasibility, costs, and effectiveness. Present ideas to the appropriate administrators and building support staff.

2. Represent data collected on a household or school waste survey in a table or graph. From this information, students can write summary statements and draw conclusions.

EXTENSIONS:

A. **Create skits or big books.** Students create skits or plays to present to the class or to other classrooms that deal with reduction of waste. Big books could also be created by older students to share with those at younger grade levels.

B. **Send a community message.** Students create an illustrated pamphlet, radio message, or video for the community, incorporating ideas on diminishing waste. *(One idea might be using popcorn instead of Styrofoam when mailing items Outside.)*

C. **Research hazardous waste disposal.** Older students research hazardous waste products, determining which of these products exist in the home. Students research the "life cycle" of these products, discovering how these products are usually disposed of in their community. A plan could be developed toward educating community members on the least harmful disposal of hazardous waste items.

Credit:

This activity was modified by Val Chabot, Eagle River, Alaska.

Curriculum Connections:
(See appendix for full citations)

Books:
50 Simple Things Kids Can Do to Recycle (EarthWorks Group)

Chattanooga Sludge (Bang)

Compost Critters (Lavies)

Just a Dream (Van Allsburg)

Kid's Guide to Social Action (Lewis)

The Lorax (Seuss)

The Paper Bag Prince (Thompson)

Reducing, Reusing and Recycling (Kalman)

The Worm Cafe: Mid-Scale Vermicomposting of Lunchroom Waste (Payne)

Worms Eat My Garbage (Appelhof)

Wump World (Peet)

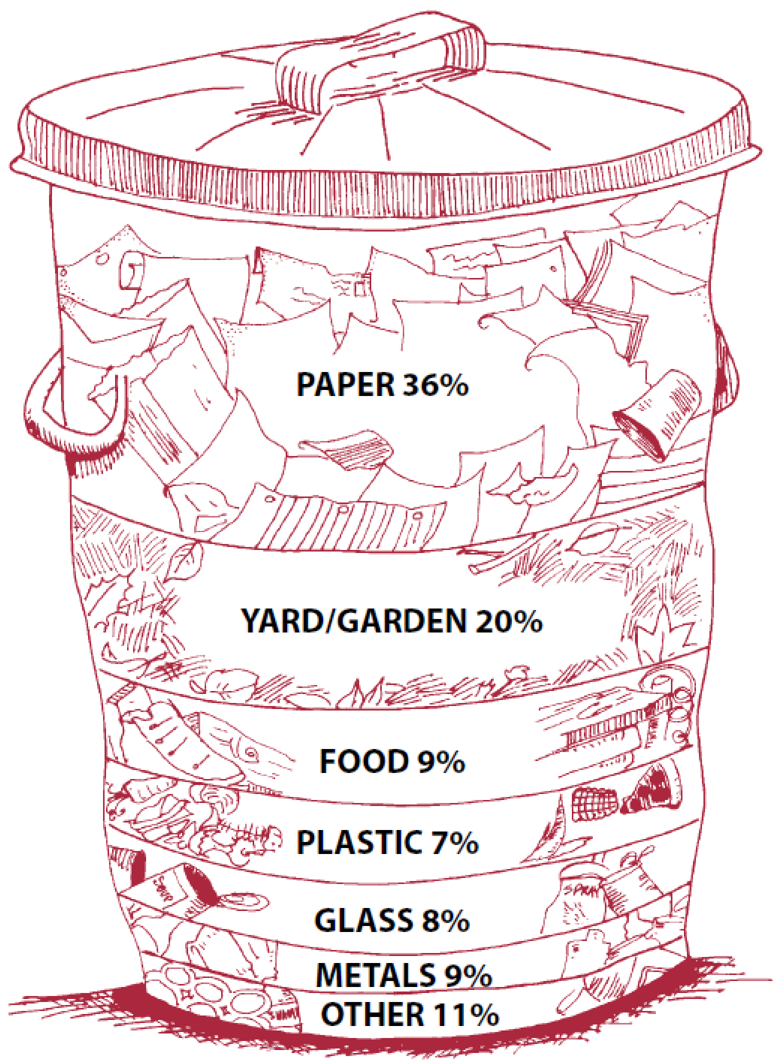
Media:
It's Gotten Rotten (Video) (Gr. 9-12)

The Rotten Truth (Video)
(Children's Television Workshop)

Website:
EPA Office of Solid Waste. *Students' and Teachers' Page* <www.epa.gov/epaoswer/osw/students.htm>

School Resources for Waste Prevention and Recycling <www.deq.state.ok.us/waste/education/resources2.html>

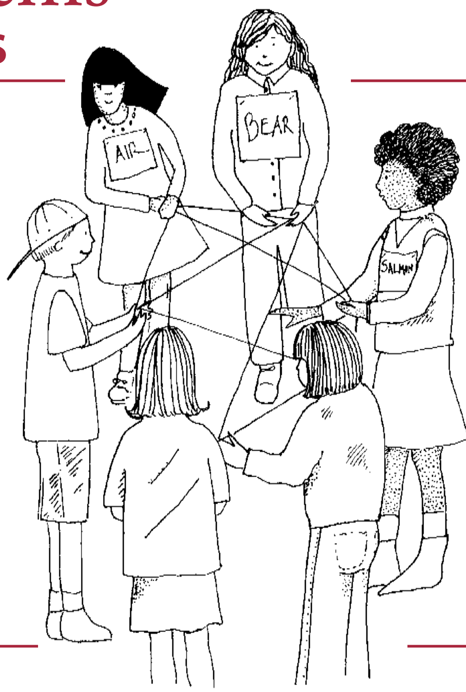
Teacher Resources:
(See appendix)



Solid Waste in Anchorage, Alaska
Statistics reported by
Anchorage Recycling Center,
Anchorage, Alaska

Spinning a Yarn about Ecosystems

4 EXTENSIONS



Section 4
ECOLOGY ACTIVITIES

Grade level: K - 12

State Standard: S A-14
NGSS: K-ESS3-1,5-LS2-1, MS-LS2-2, MS-LS2-3, MS-ESS3-4, HS-LS2-4, HS-LS2-5, HS-LS2-6.

Subjects: Science, art, language arts

Skills: Analyzing, applying

Duration: 30 minutes

Group Size: Groups and whole class

Setting: Outdoors or indoors

Vocabulary: Carnivore, consumers, detritivore, ecosystem, herbivore, omnivores, producer

Objective:
Students will be able to describe why changes in one part of an ecosystem can affect other, seemingly unrelated parts.

Teaching Strategy:
Students standing in a large circle represent an ecosystem. Each student represents a different part of an ecosystem. Yarn connects all of the students in an intricate web.

Complementary Activities:
This is a good synthesis, so all activities in this book apply.

Materials:
One large ball of yarn, scissors, name cards representing living and nonliving parts of an ecosystem (pre-made or students can make them), a list of Alaska organisms from "Alaska Food Chains and Webs" from INSIGHTS *Section 2.*

Background:
See INSIGHTS, *Section 1, Elements of Ecosystems;* INSIGHTS, *Section 2, Ecosystems – Community Connections;* INSIGHTS, *Section 3, Living Things in their Habitats;* and INSIGHTS, *Section 4, Human Impacts.*

Procedure:
1. Divide the class into five groups: nonliving things *(sun, water, minerals)*, producers, herbivores, carnivores, and detritivores.

2. Using a list of Alaskan organisms and nonliving things, assign or have each student choose a different organism or nonliving thing that they will represent from their group.

3. Each student should create a name tag for his choice (*for example, the nonliving groups can choose to be sun, water, air, soil*). The name tag should include the name of the organism or nonliving element in large letters. Students may also draw what they want to represent on the nametags.

4. Students should work in groups combining their knowledge or using reference materials to determine how their organism or element relates to other parts of the food

web. Each student should be aware of what their element needs to survive, and what other elements rely on it for survival.

(For example, a mosquito could eat nectar from plants or blood from warm-blooded animals and, in turn, they are eaten by bats and birds. Mosquitoes also need warmth from the sun, air for flying, and fresh water for eggs and larvae.) Have students include this type of information on the back of the card, if appropriate.

5. After students have donned their name tags, have the groups break apart and mingle randomly with the other students. Students "introduce themselves" as the organisms or elements represented on their cards. Following introductions, arrange the students in a large circle, arms distance apart.

6. Hand the ball of yarn to the sun and instruct the sun to say "I am the sun and plants need me in order to live." Holding on to the end, the sun then should pass the ball of yarn to a plant. For example, the sun might hand the ball of yarn to a willow.

7. As the web begins, be very explicit that no one is to throw the yarn or pass it without the complete attention of the other class members. Explain that one organism (or nonliving thing) must "interact" with another by first stating the relationship between the two, and then by passing the ball of yarn to the next person in the food chain. *For example, the willow would say, "I am a willow, (a producer) and I am eaten by a moose."*

8. The receiving organism (or nonliving thing) should then wrap the ball of yarn **loosely** around a finger and continue the chain. **Remind students not to pull on the yarn!**

9. Review the rules of the game until each student understands the procedure.

10. Continue until all the students are holding the yarn at least once. Get as many "interactions" as possible so that there will be a net of yarn connecting the students.

11. Reinforce the concept that all living and nonliving things are connected, as has just been demonstrated. Ask the students to predict what would happen if one organism or nonliving thing was removed from the web.

12. Pick one member of the web, (*for example, a salmon*) and ask students to identify other web members that would be affected if this animal disappeared. Reinforce that each member of the web is connected and cannot leave without affecting every other part of the ecosystem.

13. Have pairs of scissors ready and cut students free of the yarn when the activity has demonstrated the connections in ecosystems. Collect the yarn and cards and ask students to reproduce their webs in a bulletin board or mural display.

Evaluation:

1. Students draw a food web from their own local ecosystem or from another area. They explain the relationships between the elements in the web.

2. Students list all possible relationships for their web element. *For example, a willow* needs *sun, soil, water, air, and detritivores to break down organic material for minerals. A willow is* needed *by moose, hares, birds (for nesting), carnivores (for cover), and detritivores (after the willow leaves fall or the plant dies).*

EXTENSIONS:

A. **Reflect on activity in words or drawings.** Students describe in words or pictures the interconnections depicted by the web, including what happens if the web is broken or one of the web members is missing.

B. **Experiment with "What Ifs" in the yarn web.** After the web has been established, instruct one of the migratory animals (bird, salmon, or caribou) to move. The entire web will need to move or be modified in order to survive. What are the closest connecting elements to the migratory animals?

While the class is still attached in the web, discuss what happens in a real ecosystem when migratory animals move away. What about animals that hibernate in the winter? How are other members of the ecosystem affected? What happens if pollution occurs in a part of the ecosystem? What if the population of one element grows too large for the ecosystem to support?

C. **Describe their living kingdom.** If students have studied the five kingdoms of life, have each web element describe their kingdom.

D. **Trace pollution through the food web.** Simulate an environmental disaster once the web has been set up. Show how toxins, like oil or lead, can be passed by consumers through an ecosystem until almost all members have been affected.

Credits:

Activity contributed by Steve Kemper, Anchorage, and modified by Val Chabot, Eagle River.

Curriculum Connections:

(See appendix for full citations)

Books:

One Small Square Series (Silver)

Webs of Life Series (Fleisher)

What are Food Chains and Webs? (Kalman)

Who Eats What? Food Chains and Food Webs (Lauber)

What is a Biome? (Kalman)

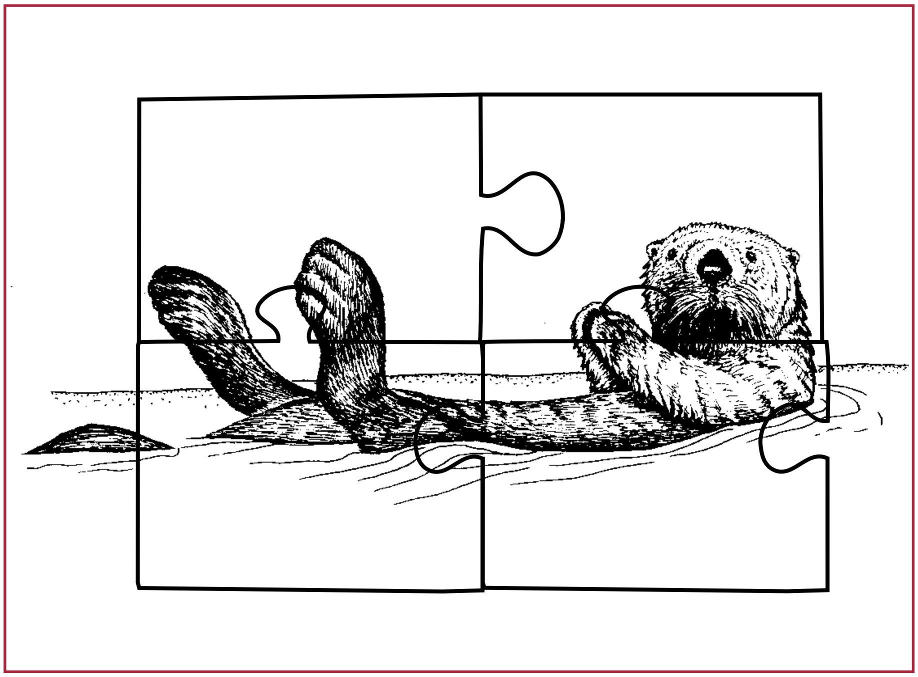
Media:

Into the Forest, Krill, Onto the Desert, Predator (Nature's Food Chain Games) (Ampersand Press)

Teacher Resources:

(See appendix)

Ecology Puzzlers
1 EXTENSION



Section 4
ECOLOGY ACTIVITIES

Grade Level: 7 - 12

State Standards: S A-14, S B-15, Geo E-5
NGSS:
Subjects: Science, social studies, language arts

Skills: Reading, analyzing, hypothesizing, concluding

Duration: 60-120 minutes

Group Size: 2-4

Setting: Indoors

Vocabulary: See each Puzzler

Objective:
Given an environmental dilemma, students will be able to analyze causes and effects.

Teaching Strategy:
Students work in small groups on "Ecology Puzzlers" which describe actual situations.

Complementary Activities:
"Create and Destroy" *in this section.* "Investigating (Non-living Things)" *in Section 1;* "Who Eats Whom," "Oh Moose,“ *and* "Mineral Cycling" *in Section 2; and* "Investigating (Living Things) *in Section 3.*

Materials:
Copies of the Ecology Puzzlers (*following pages*).
OPTIONAL: research materials.

Background:
See INSIGHTS, *Section 1, Elements of Ecosystems;* INSIGHTS, *Section 2, Ecosystems – Community Connections;* INSIGHTS, *Section 3, Living Things in their Habitats;* and INSIGHTS, *Section 4, Human Impacts.*

Puzzler Concept:
The following Puzzler pages are intended to encourage students to think and apply their knowledge of ecology. They must use their understanding of food webs and chains, mineral cycling, and symbiosis in order to answer the puzzle questions. All of the examples are real world ecological problems.

"What Really Happened" follows with a summary of the observations and opinions of scientists who have studied these ecology problems *(with the original reference citation included).* Some of the problems are evolving, with final resolutions still to be written. For research suggestions, contact the Division of Wildlife Conservaton/Wildlife Education.

Procedure:
1. Give each group a different Ecology Puzzler. Ask each group to read the facts and try to solve the puzzle featured at the bottom of the page. Tell them to record their answers on paper. Do not give them the section, "What Really Happened."

2. Each group should research their problem, define difficult vocabulary, and prepare a presentation to the entire class.

3. Groups make their presentation to the whole class about their puzzle. Be sure that each group gives both the causes and effects of their ecological problem.

4. Groups could take suggestions for solutions from the class at this time. As part of their report, groups should give the solutions that they suggest for their own puzzle.

5. Hand out the appropriate "What Really Happened" information sheets to each group. Were the "real" solutions as good as each group's solution? Why would the real solutions differ from the students' hypothetical solutions?

6. After reviewing and discussing the puzzles, ask students to discuss how they might be affected individually by an ecosystem change. How might humans in general be affected? Ask students to discuss how they might **contribute** to each specific ecological problem.

- For example, placer mining affects stream ecosystems. Is gold used in any material used by students *(jewelry, computers and other electronics, tooth fillings)*?
- Pesticide pollution is a problem. Do students eat foods from agricultural crops that are raised with the use of pesticides?
- The increasing amount of carbon dioxide in the atmosphere is a problem. Do students (or their families) burn fossil fuels?
- Plastic particle pollution (caused by ocean dumping) is a problem. Do students use plastics?

7. Ask students to discuss how and whether they, individually, or collectively as a community, could help **solve** or **reduce** these ecological problems.

Evaluation:

Choose one of the puzzlers and describe the problem, its cause and effects, and describe possible solutions.

EXTENSION:

Research a local cause and effect. As a research project, students (individually or in groups) select a local human activity and evaluate its effects on local ecosystems. Students must decide what facts they need, then gather them through resource materials, by interviewing experts, and/or by making observations and collecting data. Students individually or in groups write a report that includes:

- A description of the effects of the activity on the ecosystem based on their knowledge of ecology.
- An evaluation of the advantages and disadvantages of the human activity (from the perspective of both humans and wildlife)
- Possible methods of reducing or preventing the undesirable effects.
- Suggestions of legislation needed. Students might write letters to local representatives.

Curriculum Connections:

(See appendix for full citations)

Books:

The Case of the Mummified Pigs; and Other Mysteries of Nature (Quinlan)

Chattanooga Sludge (Bang)

Ecological Mystery Series (George)

Endangered Species (de Koster)

Extinction is Forever (Silver)

Nuclear Power: Promise or Peril? (Daley)

Our Endangered Earth (Langone)

Pollution: Examining Causes and Effect Relationships (Anderson)

Websites:

Alaska Statewide Databases, accessed through your local library website or <sled.alaska.edu >

Anchorage *Daily News* <www.adnsearch.com> Staff written newspaper articles, current and past. Article citations can be located at no charge. For full text, a fee must be paid.

Environmental News Network <www.enn.com> Searchable by subject. Good for current news articles.

Fairbanks *Daily News-Miner* <www.newsminer.com> Staff-written newspaper articles, current and past, no fee.

ADFG Wildlife News. http://www.wildlifenews.alaska.gov

This "Otter" Be Examined

Books:

Sea Otters (Silverstein)

Websites:

Environmental News Network <www.enn.com> For recent articles including some on the problem with the orcas preying on the sea otters.

Cracked Eggshells

Books:

Frightful's Mountain (George)

Websites:

Tundra Peregrine Falcons in the North Yukon <www.taiga.net/coop/indics/peregrin.html>

U.S. Fish and Wildlife Service <refuges.fws.gov > From the home page select *Wildlife* and then *Species Account,* then *Birds.* From there you can find information on the arctic peregrine falcon.

U.S. Fish and Wildlife Service <endangered.fws.gov/peregrin.html> Information on the peregrine falcon.

Pass It On

Books:

Air Alert: Rescuing the Earth's Atmosphere (Miller)

Website:

University of Alaska Fairbanks Reindeer Research Program <reindeer.salrm.alaska.edu/index.htm>

Some Plastic Rap

Websites:

Plastics in Our Oceans <www.umassd.edu/Public/People/Kamaral/thesis/plasticsarticle.html>

All That Glitters Is Not Gold

Books:

Come Back Salmon (Cone)

The River of Life (Miller)

Websites:

Adopt-a-Stream <www.streamkeeper.org/opportun/links.htm> Has links for stream restoration, resource protection, and water quality.

Streambank Revegetation and Protection: A Guide for Alaska http://www.adfg.alaska.gov/index.cfm?adfg=streambankprotection.intro

Rainforests, Volcanoes, and Glorious Sunsets

Books:

The Amazon Rain Forest (Johnson)

Our Endangered Planet: Atmosphere (Hoff)

Websites:

EPA Climate Change: https://www.epa.gov/climate-indicators/weather-climate

explorezone<explorezone.com>

The US Global Change Research Information Office <www.gcrio.org/gwcc/toc.heml>

Yahoo Geocities <yahoo.geocities.com> Type in the subject box *Greenhouse Effect* and/or *Global Warming* for numerous websites.

Teacher Resources:

(See appendix)

Ecology Puzzler

This "Otter" be examined

THE FACTS

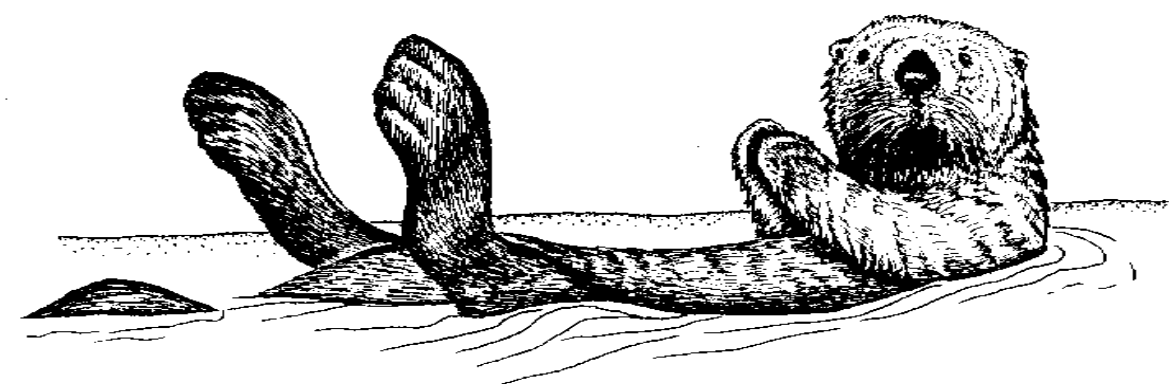
Sea otters feed on a variety of marine **invertebrates**, including crabs, clams, mussels, limpets, sea stars, and sea urchins. They also eat some fish.

Crabs, limpets, sea stars, and sea urchins live along rocky, wave-washed coastlines. Limpets and sea urchins feed on algae and kelp.

Dense stands of algae and kelp can reduce the force of waves, so that floating algae and **detritus** (decaying plant and animal material) are trapped and deposited on the sea floor.

Amphipods, isopods, and some shrimp live in dense kelp beds and feed on algae and detritus. Many predatory fishes feed on amphipods, isopods, and shrimp.

Sea otter **populations** were reduced to near **extinction** due to overharvesting between 1750 and 1900 by Russians, Americans, and other traders who sold their fur. After sea otters and their habitat were protected by international treaty, laws, and refuge designation, the population **recovered** in much of Alaska.



THE PUZZLE

Explain how you think the aquatic ecosystem might have changed when sea otter populations were reduced. What changes probably occurred when sea otters were re-established

Ecology Puzzler

This "Otter" be examined

WHAT REALLY HAPPENED

Since there were no studies of the marine ecosystems in 1700 prior to the decline of sea otters, the effects of removing them at that time are not certain. In some areas where sea otters were killed off, it appears that populations of sea urchins and limpets increased. These **herbivore** populations then reduced the amount of kelp and sessile algae *(stationary)* growing in nearshore waters.

Alaska's Aleutian Islands were a center for early exploitation of sea otters. Because there are so many islands, however, and some are hard to approach, several small **populations** of sea otters survived. They slowly grew and slowly spread to nearby islands.

From 1970 to present biologists recorded changes in the ecosystem that occurred as sea otters repopulated islands in the Aleutians.

The sizes and numbers of limpets and sea urchins (both grazing herbivores) were reduced due to sea otter **predation**. This reduced grazing pressure on kelp and algae and allowed dense underwater forests to develop.

These kelp forests reduced the force of wave action and trapped silt and detritus. Limpets and mussels cannot hold fast to silty rocks so they became fewer in number. The kelp forests provided a good environment for filter-feeding herbivores (amphipods, isopods, and shrimp) that eat **detritus** and algae floating in the water. These in turn provided food for predatory fishes, so they moved into the area.

The changes observed did not necessarily occur in all areas, however. A variety of factors, including the force of the incoming waves, the bottom, and the relative abundance of the various **producers** and herbivores combine to cause different kinds of ecosystem responses in some areas. Large sea otter populations have been known to depress populations of prey (including sea urchins, crabs, and abalone) in other areas.

NEW 2000 MYSTERY: In 2000 biologists surveying sea otters in the Aleutian Islands found a 70 percent decline in sea otter numbers in less than a decade. What is happening in the Bering Sea and North Pacific Ocean to cause this magnitude of change?

The sea otters seem healthy and their food seems to be plentiful. Orcas (killer whales) have been preying on sea otters as never before seen. But can that account for such great loss of numbers? Scientists have yet to discover the answer.

Ecology Puzzler

Cracked Eggshells

THE FACTS

DDT is a pesticide used to kill problem insects. It was widely used on farmlands *(to kill insects that ate crops)* and on wetlands *(to kill mosquitoes)* in the Lower 48 and Europe from 1946 until 1969, when its use was outlawed in the United States, Canada, and most European countries. It is still being used extensively in South America and Asia.

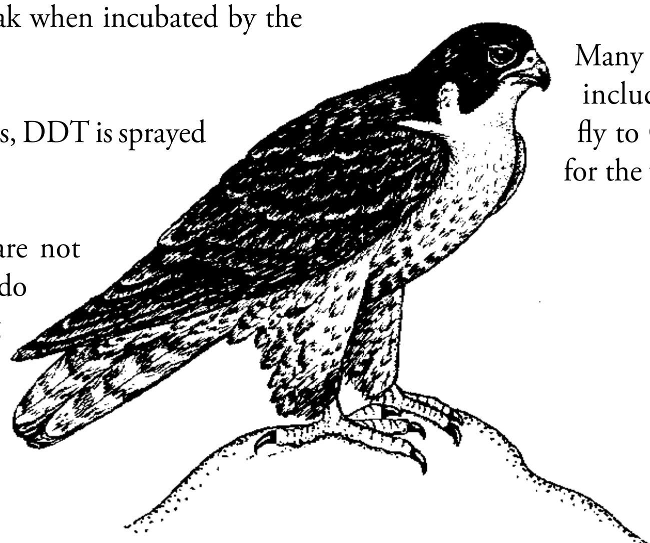
DDT is very poisonous to most living things, including humans. Concentrations of less than 10 parts per million cause bird eggs to be thin-shelled. This makes the eggs more likely to break when incubated by the parent.

When used to control insects, DDT is sprayed on plants from the air.

Because DDT molecules are not very soluble in water, but do dissolve in oil, most living things are not able to excrete DDT in waste materials. Instead it accumulates in body fat and tissues.

DDT is broken down extremely slowly, if at all, by detritivores and weathering. Thus, any DDT applied to the environment continues to exist and remains poisonous for decades.

Peregrine falcons prey on small birds, particularly shorebirds and ducks.



Many of Alaska's migratory birds including shorebirds and ducks fly to Central and South America for the winter.

THE PUZZLE

1. Based on what you know about ecology, why is DDT now found in the systems of nearly all living things, including penguins in Antarctica, humans in Alaska, and in other areas where it was never used?
2. Why do you think that peregrine falcons nesting in northern Alaska continued to have poor nesting success for several years after the few remaining falcons in the Lower 48 appear to have improved nesting success

Ecology Puzzler

Cracked Eggshells

WHAT REALLY HAPPENED

DDT is now found in living things around the world because it was spread in the atmosphere by winds and deposited with rain from the Arctic to the Antarctic. Particles were washed into rivers, lakes, and oceans where currents continued the spread. Since DDT breaks down so slowly, repeated applications of the chemical rapidly increased the amount present in the earth's environment.

A marsh in New York that was sprayed with DDT for 20 years had DDT residues amounting to 32 pounds per acre. Almost all the DDT eaten by a living thing remains in its system for life, concentrating in tissues and fats. An **herbivore** that eats a producer with DDT in it, retains all the **producer's** DDT and stores it in its own system. A **carnivore**, after eating dozens of herbivores – each with a small store of DDT – ends up with a much higher concentration of DDT than any one of its prey.

Top carnivores that eat other contaminated carnivores concentrate the poison even further – and end up with toxic concentrations. For example in the New York marsh mentioned above, plankton in the water had concentrations of .04 parts per million (ppm), while minnows had 1 ppm, and a gull (carnivorous scavenger) had 75 ppm in its body.

Since DDT use has been halted in the Lower 48 for about 25 years, the concentration of DDT in the environment is decreasing. What remains is spread by winds and water over a larger area. Some of it is becoming trapped in the bottom of lakes and on the bottom of the ocean. The amount of DDT accumulating in **food chains** is decreasing in the Lower 48.

While it is illegal to use DDT in the U.S. (except by special permit), it is still being manufactured and exported to other countries where it is used as a pesticide. In winter, peregrines migrating to other countries eat local birds that ingest DDT. In summer, peregrines may ingest more DDT because the birds they eat in Alaska migrate from other countries to nest here. The use of DDT in peregrine wintering habitat is decreasing and the damaging effects on these falcons, such as eggshell thinning, have declined.

Peregrine falcons are increasing in number and locations in the United States and Canada. One subspecies in Alaska and Canada, the Arctic peregrine, was removed from the federal Endangered Species List in 1994. Another subspecies, the American peregrine falcon was removed in 1999 when its populations reached conservation goals.

Ecology Puzzler

Pass It On

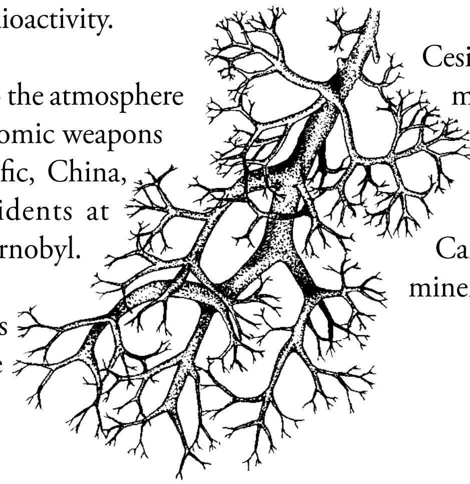
THE FACTS

The radioactive isotope cesium 137 is a product of atomic fission reactions such as the explosion of nuclear weapons. It has a **half-life** of 30 years, which means that it loses half of its radioactivity every 30 years. After 60 years, it still has 1/4 of its original radioactivity, and after 90, it has 1/8 its original radioactivity.

Cesium 137 has been released into the atmosphere by above-ground explosions of atomic weapons in the United States, South Pacific, China, Russia, and Japan and by accidents at nuclear power plants such as Chernobyl.

Air circulation and magnetic fields around the globe cause more Cesium 137 to be deposited in the Arctic than elsewhere.

The effects of radiation from radioactive materials on living things depends on many variables, such as the intensity of the radiation and the length of exposure.

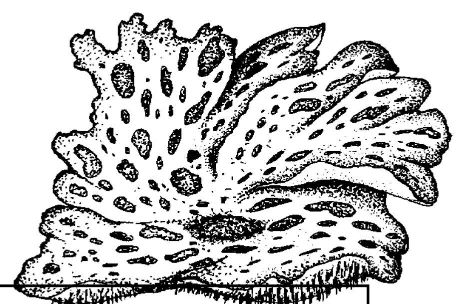


Prolonged exposure to even low levels of radiation can cause cancer and other diseases in living things.

Cesium 137 has chemical properties that make it react with other chemicals in ways similar to potassium.

Cesium 137 accumulates in tissues as it moves up the **food chain**. Potassium is an essential mineral in the cells of living things.

Caribou eat lichens. Lichens obtain the minerals they need from rain water.



THE PUZZLE

Based on what you know about ecology, explain why you think some humans living in arctic regions have had concentrations of cesium 137 in their tissues over three times the concentration found in precipitation in their area.

Ecology Puzzler

Pass It On

WHAT REALLY HAPPENED

Atmospheric testing and explosions of atomic weapons sent cesium 137 and other radioactive isotopes high into the earth's atmosphere. They were spread widely and quickly by air currents. The isotopes were eventually washed out of the atmosphere by rain and deposited on vegetation, land, and water.

In part due to the patterns of air circulation, and in part due to the earth's magnetic fields, more Cesium 137 has been deposited in the Arctic than elsewhere.

Lichens are a dominant **producer** in the Arctic. These **symbiotic** organisms get most of their nutrients from rainwater, so they absorb much of the Cesium 137 that has been deposited.

During winter, caribou eat mainly lichens. All the Cesium 137 in those lichens accumulates in their body tissues and fats. Some caribou that were examined had concentrations of 15 **microcuries** of cesium 137 per gram of tissue.

Humans who ate caribou accumulated their Cesium 137 and ended up with concentrations of 30 microcuries per gram of tissue. Wolves and foxes that fed on the caribou sometimes contained 45 microcuries of cesium 137 per gram of tissue. The health risks of this concentrated exposure are poorly known.

Ecology Puzzler

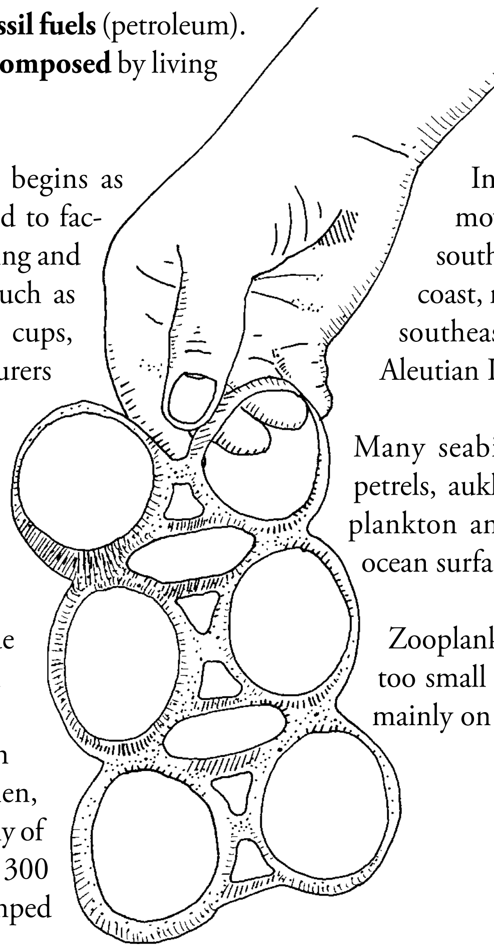
Some Plastic Rap

THE FACTS

Plastic is a material made from **fossil fuels** (petroleum). It cannot be broken down or **decomposed** by living things.

Much of the plastic produced begins as small particles which are shipped to factories around the world for melting and forming into plastic products such as toys, buckets, bags, food wrap, cups, gadgets. Major plastic manufacturers are located in California, Japan, and other Pacific Rim nations. Alaska did not manufacture any plastic until 1985.

STUDENT ACTIVITY
Some of the plastic particles made by the producers are lost at sea in shipping accidents. Plastic materials are also dumped in the ocean by ocean-going vessels, fishermen, and others. The National Academy of Science estimates that more than 300 million pounds of plastic are dumped in the ocean every year.



Plastic particles float on the surface of the water.

In the North Pacific Ocean, currents move in a counter-clockwise direction southeast past Japan toward the California coast, northwest past British Columbia and southeast Alaska, then southwest past the Aleutian Islands.

Many seabirds including shearwaters, storm petrels, auklets, and puffins feed on small zooplankton and cephalopods that float near the ocean surface.

Zooplankton and cephalopods are, in general, too small to ingest plastic particles. They feed mainly on algae and smaller zooplankton.

THE PUZZLE

Based on your knowledge of ecology, would you expect to find plastic in the stomachs of Alaskan seabirds? Explain why or why not.

Ecology Puzzler

Some Plastic Rap

WHAT REALLY HAPPENED

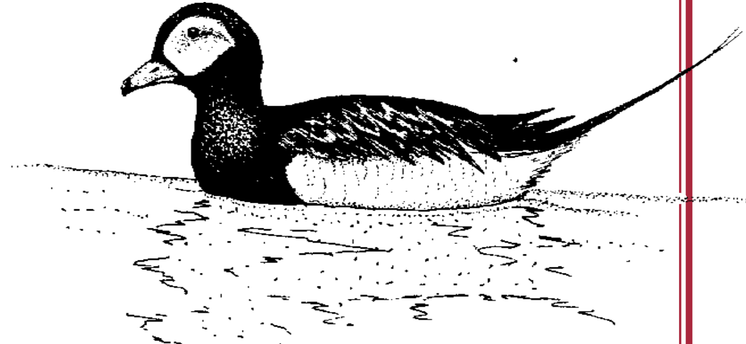
Even though there were no plastic manufacturers in Alaska until 1985, plastic was imported, and plastic particles have been found in Alaskan seabirds. Plastic particles have been found in the digestive tracts of 21 of the 37 species of Alaskan seabirds examined. In some species, 40-50 percent of the birds examined had plastic in their digestive tracts. The puffins, auklets, storm petrels, fulmars, and shearwaters found with plastic particles feed mainly on crustaceans and cephalopods (squid) which are too small to eat the plastic particles.

Scientists do not know why seabirds are picking up the plastic, but hypothesize that the birds are mistaking the plastic particles for zooplankton or fish eggs. Different species of birds seem to pick up different kinds of plastic particles.

Alaskan seabirds find and eat the plastic particles while migrating through waters off Japan and California where plastic manufacturing occurs. They also find plastics in Alaskan waters where plastic particles have become concentrated as a result of ocean currents. A visit to any outer coast beach of Alaska will quickly show that industrial plastic pollution is not the only source of the problem. The beaches are littered with plastic of all descriptions, from six-pack rings and disposable lighters to rope.

The plastic particle problem appears to be a recent phenomenon, at least in Alaska. Parakeet auklets nesting on St. Lawrence Island in the Bering Sea did not have any plastic particles in their digestive tracts in the mid 1960s. By the mid 1970s, 50 percent of the birds in the area contained plastic. The effects of the plastics on the seabirds are unknown. There is some evidence that seabirds with digestive tracts packed with plastic may have trouble digesting real food and starve.

A recent report by the National Academy of Sciences indicated that, worldwide, an estimated 1 to 2 million birds and 100,0000 marine mammals may die each year as a result of plastic pollution. This figure refers mainly to birds and mammals that become entangled in discarded or lost commercial fishing nets and lines.



Ecology Puzzler

All That Glitters Is Not Gold

THE FACTS

Most of the food **energy** and nitrogen available to stream **food chains** comes from leaf litter that falls from stream-side trees and shrubs and from **deciduous** trees and shrubs in upstream wetlands. A small amount of food energy is also made available by aquatic **producers** – algae and aquatic plants.

The main **herbivores** in stream **ecosystems** are aquatic insect **larvae**, such as the larvae of caddis flies, mayflies, and blackflies. These organisms filter **detritus** *(decaying material such as leaf litter)* and algae that float past in the water.

Insect larvae are the main food for fish including salmon fry, sticklebacks, whitefish, trout, and grayling. Most of these fish locate their prey by sight.

The amount of oxygen dissolved in stream water is determined by the speed the water is traveling and the temperature of the water. Fast-flowing, cold water is able to carry much more oxygen than slow-moving, warm water.

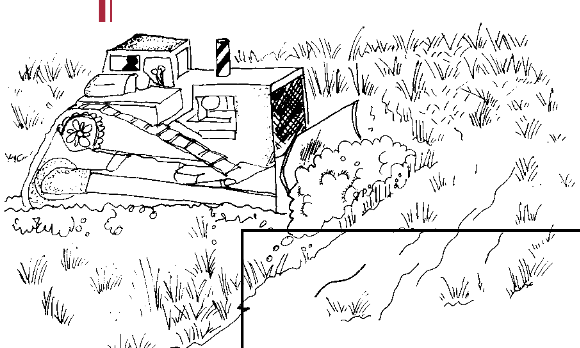
Stream-associated birds include kingfishers, mergansers, and osprey. These birds feed mainly on fish which they locate by sight. Another bird, the American dipper, feeds mainly on aquatic insects. It locates these by sight also. Dippers search for insects while walking underwater against the current and while swimming from one "lunch counter" to another.

The temperature of the stream water is affected by the amount of solar radiation that reaches the stream. Stream-side vegetation keeps water temperatures cool by shading the stream.

Stream-associated mammals include river otters, mink *(both of which feed mainly on fish)* and beaver *(which feed on stream-side shrubs and trees).*

Salmon, grayling, and other fish lay their eggs amid gravel on the stream bottom. Spaces in the gravel provide a place safe from predators for the eggs and **alevin** *(newly hatched fish)* to develop. Water moving between the gravel particles delivers a continuous supply of dissolved oxygen.

Placer mining, the main gold mining method used in Alaska, involves removing streamside vegetation, then washing the gravel and soil of a stream bed and adjacent areas with water. In the washing process, gold, which is heavier than other materials, settles out first. If dirt particles and other minerals are carried away by the stream, they cloud the water, slowly settle out, and cover the stream bottom with silt.



THE PUZZLE

Based on your knowledge of ecology, predict how placer mining affects stream ecosystems.

Ecology Puzzler

All That Glitters Is Not Gold

WHAT REALLY HAPPENED

Unregulated placer mining severely disrupts stream ecosystems. The most serious problem is the **sediments** in the water that affect nearly all the living things present by the following:

(1) The increased **turbidity** *(cloudiness)* reduces the amount of light available for producers such as algae.
(2) The cloudiness hampers predators that use vision in locating their **prey** *(fish, mammals, and birds);* **predators** cannot find and capture food.
(3) Turbidity clogs the feeding mechanisms of filter-feeding organisms.
(4) Silt irritates the tender gills of fish thus interfering with their ability to breathe.
(5) The fine-grained particles that settle on the bottom fill the air spaces between gravel particles. This smothers the eggs and **alevin** that live in these spaces.

Removal of stream-side vegetation reduces the amount of leaf litter. This means less energy is available for all organisms in the food chain. This may not be a serious problem at the site of the placer mine if upstream vegetation remains intact; however, it affects ecosystem production below the mine site.

Removal of stream side vegetation may increase water temperatures *(due to reduced shading)* and thus decease the amount of oxygen available to aquatic organisms. Vegetation removal also can cause soil erosion in addition to the sediments released in the mining process. This erosion continues until vegetation is reestablished, perhaps long after the mining operation is over. If vegetation is not reseeded by miners, it can take decades for nature to reseed the sterile tailings.

The amount of turbidity and sedimentation caused by placer mining can be significantly reduced if miners construct a series of settling ponds. Turbid water is stored in the settling ponds temporarily to allow some of the sediments to settle. Then it is returned to the stream. Settling ponds can be difficult and expensive for a miner to build and maintain.

Current regulations make settling ponds mandatory. Miners no longer wash gravel and discharge silt directly into streams.

Ecology Puzzler

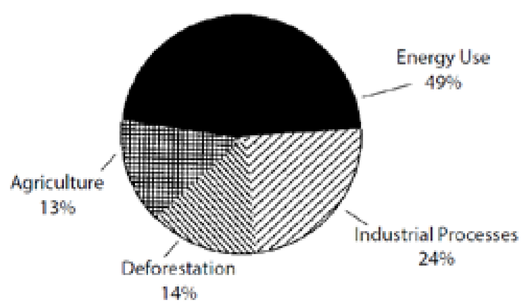
Rainforests, Volcanoes, and Glorious Sunsets

THE FACTS

Billions of years ago, the earth's atmosphere contained little or no free **oxygen**. Instead it contained much more **carbon dioxide**. Today it is made of 79% nitrogen, 21% oxygen, 0.9% rare gases, and 0.03% carbon dioxide.

Scientists hypothesize that the carbon dioxide originally in the atmosphere was converted into carbon chains by photosynthetic organisms *(plants, trees)*. Oil, coal, and petroleum are all made of the ancient remains of living organisms. Most of the carbon on earth is now tied up in these fossil fuels, in deep sea sediments, and in wood.

Contributions to Global Warming by Human Activity
(percentage of global warming)



Source: World Resources Institute in collaboration with the United Nations Environment Programme and the United Nations Development Programme, *World Resources 1990-91* (Oxford University Press, New York, 1990), Table 2.4,P. 24.

The processes of **photosynthesis** and **respiration** have maintained a balance for millions of years. The atmosphere provides the oxygen we breathe and the carbon dioxide needed by photosynthetic organisms. The atmosphere also affects the climate of the earth by absorbing and reflecting light energy. Light is reflected by dust in the atmosphere. Carbon dioxide, unlike most other components of the atmosphere, absorbs heat from the sun's rays.

Worldwide, forests are being cut for wood products, fuel, and to make room for farmland, industry, and cities at the rate of about 18-20 million hectares (7.2-8 million acres) per year.

Currently, combustion of oil, gas, coal, and wood releases 5-6 billion tons of carbon dioxide into the atmosphere annually. Combustion also releases heat into the atmosphere.

The amount of dust in the air is increased by volcanic eruptions, combustion of fossil fuels and wood, pollution, and wind erosion of soil where vegetation was removed.

THE PUZZLE

Use your knowledge of ecology and the above facts to predict whether the earth's climate is likely to warm, cool, or stay the same. If you predict it will change, explain why and the effects of these changes.

Ecology Puzzler

Rainforests, Volcanoes, and Glorious Sunsets

WHAT REALLY HAPPENED

The amount of carbon dioxide in the atmosphere has been increasing at the rate of 0.2% per year since about 1850, and this rate is accelerating. The main reason for this increase is the use of the combustion engine, along with the increased use of fossil fuels. The amount of dust in the atmosphere has also been increasing. Scientists agree humans are conducting a gigantic ecological experiment with the earth as the test tube. Almost all scientists agree that the increased amount of carbon dioxide is going to result in something happening. It is the "something" that is not agreed upon.

Some ecologists predict that the increased amount of carbon dioxide will trap more heat from sunlight (in addition to the additional heat released by combustion) which will cause a warming of the earth's climates. This is called the **greenhouse effect**. They theorize that this greenhouse effect of **global warming** would melt the polar ice caps and raise the level of the oceans by several feet, flooding much of the coastal land currently inhabited by people. It would also flood or change the climate in most of the lands where food crops for humans are raised.

Other ecologists theorize that due to the increased amount of dust in the atmosphere, the earth's atmosphere will reflect more sunlight and absorb less, which will result in a cooling of the climate and another ice age.

Even small changes in the temperature of the earth, in either direction, would result in major difficulties for humans and most living things.

Some scientists suggest that there will be no change because the increased amount of carbon dioxide in the atmosphere will allow more **photosynthesis** by **producers**, which will counteract the increasing carbon dioxide.

The problem of what will happen is complicated by the chemical reactions to various pollutants of many other atmospheric gases, such as ozone.