

3. Tell the students that planting trees is a great way to do something good for the community – and for the planet as a whole. Have them work in small groups over the next week or so to identify areas in the community (or on the school grounds) that would be improved by the presence of one or more trees. Remind students to refer to their lists of tree benefits as they consider different planting sites. If you're working with younger students, take them on a walk around the school to locate an area or areas that would be improved by adding a tree.

4. After the students have identified possible sites, have a group discussion about the feasibility of each site. Have students decide which site (or sites) should be the focus for their tree-planting campaign. With proper supervision, teams can work on different sites.

5. If you're working with older students, ask them whom they think they should contact to get permission to plant in the area(s) they've chosen. Help them learn about tree planting in your community, finding answers to questions such as:

- How much money is spent annually on tree care in the community? How many trees are planted, and where?
- Which species are most often chosen for planting?
- Do any criteria exist for selecting the species that will be planted? If so, what are they? Whether or not such

criteria exist, you may want to suggest to students that they consider many different factors before deciding on which trees to plant. For example, depending on where they'll be planting, they may want to consider native species and species that are resistant to air pollution, drought, and so forth.

- What are some hardships that urban trees face? What is the average life span of a city tree?
- How can citizens become involved in planting and maintaining trees on public property?

Help students use this information to compose a letter to the appropriate people, agencies, or organizations for permission to plant.

6. After the students have received permission to plant, help them detail plans for their tree-planting project. For instance, they may decide to raise money to buy trees from a local nursery, or they might ask people to donate trees. You may contact local foresters or nurseries to get help with planning and carrying out the planting.

Students can do Internet research to find out what kind of tree to plant and the specific requirements for that tree.

7. Have students plant trees and take care of them. See the planting recom-

mendations on the student page, and get directions from the nursery on how to plant and care for the particular species of tree.

The students can take digital pictures before and after planting the tree. Using presentation software they can keep a scrapbook of the tree over time.

Enrichment

- Students could arrange for a special tree-planting ceremony, possibly in conjunction with a special occasion such as Earth Day or Arbor Day. Students should plan the event and send out news releases to publicize it, including the benefits of planting trees.
- Have students make a map of the planting site using graph paper. The map should show the site as it is now and the area the tree canopy will cover when the tree reaches maturity. Have students use garden books or on-line resources to determine the mature size of the tree. Students calculate and compare the areas of the two canopies.
- Use selected music ("My Roots Run Deep" and "These Trees") from the *Billy B Sings About Trees* CD to enhance the concepts covered in this activity.

READING CONNECTIONS

Aliki. *Story of Johnny Appleseed*. Prentice-Hall. 1963. Retells the wandering of John Chapman whose devotion to planting apple trees made him a legendary figure in American history. Also available in Spanish. Grades K-3. ISBN: 0671667467.

Giono, Jean. *The Man Who Planted Trees*. Chelsea Green Publishing Co. 1985. Jean Giono's beautiful allegorical tale is legendary. Written in the 1950's, its message was ahead of its time, inspiring readers to rediscover the harmonies of the countryside and prevent its willful destruction. Grades 4+. ISBN: 1570625387.

Locker, Thomas. *Sky Tree: Seeing Science Through Art*. HarperCollins. 1995. A tree stands on a hill by a river. As the sky changes, so does the tree, its branches filling with clouds, stars, snow, birds, mists, and the golden spring sun. One tree can mean many things. Grades K-4. ISBN: 0064437507.

Manson, Christopher. *The Tree in the Wood: An Old Nursery Song*. North-South Books. 1993. A cumulative folk song that traces a tree back to the acorn planted by a boy whose bed was feathered by a bird nesting in a similar tree. Grades K-3. ISBN: 1558581928.

Mellet, Peter. *Trees: Fantastic Facts*. Anness Publishing, Ltd. 2000. Reveals for young readers the secret life of trees – what really goes on inside the trunk, how leaves make food, when trees first grew on the earth, and

more. Includes 19 information sections on the different parts of a tree and their functions, 23 practical projects that help you discover the life-cycle of a tree, and more than 250 illustrations, photos, and explanatory artwork. Grades 3-6. ISBN: 1842150944.

Winter, Jeanette. *Wangari's Trees of Peace: A True Story from Africa*. Houghton Mifflin Harcourt. 2008. This book depicts Wangari Maathai's inspirational story in brief words and colorful images. It offers a welcome introduction to Wangari's awe-inspiring work and to the subject of activism in general. Grades K-4. ISBN: 0152065458.





Student Page

Plant a Tree

Choose Your Site Carefully.

Look up, around, and down. The tree you plant today could eventually reach 40 to 100 feet (12 to 30 meters) in height, depending on the tree type. Give your tree plenty of room – its roots will grow wide and deep.

Plant it well away from buildings and power lines, so that it won't do any damage, or need harmful pruning later in its life. Plant the tree where its roots will not grow into sewers and pipelines, or under drive-ways and sidewalks.

Look at the tree. Make sure it's suited to the environment you are planting it in, so that it has the best chance of surviving.

Take Care Before and During Planting.

Keep the tree cool and shaded, and keep its roots moist until planting. During planting, try not to handle the tree's roots. Tamp the dirt firmly, but don't pack it too tightly or the roots won't be able to either reach out for water and nutrients, or anchor the tree. Soak the soil around the tree with water to encourage deep rooting.



If you're planting a sapling...

Dig a hole twice as wide and as deep as the rootball. Build a mound of soil, and place the sapling on top of the mound so that it is two inches (five cm) above the hole's bottom. If the roots are wrapped, remove the burlap. Fill the hole with dirt, tamping it down with your foot and wetting it with water as you fill the hole.

If you're planting a seedling...

Dig a hole a little deeper than the roots' length. Fill the hole around the seedling with dirt. Then gently pull the trunk of the seedling up slightly to straighten the roots.

Give Special Care During the Early, Developmental Years.

A tree is most vulnerable during the first years of its life. Protect it from pests and animals. Water it as appropriate for the tree type. Add a 3- to 4-inch (8 to 10 cm) layer of mulch around the base of the tree to help keep the soil moist and improve soil aeration (mulch should not touch trunk).

Then sit back and enjoy! If cared for properly, each tree you plant will grow and flourish, providing you and all of us with benefits and beauty for generations.

400-Acre Wood

In this activity, students will play the role of managers of a 400-acre (162 hectare) piece of public forest. Through this role, students will begin to understand the complex considerations that influence management decisions about forest lands.

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Activity 5

Levels

Grades 7-8

Subjects

Science, Math, Social Studies

Concepts

- Resource management and technological systems help societies to meet, within limits, the needs of a growing human population.
- Conservation technology enables humans to maintain and extend the productivity of vital resources.
- Natural beauty, as experienced in forests and other habitats, enhances the quality of human life by providing artistic and spiritual inspiration, as well as recreational and intellectual opportunities.

Skills

Identifying Main Ideas,
Analyzing, Solving Problems



Technology Connections

Spreadsheet/Database Software

Materials

Copies of student pages; a yellow marker; chart paper; colored markers; calculators (optional); masking tape; transparencies and overhead projector (optional)

Time Considerations

Preparation: 60 minutes
Activity: Two to three 50-minute periods

OBJECTIVES

- Students will experience the analysis and decision-making involved in managing forest land.
- Students will understand that any land-use decision has a number of consequences for people, wildlife, and plants.

ASSESSMENT OPPORTUNITY

- Have student teams present their plan for 400-Acre Woods to a Community Council (made up of students). Give each team five minutes to explain why their plan should be accepted by the council. After all teams have presented their plans, give the council members time to choose the plan they believe is best. Use team presentations to assess how well students understand the pros and cons of their proposals.

BACKGROUND

Public and private forests cover nearly one-third of our nation's land. More than just trees, forests are made up of a wide variety of species that interact to create a thriving ecosystem. They provide habitats for many species of plants and animals as well as vital resources for people. People use forests in many ways such as harvesting timber, camping, hiking, hunting, and fishing. Forests also provide clean water by anchoring the soil and preventing soil erosion.

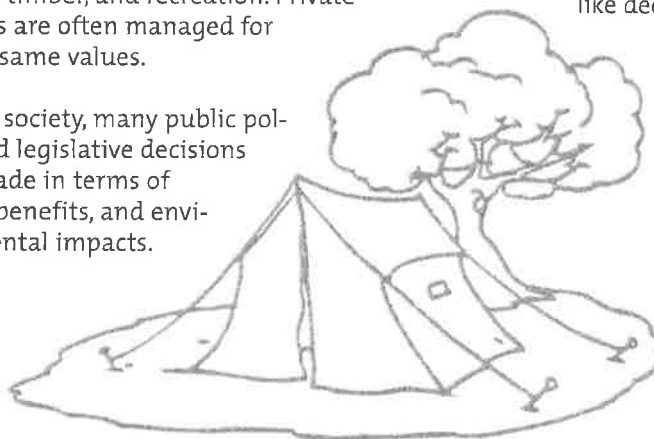
The Multiple Use and Sustained Yield Act of 1960 requires that national forests be managed "in a manner to provide the maximum benefit for the general public." Multiple use management of public lands means forest managers must consider values for fish and wildlife, soil, water, timber, and recreation. Private forests are often managed for those same values.

In our society, many public policy and legislative decisions are made in terms of costs, benefits, and environmental impacts.

Forest managers must consider the economic effects of their decisions about forest lands. But they must also consider the forest's intangible elements such as recreation, water, soil, and wildlife values, even though those items are harder to evaluate. One way to consider the value of a forest for recreational use would be to compare costs and benefits, for example, the cost of developing a campground versus the income from fees charged. Another way is to calculate the number and type of visitors a specific attraction or activity will bring to the forest in a year.

One way to determine the value of wildlife is to measure its contribution to the forest's economic value. Calculate this value by finding out the species of wildlife that live in the forest and if those animals consist of game (hunted) species like deer, turkey, or quail.

Then determine the income generated from hunters through licenses, guns, equipment, lodging, and travel.



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Wildlife's economic value might include other uses that generate income such as wildlife photography and bird watching.

Another way to determine the importance of wildlife is to realize that it has intrinsic value, regardless of its economic value. With this approach, managers view the forest as a complex ecosystem in which every part of the system is important to every other part. If managers maintain each component of the ecosystem, the result will be healthy and assorted wildlife and plant communities, or biodiversity. To figure out how a specific action or non-action might impact biodiversity, forest managers look at the impact of an action on several wildlife species with different habitat needs.

One impact of human development can be **fragmentation**. Fragmentation is the process of dividing large, continuous ecosystems and habitats into smaller, isolated parcels. When humans develop a piece of land for homes, roads, businesses, agriculture, parking lots, and other developments, they change the biological community. As the size of a habitat becomes smaller and smaller, more and more animal and plant species are affected. Sometimes, the decline of a certain species can serve as an early indicator that a whole community or ecosystem is changing.

GETTING READY

Make copies of the student pages. Using a light-colored marker, draw a 20" x 20" (50.8 cm x 50.8 cm) grid map of 400-Acre Wood on a piece of chart paper for each team of four or five students. (Teams can also make their own.) The grid should have 400 1" x 1" (2.5 cm x 2.5 cm) squares, each representing 1 acre (0.4047 hectare). On another piece of chart paper, make an identical, but larger, grid to use in up discussion. If you have an overhead projector, you may want to prepare a transparency of the grid.



DOING THE ACTIVITY

1. Introduce the activity by explaining that students will look at several complex issues that face forest managers. Help students brainstorm a list of activities that take place on forest land. List their ideas on the board. Include uses like hiking, fishing, hunting, reading, taking pictures, camping, rock climbing, skiing, snowmobiling, logging, grazing, or mining. Ask the class to look at the list and decide if any activities would conflict with each other if done on the same piece of land.

2. Discuss these questions:

- Which activities would cost the most to provide on forest land?
- Which would bring the most visitors?
- Which would have the greatest impact on the forest ecosystem? On the wildlife there? Would this effect be permanent or temporary?
- Which would cause fragmentation?
- Which would provide for society's most critical needs?

3. Have students read the "If You Were the Boss" student pages. Divide the group into teams of four or five, and explain that each team will decide the

best use (or uses) of 400-Acre Wood, which has been donated to the community. Each team will develop a land management plan that will serve the best interests of the entire ecosystem. Make sure students understand that their team can use the entire 400 acres (162 ha) for one use, or can divide it up for multiple uses. For example, they may devote 200 acres (81 ha) to wilderness and hiking, 80 acres (32 ha) to a campground, and 120 acres (49 ha) for harvesting timber or hunting.

4. Before students begin, ask these questions:

- Which forest uses in "If You Were the Boss" are compatible with other uses? (for example, building a campground and hiking trail next to each other)
- Which might be incompatible with each other? (hunting near a campground)
- What could you learn by figuring out the costs, revenues, trees, wildlife populations, and number of visitors for each management plan? (how the plan affects different forest values)
- Are owls, wood rats, and salamanders the only wildlife in the forest? (no) What could you learn about the

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forest ecosystem by analyzing the populations of these three species? (By looking at three animals with different habitat requirements, you get an idea of the general health of the forest ecosystem.)

5. Give each team a map (grid) of the 400-Acre Wood. Also give each team a copy of the "What's the Score?" student pages. Each team should discuss various strategies for managing the forest. When the team arrives at a consensus on how the land should be managed, direct members to use "What's the Score?" for a cost and benefit analysis of their plan. They should discuss what impact their plan would have in terms of visitors, wildlife, trees, and cost and revenue.

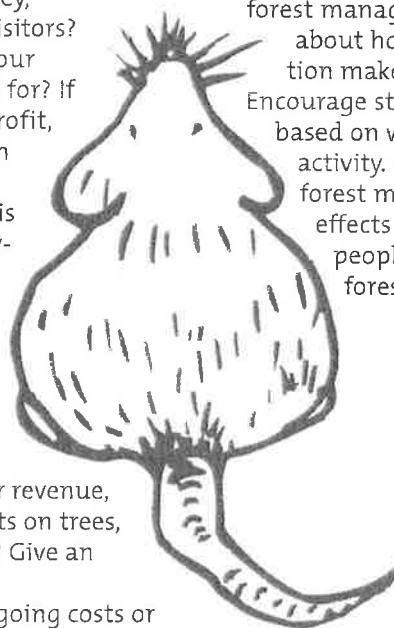
See the PLT website, www.plt.org, for information about obtaining a spreadsheet or database to use in conjunction with the "What's the Score?" student pages.

6. When the teams have completed their management plans, they should use crayons or colored markers to illustrate their plans on the grids. Remind them to include a key showing what different colors and symbols mean.

7. Ask teams to present their plans to the entire group, making clear how they decided on their plans. Have them also report the findings of their "What's the Score?" student pages. Post the maps around the room.

8. Use the large grid map to lead a group discussion of different plans. Ask these questions:

- Which plan enables the most people to enjoy the forest? What is the monetary cost in attracting the most visitors? Are there any other costs besides money?
- Which plan does the most to preserve the forest in its original state? What are the costs of this plan?
- Which plan has the most impact on wildlife and fragmentation? Why should we care if one animal species leaves the forest?
- Which plan seems to provide the best balance of money, trees, wildlife, and visitors?
- How do you think your plan should be paid for? If your plan made a profit, what should happen with the money?
- Which do you think is most important: having the most trees, the most wildlife, or the most visitors? What makes you think so?
- Which do you think is most important—an activity's cost or revenue, or the activity's effects on trees, wildlife, and visitors? Give an example.
- Which items are on-going costs or revenues? Which are one-time costs or revenues?



- What will be the long-term effects of each plan? How will costs or revenue change in the next year? Will the numbers of trees, wildlife, or visitors change?

Enrichment

- Repeat the activity and have each team extend its management plan into the next year, and calculate the effect on money, trees, wildlife, and visitors for the second year.
- Contact the local Forest Service office or forestry agency, and invite a forest manager to talk to your class about how his or her organization makes land-use decisions. Encourage students to ask questions based on what they learned in the activity. For example, how do forest managers weigh the effects of an action on trees, people, and animals in a forested area?

READING CONNECTIONS

Bryan, Nichol. *Los Alamos Wildfires*. Gareth Stevens. 2003. Describes the events surrounding the wildfire that raged in New Mexico in 2000, and the resulting debate over the policy of prescribed burning, or purposely setting fires as a means of forest management. Grades 4+. ISBN: 0836855078.

Camp, William G. and Thomas B. Daugherty. *Managing Our Natural Resources*. Delmar Learning. 1995. Examines the nature, history, and management of natural resources

ranging from soil and water to forests, wildlife, and marine resources. Includes suggested activities and discussion of occupations in the field. Grades 6+. ISBN: 0827367163.

Foster, David R. and John F. O'Keefe. *New England Forests Through Time: Insights from the Harvard Forest Dioramas*. Harvard University Press. 2000. The historical and environmental lessons of New England's landscape are told through the world-renowned dioramas in Harvard's Fisher Museum. This first book based on the dioramas conveys the phenomenal history

of the land, the beauty of the models, and new insights into nature. Grades 6+. ISBN: 0674003446.

Heinrich, Bernd. *The Trees in My Forest*. HarperCollins Publishers. 1997. The author takes the readers on an eye-opening journey through the hidden life of a three hundred acre forest. Each of the 24 essays explores a different aspect of the relationships among plants, animals, and people of the forest. Grades 7+. ISBN: 0060174463.





Student Page

If You Were the Boss



A magnificent forest, 400-Acre Wood, has just been donated to your community. You and your team have the job of deciding what to do with this forest.

As you might have guessed, 400-Acre Wood is 400 acres (162 hectares) in size. An acre is an area of land equal to a square that is 208.7 feet on each side, and 400 acres is a little less than 1 square mile. (A hectare [ha] is 10,000 square meters and is equal to about 2.47 acres. To convert acres to hectares, multiply by 0.4047).

400-Acre Wood is made up of pine forest, with about 150 mature pine trees per acre. In addition, it contains lots of wildlife such as owls, deer, bear, woodpeckers, turkey, quails, wood rats, fish, and woodland salamanders.

Wildlife biologists use something called management indicator species (MIS) to evaluate the impact of people's actions on the environment. For 400-Acre Wood, the indicator species are barred owls, wood rats, and woodland salamanders. Wildlife biologists estimate that 400-Acre Wood currently has two barred owls per 100 acres (40 ha) of forest, and one wood rat and 25 woodland salamanders per acre (0.40 ha). That means a total of 8 barred owls, 400 wood rats, and 10,000 salamanders currently live in 400-Acre Wood.

Because the forest currently has no roads or trails, few people use or visit it.

You and your team will make a map of 400-Acre Wood and develop a management plan for it. You may decide to do one thing with the entire forest. Or you may want to divide the forest and do different things in different areas. Your goal is to find what you think is the best balance between visitor enjoyment, trees, wildlife, and money.

Below are the different forest uses you can include in your plan. The "What's the Score?" student page will help you evaluate your plan's total effect on visitors, trees, wildlife, and money.

Wilderness Preserve

The purpose of a wilderness preserve is to allow wildlife and plants to exist without humans interfering. Typically a wilderness preserve has no roads, graded trails, or campsites. Wilderness preserve areas will have the following effects.

Visitors: About 5 people per acre per year will visit the preserve.

Trees: The number of trees per acre will remain the same.

Wildlife: The numbers of owls, wood rats, and salamanders per acre will remain the same.

Money: It will cost money to manage the preserve, and each visitor will pay an entrance fee.

Trails

Graded trails allow different types of visitors to enjoy a forest area, including walkers, cyclists, families with strollers, and wheelchair users. Trails areas will have the following effects.

Visitors: About 25 visitors per acre per year will use the trails.

Trees: Some trees must be cut to build a trail.

Wildlife: The increase in visitors will disturb the wildlife. Owls will leave areas with trails (they sleep during the day when people are about), and trails are dangerous for woodland salamanders as they migrate to pools of water during breeding season. There will be no effect on the wood rat population.

Money: It costs money to build and maintain trails. Trees removed to make the trail can be sold. Each visitor will pay an entrance fee.

(continued on next page)



Student Page

If You Were the Boss (continued)

Campground

A campground allows visitors to enjoy a forest area overnight or over the weekend. It typically has a number of campsites, plus picnic tables, fire pits, parking spaces, and bathrooms. A campground also needs to have a road winding through it. A campground has about 4 sites per acre. Campground areas will have the following effects.

Visitors: About 12.5 campers per site per year will come to the campground, or 50 campers per acre per year.

Trees: Trees need to be removed to build the road and the campsites.

Wildlife: A campground and campers will cause all three indicator species—owls, wood rats, and salamanders—to disappear from the area.

Money: It costs money to build and maintain the road, to clear and level the campsites, and to build and maintain the restrooms. It also costs money to manage the campground. Trees removed for the road and campsites can be sold. Campers pay a camping fee.



Hunting

Some forest areas are managed to encourage game animals (deer, turkey, and quail) for hunters. These areas require a road for visitors. Hunting areas will have the following effects.

Visitors: About 1 hunter per acre per year will visit.

Trees: Trees will need to be removed to build the road.

Wildlife: With regulations to keep game populations constant, there should be no effect on the three indicator species—owls, wood rats, and salamanders.

Money: It will cost money to build and maintain the road. It will also cost money for management. Trees removed for the road can be sold. Hunters will pay a hunting fee.

Fishing

To encourage fish for anglers, a lake can be created by damming the forest stream. Fishing areas will have the following effects.

Visitors: About 2 anglers per acre per year will visit.

Trees: Trees will need to be removed to create the lake.

Wildlife: Creating the lake will cause all three indicator species—owls, wood rats, and salamanders—to disappear from the fishing area.

Money: It will cost money to build the dam to create the lake. It will also cost money for management. Trees removed for the lake can be sold. Anglers will pay a fishing fee.

Timber Harvest

Some forest areas are set aside for timber harvesting, which means cutting trees to sell the logs. Using a sustainable yield approach, only a portion of the trees are removed at any given time. This minimizes the effect on wildlife, while producing as many logs as possible over the long-term. For pine trees, which take 35 years to reach maturity, one-fifth of the trees are cut every 7 years. Timber harvest areas will have the following effects.

Visitors: About 5 people per acre per year will visit.

Trees: Trees will be removed to build the road, plus one-fifth of remaining mature trees will be removed.

Wildlife: The timber harvest will have a minimal impact on the three indicator species.

Money: It will cost money to build and maintain the road and for management. The harvested trees can be sold. Visitors will pay a fee.



Student Page

What's the Score?

Step 1.

Determine how many acres you plan for each **land use**. The total should be 400 acres.

(____ acres Wilderness) + (____ acres Trails) + (____ acres Campground) + (____ acres Hunting) + (____ acres Fishing) + (____ acres Timber Harvest) = ____ Total Acres

Step 2.

Calculate how many **visitors** per year this plan will attract to your community.

(____ acres Wilderness x 5 visitors/acre) + (____ acres Trails x 25 visitors/acre) + (____ acres Campground x 50 campers/acre) + (____ acres Hunting x 1 hunters/acre) + (____ acres Fishing x 2 anglers/acre) + (____ acres Timber Harvest x 5 visitors/acre) = ____ Total Visitors per Year

Step 3.

Calculate how this plan will affect the **wildlife** management indicator species. Compare the totals you get to the original population of 8 owls, 400 wood rats, and 10,000 salamanders.

Owls: (____ acres Wilderness) + (____ acres Hunting) + (____ acres Timber Harvest) = ____ acres that will support owls x 0.02 owls/acre = ____ Total Owls (Note: Round down to the nearest whole owl.)

Wood Rats: (____ acres Wilderness) + (____ acres Trails) + (____ acres Hunting) + (____ acres Timber Harvest) = ____ acres that will support wood rats x 1 wood rat/acre = ____ Total Wood Rats

Salamanders: (____ acres Wilderness) + (____ acres Hunting) + (____ acres Timber Harvest) = ____ acres that will support salamanders x 25 salamanders/acre = ____ Total Salamanders

Step 4.

Calculate how many **miles of trail or road** are needed for your plan.

(____ acres Trails) ÷ 6 acres/mile = ____ Total Miles of Trail
 (____ acres Campground x 250 ft/acre) ÷ 5,280 ft/mile = ____ miles of road for Campground
 (____ acres Hunting x 100 ft/acre) ÷ 5280 ft/mile = ____ miles of road for Hunting
 (____ acres Timber Harvest x 100ft/acre) ÷ 5280 ft/mile = ____ miles of road for Timber Harvest

Step 5.

Calculate how many mature **trees** remain based on your plan.

(____ miles of Trail x 0.36 acres/mile) x 150 trees/acre = ____
 (____ miles Campground road x 1.45 acres/mile) x 150 trees/acre = ____
 (____ miles Hunting road x 1.45 acres/mile) x 150 trees/acre = ____
 (____ acres of Fishing) x 150 trees/acre = ____
 (____ miles Timber Harvest road x 1.45 acres/mile) x 150 trees/acre = ____
 (____ acres Timber Harvest x 1/35 harvested) x 150 trees/acre = ____
 Total trees removed ____

60,000 mature trees in 400-Acre Wood – trees removed = trees remaining ____

(continued on next page)



Student Page

What's the Score? (continued)

Step 6.

Calculate the **revenue** and **costs** associated with your plan, and determine the net profit or loss.

Revenue

Fees (per year)

_____ Wilderness visitors x \$2 fee per visitor = \$ _____
 _____ Trails visitors x \$2 fee per visitor = \$ _____
 _____ Campground campers x \$20 fee per site ÷ 2 campers per site = \$ _____
 _____ hunters x \$5 fee per hunter = \$ _____
 _____ anglers x \$2.50 fee per angler = \$ _____
 _____ Timber Harvest visitors x \$2 fee per visitor = \$ _____

Sale of Trees

_____ trees removed for Trails x \$50 per tree = \$ _____
 _____ trees removed for Campground road x \$50 per tree = \$ _____
 _____ trees removed for Hunting road x \$50 per tree = \$ _____
 _____ trees removed for Fishing x \$50 per tree = \$ _____
 _____ trees removed for Timber Harvest x \$50 per tree = \$ _____

Total Revenue \$ _____

Costs

Management Costs (per year)

_____ acres Wilderness x \$2.50 per acre = \$ _____
 _____ acres Trails x \$50 per acre = \$ _____
 _____ acres Campground x \$200 per acre = \$ _____
 _____ acres Hunting x \$5 per acre = \$ _____
 _____ acres Fishing x \$2.50 per acre = \$ _____
 _____ acres Timber Harvest x \$5 per acre = \$ _____

Construction Costs

_____ miles of Trail x \$100 per mile = \$ _____
 _____ miles Campground road x \$600 per mile = \$ _____
 _____ acres Campground x 4 sites per acre x \$1000 per site = \$ _____
 _____ miles Hunting road x \$600 per mile = \$ _____
 _____ acres Fishing x \$3000 per acre = \$ _____
 _____ miles Timber Harvest road x \$600 per mile = \$ _____

Total Costs \$ _____

Profit or Loss

(Total Revenue \$ _____) - (Total Costs \$ _____) = \$ _____ Net

If the Net amount is positive, it is a profit; if it is negative, it is a loss.

ANIMALS AND THEIR FEELINGS

SHARE
THE WORLD

We think of some animals as our friends. Others we may think of as dangerous, and others we hardly think of at all. But all animals, from the family dog to the tiniest mouse, are, like us, living, feeling beings. We can learn more about how animals experience life by developing **empathy** toward them—in other words, by identifying with their needs and feelings to understand them better.

For a classic example of writing that displays empathy toward an animal, read this passage from Anna Sewell's classic novel **Black Beauty—The Autobiography of a Horse**. In it, a horse named Ginger tells Black Beauty of her experience with humans. Then think about how the author shows empathy toward Ginger and her plight.

The man that had the care of us never gave me a kind word in my life. I do not mean that he ill-used me, but he did not care for us one bit further than to see that we had plenty to eat and shelter in the winter. Very often the great boys passing through [our field] would fling stones to make us gallop. I was never hit, but one young colt was badly cut in the face ... we settled it in our minds that boys were our enemies.

We had very good fun in the free meadows, galloping up and down ... and chasing each other round and round. But when it came to breaking in, that was a bad time for me; several men came to catch me ...

one caught me by the nose ... so tight I could hardly draw my breath; ... and so by force they got on the halter and the bar in my mouth; one dragged me along by the halter, another flogging behind ... this was the first experience I had of men's kindness ...

... I had a good deal of spirit ... it was dreadful to be shut up in a stall day after day instead of having my liberty, and I fretted and pined and wanted to get loose.



part 1

The passage you've just read shows that **empathy** is the key to understanding what animals are feeling. Now read each situation below. Then, in the spaces provided, list all the feelings you can think of that each animal might be experiencing.

1. A dog let into a warm home on a very cold night feels ...

2. A pony giving rides to children, walking around and around in circles on a hot day, feels ...

3. A small calf separated from his or her mother feels ...

part 2

Now stretch your imagination further. Imagine that you are any animal of your choice. On the other side of this sheet, write a brief story from the animal's point of view, based on the topic "If I had three wishes." Give your story a title, and draw a picture to go with it on a separate sheet of paper. Then share both your story and your picture with the class.

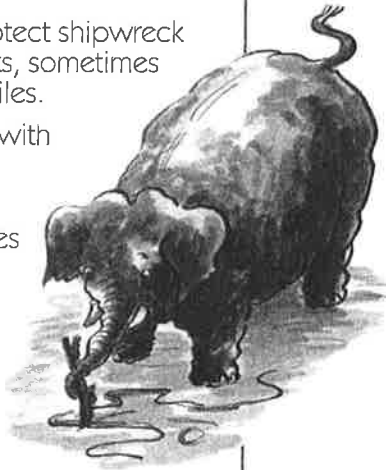
THE AMAZING WORLD OF ANIMALS

**SHARE
THE WORLD**

part 1/AMAZING ANIMAL FACTS

The more you know about animals, their abilities, and their behavior, the more you'll see how complex and amazing they are. Here are some fascinating facts about animals that may surprise you.

- ✓ **Dolphins** have been known to protect shipwreck survivors from drowning and sharks, sometimes keeping people afloat for many miles.
- ✓ **Beavers** live in complex societies with homes, lodges, and food storage.
- ✓ **Musk oxen and cows** form a protective circle around their calves when danger or rough weather threatens.
- ✓ **Elephants** have been known to enjoy painting or drawing, using paintbrushes or even twigs held in their trunks.



- ✓ **Orangutans** build overhead platforms in their "nests" to keep out the rain and use large leaves as umbrellas.
- ✓ A **blackpoll warbler** can fly all the way from Canada to South America and back, then return to the exact same nest.
- ✓ Male **emperor penguins** guard and incubate the females' eggs for two continuous months, without food, in the perpetual Antarctic cold.
- ✓ **"Electric" fish and eels** communicate by transmitting electrical signals to one another.

part 2/ANIMAL I.Q. TEST

Now, let's put your animal I.Q. to the test. Read each statement below. Check "A" if you agree that the statement is true, "D" if you disagree, or "NS" if you're not sure.

1. **Whales'** communication powers are so strong that a whale in Antarctica can hear the calls of a whale in Alaska.
2. **Crows** in the south of France have a different "accent" from crows in the north.
3. If an injury forces a **goose** to leave the flock, others stay with the injured bird until he or she recovers or dies.
4. **Deer** have been known to "guide" other deer who have gone blind.
5. **Elephants** mourn their dead and can shed tears of grief.
6. Black-tailed **prairie dogs** use "kisses" to identify members of their community.
7. After a fight, **chimpanzees** sometimes comfort the loser by putting an arm around or grooming him or her.
8. Some **birds** use mud and plants to set and heal broken bones.
9. There have been thousands of cases in which **dogs** and **pigs** have saved children from danger.



A	D	NS
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part 3/ANIMAL PROJECT

Although we have yet to fully understand animal languages, we can imagine what animals might be thinking and feeling. Choose an animal and research his or her natural habitat. Then turn this sheet over and write a "letter to the editor" from the animal's point of view in response to a threat to his or her home.



Animals Around Us

Grade level K-2

Duration- 1 hour

Objectives

Students will

- Learn and understand the term habitat.
- Discover that forests, deserts, wetlands, and grasslands are unique and separate habitats.
- Identify animals that live in four different environments.

Materials

- Crayons
- White construction paper, 1 sheet per student
- Magazines, nature calendars and other print resources with photographs of desert, forest, wetlands, and prairie environments

Procedures

1. Talk about different natural environments with the class. What is a forest? What does it look like? How is a forest different from a desert? Explain the term "habitat" and talk about the many kinds of animals that live in different habitats. Print resources to illustrate the unique features and animals of the forest, desert, grasslands, and wetlands.
2. Continue discussing forests, wetlands, deserts, and grasslands until students demonstrate a clear understanding of the basic characteristics of these environments and can identify some animals that live in each habitat. Once students have a solid understanding, tell them to draw a picture of the one they would most likely to visit. Talk about the kinds of things you would expect to see in each picture, such as the animals and plants that live and grow there. Check for comprehension by asking questions like these: Should a drawing of the desert have a lot of trees? What kinds of animals might you draw if you were making a picture of a wetlands habitat?
3. Allow students time to work on their drawings. Write the words "forest," "desert," "wetlands," and "grasslands" on the board so students can write the word for their chosen habitat in a visible spot on their drawings.
4. Once the drawings are complete, ask students to share them with the rest of the class. Which habitat did most of the students want to visit? Ask them to explain why. What kinds of plants and animals appear in the different drawings?
5. At the close of the lesson, take the students outside to observe animals that live in your school environment. What do they see? How would they describe the habitat these animals live in?
6. Finally, display the habitat drawings in the classroom so students have a visual reminder of the unique features of the forest, desert, wetlands, and grasslands.

Animal Habitat Vocabulary**desert**

Definition: A dry, often sandy region that has little rainfall, extreme temperatures, and sparse vegetation

Context: Because the desert gets so little rainfall, very few plants can grow there.

forest

Definition: A dense growth of trees, plants, and underbrush covering a large area

Context: A forest, also called woodland, is a habitat with lots of trees.

grasslands

Definition: Land where mainly grass or grasslike vegetation grows, such as a prairie or a meadow

Context: Some of the biggest animals living in the grasslands are grazers, or grass eaters, such as bison.

habitat

Definition: The type of environment in which an organism or group normally lives or occurs

Context: Every habitat provides animal species with food, water, shelter, and space to move around.

wetland

Definition: An area of land where water covers the soil or is present either at or near the surface of the soil year-round or for varying periods of time during the year, including during the growing season

Context: A wetland is any place where the soil stays moist and wet, such as a bog, swamp, or marsh.

Habitats of the World

LENGTH OF LESSON: Three hours

GRADE LEVEL: 3-5

SUBJECT AREA: Ecology

OBJECTIVES: Students will understand the following:

- Earth supports many different habitats, each of which has distinct features and distinct plant and animal populations.
- Animals and plants are adapted to the conditions of the habitats in which they live.

MATERIALS: For this lesson, you will need:

- Research materials on habitats
- Computer with Internet access
- Materials needed by groups for their projects

PROCEDURE:

1. Tell students they are going to form groups to research different habitats of the world. Each group will produce a report on its habitat including the following information:

- A physical description of the habitat
- Examples of the habitat (geographical locations)
- Examples of animals and plants that live in the habitat

In addition, each group will be given a specific assignment that will require the group to show how the animals in the assigned habitat are adapted for life there.

2. On the chalkboard, write the names of the different habitats students will investigate: grasslands (or savanna), temperate forest, tropical rain forest, desert, polar ice, tidepools. Then divide your class into six groups, assigning each group one of those habitats to research. Following are specific assignments for each group.

3. Grasslands (savanna): Research the speeds of animals that live in the African grasslands. Project: Create a display that compares the different speeds of these animals. Write an explanation for why speed is important for survival in the grasslands. (There are few trees or places for animals to hide in grasslands habitats. Therefore, speed is important for both predators that are hunting and animals that are fleeing predators.)

4. Temperate forest: Explain to students that in the winter, less water is available for trees to take in through their roots, because much of the water in the ground is frozen. Since trees lose water

through their leaves, losing leaves is a way for a tree to conserve water. Coniferous trees do not lose nearly as much water through their needles as deciduous trees lose through their leaves.

Project: Put a twig from a coniferous tree (cone-bearing tree with needles instead of leaves) in a cup of water, and tightly fasten a clear plastic bag around its needles. Put a twig from a deciduous tree (leafy tree that loses its leaves in the fall) in a cup of water, and tightly fasten a clear plastic bag around the leaves. Observe what happens. Draw pictures and write an explanation for what you observed. (There will be more water droplets on the inside of the bag covering the leaves, showing that leaves lose more water than do needles.)

5. Tropical rain forest: Describe the three main levels of the rain forest—canopy, understory, and forest floor. Project: Make a diagram or model showing examples of animals and plants that live on each level. Choose an animal or plant from each level and explain how it is adapted to its particular place in the tropical rain forest. (Canopy examples: monkeys can use arms and legs and sometimes even tails to swing from branch to branch; birds such as parrots have specialized feet with two curling front toes and two curling back toes to help them hang on to branches. Understory example: snakes such as boa constrictors spend their days curled around branches or vines. Forest floor example: jaguars' spots help them to be better hunters by making them hard to see among the speckled shadows of the rain forest floor.)

6. Desert: Choose a desert animal or plant. Project: Make a model of it, draw it, or describe it. Explain how it is particularly well adapted to survive in a place where there is very little water. (Plant example: the saguaro cactus has an expanding trunk that allows it to take in a great deal of water when water is available. The saguaro has stored-up water during the long desert dry periods. Animal examples: many desert animals dig burrows in the sand to stay cool in the intense heat; many desert animals sleep during the day and are active at night, when the temperature is lower.)

7. Polar ice: Research both the polar bear (North Pole) and the penguin (South Pole). Project: Draw or make a model of each animal. For each animal, explain at least three ways—physical or behavioral characteristics—in which it is well adapted for life in a very cold and snowy climate. (Polar bear examples: two layers of fur and an extra layer of fat under its skin keep it warm; ears are very small so that very little heat can escape from them; paws are huge to help spread out its weight over the snow and keep it from sinking in; it builds snow dens to keep its babies warm in winter; it has white fur that helps it blend in to its surroundings.)

8. Tidepool: Explain how a tidepool is formed, and describe several animals that are found in tidepools. Project: Make two models of a tidepool—one at high tide and one at low tide. Use sand, rocks, salt water, and other materials (e.g., modeling clay) for your models. Draw at least three tidepool animals and explain how they survive in a constantly changing habitat (sometimes wet, sometimes dry). (Examples: periwinkles, limpets, and barnacles attach themselves to rocks by suction so they will not be swept away when the tide goes out; the incoming tide brings food to clams, oysters, and mussels—all they have to do is open up their shells and tiny bits of animals and plants flow in.)

9. When students have completed their assignments, have each group present its project to the class.

ADAPTATIONS:

Have each group choose a habitat and draw pictures of plants and animals that would be found there.

DISCUSSION QUESTIONS:

1. Compare a cheetah to a top athlete. In what types of sports would cheetahs excel?
2. Many trees grow in the temperate forest. Talk about several ways in which the animals that live in the temperate forest depend on trees.
3. The tropical rain forest is home to more species of animals than any other habitat, and yet the rain forest is in danger because so many rain-forest trees and other plants are needed for many products we use. Can you devise a plan to preserve the rain forest without depriving human beings of products on which they depend?
4. Humans, as well as animals, live in the desert. Compare and contrast the ways in which humans and animals have adapted to life in this habitat.
5. Many scientists believe that, as a result of global warming, the polar ice cap is beginning to melt. Discuss what the effects that the melting of the polar ice cap might have on the rest of the world. Can anything be done to stop or slow down the process of global warming?
6. Imagine that you are a tidepool animal, and describe a day in your life in the tidepool. What difficulties do you have to overcome? What are the positive aspects of life in a tidepool?

EXTENSION:**Habitat Sites**

To learn more about the habitats the class has been studying, have students visit a Web site for each habitat. Students should be able to find sites easily, but here are some suggestions:

Grasslands: cheetahspot

Temperate forest: northolympic

Tropical rain forest: edens

Desert: desertusa

Polar ice: antarctica

Tidepool: tidepools

Mystery Animals

Divide your class into groups. Have each group choose an unusual or unfamiliar animal from the

habitat it has been assigned and prepare a card with the name of the animal, a description of the animal's physical and behavioral characteristics, and a picture of the animal. Mix up the cards and give one to each group, making sure that no group gets its own card. Then challenge each group to figure out, on the basis of the animal's physical and behavioral characteristics, whether the animal it has been given belongs in the habitat the group was assigned.

SUGGESTED READINGS:

The Serengeti Migration: Africa's Animals on the Move

Lisa Lindblad. Hyperion Press, 1994.

Cheetah

Taylor Morrison. Henry Holt & Company, 1998.

Grassland

April Pulley Sayre. NY, Twenty-First Century Books, 1994.

The Kingdon Field Guide to African Mammals

Jonathan Kingdon. San Diego, Academic Press / Harcourt Brace & Co., 1997.

The Temperate Forest (Deep Green Planet)

Lorenzo Fornasari, Renato Massa, and Monica Carabella. Raintree/Steck Vaughn, 1996.

Vanishing Forests

Helen J. Challand. Chicago, Childrens Press, 1991.

Washington

Dennis Brindell Fradin and Judith Bloom Fradin. Chicago, Childrens Press, 1994.

Tropical Rain Forest

April Pulley Sayre. NY, Twenty-First Century Books, 1994.

Welcome to the Green House

Jane Yolen (Illustrated by Laura Regan). NY, Putnam's Sons, 1993.

The Most Beautiful Roof in the World: Exploring the Rainforest Canopy

Kathryn Lasky. Gulliver Books, 1997.

Rainforest (Biomes of the World)

Edward R. Ricciuti. Benchmark Books, 1996.

Antarctica (Enchantment of the World)

Henry Billings. Children's Press, 1994.

What's a Penguin Doing in a Place Like This?

Miriam Schlein. Brookfield, CT, The Millbrook Press, 1997.

Penguins

Gallimard Jeunesse and Rene Mettler. NY, Cartwheel Books / Scholastic, Inc., 1995.

WEB LINKS:**The Cheetah Spot**

This site allows all who visit to be contestants on a quiz show. Everything you ever wanted to know about these denizens of the Serengeti is at your fingertips. Students will learn about physical descriptions, fur patterns, and preservation efforts and view photos of the world's fastest animal.
<http://www.cheetahspot.com/>

Olympic National Park

This site includes information on climate and glaciers and even contains a list of animals common to the area.
<http://www.northolympic.com/onp/index.html>

The Living Edens “Manu”

This site provides information on the people of Peru's rainforest.
<http://www.pbs.org/edens/manu/index.htm>

Penguin Adaptation

Find out about the special features penguins have that enable them to survive in severe climate of the Antarctic.
<http://octopus.gma.org/surfing/antarctica/penguin.html>

VOCABULARY:

Evaporates--Changes into vapor, removes, dissolves, or disappears.

Context: When it doesn't rain for months at a time in the marshes, much of the water evaporates and many of the plants die.

Carnivores--Animals who eat flesh.

Context: In the grasslands of the Serengeti, you will find animals that are carnivores, herbivores, and scavengers.

Herbivores--Animals who eat plants.

Context: In the grasslands of the Serengeti, you will find animals that are carnivores, herbivores, and scavengers.

Circumference--The distance around a circular object.

Context: Sitka spruces can reach a circumference of 23 feet.

Peninsula--An area of land surrounded on nearly all sides by water.

Context: The Olympic Peninsula in Washington state receives about 12 feet of rain each year.

Canopy--The thick layer of leaves at the top of trees in the rainforest.

Context: Many rainforest animals live in the canopy.

Decomposes--Rots and decays; breaks down into smaller pieces.

Context: When a tree or plant dies naturally in the forest, it decomposes.

Unique--The only one of its kind, original and unmatched.

Context: The feather patterns on each macaw are unique.

Circulate--To move in a circle, circuit, or orbit.

Context: The cooler air and water from Antarctica circulate around the globe, helping to regulate the temperatures of the whole Earth.

Back to Nature

Concept Areas

The idea that organisms live in the environments to which they are best adapted. Whale families, life on mountains and in the salt marsh. The effects of temperature and altitude.

For Each Group:

- Only materials from this book.

Note: three of the problems require a separate page where students place the answer pieces.

Also: all of these problems require all six clues; there are no "optional" clues in this family!

Description

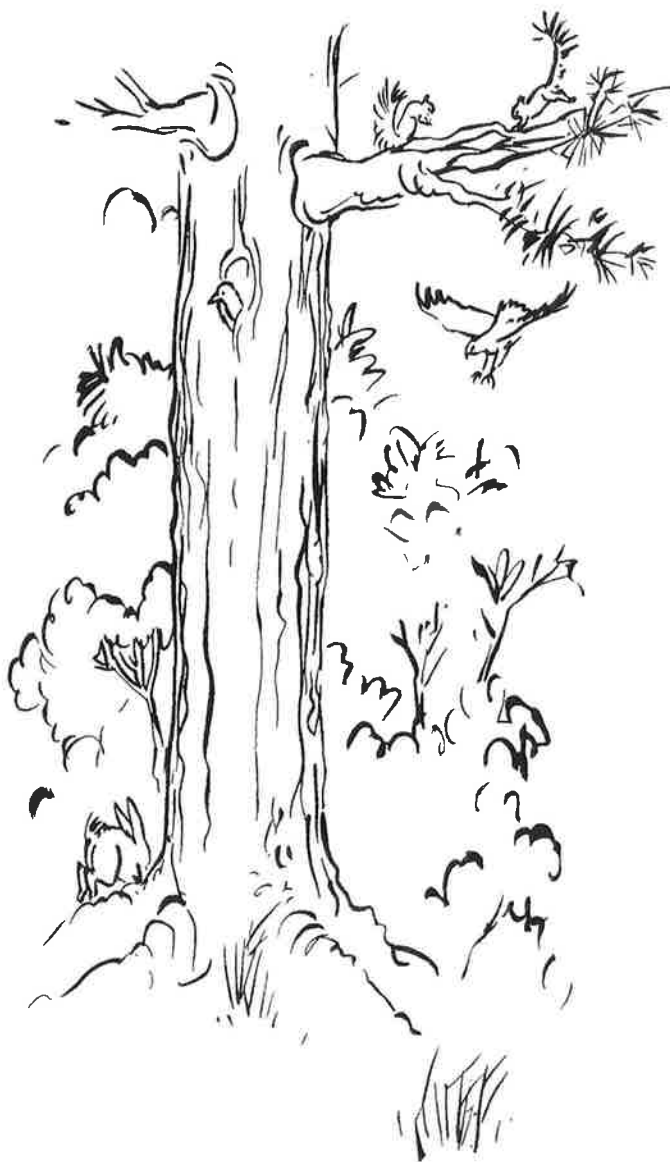
Students get clues about parts of an environment or particular organisms. The group has to put the information together to decide which organisms live where. The first problem is somewhat different; here we're compiling information about the sizes of whales.

Features

As we saw in the family *Around the World*, problems in this form don't have to be strictly mathematical. Here we move into the natural world and study the interaction of organisms with their environments.

These problems are ideal if you are planning or have just been on a field trip to the area in question. But they are also useful as springboards for any discussion of habitat and adaptation.

The last two problems, *Where Do They Live?* and *Where Do They Grow?* are about the same regions—but one is about animals and one is about plants. The two are related. Doing *Grow* first will help the students.



Possible Debriefing Questions

Why do you suppose those different plants live at different altitudes?

Why do the different salt marsh organisms live at different levels?

Have you ever seen a jackrabbit? A whale? A marsh hawk? Jeffrey pine tree?

If you look at plants around your school, can you think of why some of them live where they do? For example, where does grass grow? And where doesn't it grow?

Whale Lengths

The bowhead whale is 20 feet shorter than the sperm whale.

The whales (order Cetacea) have two suborders, the baleen whales and the toothed whales.

Whale Lengths

A one-week-old baby blue whale is as large as a pickup truck.

A full-grown fin whale is about 20 feet shorter than a full-grown blue whale.

Use the information on this card to help your group solve the problem.

Whale Lengths

A mature blue whale measuring 100 feet has a heart as big as a Volkswagen (a beetle, not a van).

No one knows for sure how many species of whales there are, but scientists estimate there may be 80 to 100 different species.

Whale Lengths

The largest toothed whale is 63 feet long.

A full-grown gray whale is half the size of a full-grown blue whale.

Use the information on this card to help your group solve the problem.

Whale Lengths

A sperm whale (the kind in *Moby Dick*) can dive to 10,000 feet and stay underwater for 90 minutes.

The maximum lengths of the bowhead whale and the sei whale are about the same.

Whale Lengths

All whales that grow to 50 feet or more are baleen whales except one, the sperm whale, which is a toothed whale.

Here is your group's problem: how long is each of the six species of whale when it is fully grown?

Sperm
Whale

Bowhead
Whale

Sei
Whale

Blue
Whale

Gray
Whale

Fin
Whale

The Salt Marsh

Runners of salt grass lay a dark green carpet on the mud above the upper boundary of pickleweed.

The marsh hawk has a white rump patch and feeds on mice and other small animals that cross the dry grasslands to nibble on saltbushes and juicy pickleweed.

The Salt Marsh

Pickleweed grows nearer the high tide mark than alkali heath and its string of gray-green "pickles" are actually fleshy leaves fused together around the central interior stem.

Copepods swim in the waters of the salt marsh.

Use your information to help your group put the labels on the right places on the mat.



The Salt Marsh

Although pickleweed can tolerate having its roots in wet mud, it cannot tolerate long periods of submergence.

On the other hand, cordgrass can endure many hours of submergence; it dominates the mid-tide zone.

Use your information to help your group put the labels on the right places on the mat.

The Salt Marsh

Cordgrass is the pioneering plant of the salt marshes and is one of the most productive plants in the world, yielding up to eight tons of dried material per acre.

The largest wading bird of the salt marshes is the Great Blue Heron, standing four feet high with a seven-foot wingspread.

The Salt Marsh

Sometimes a few spikes of cordgrass get a start in the saltgrass, but most cordgrass grows below the high tide line.

Pickleweed is the dominant plant of the average high-tide level, growing about 18 inches tall.

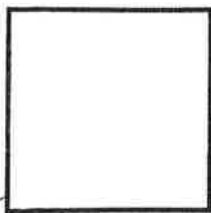
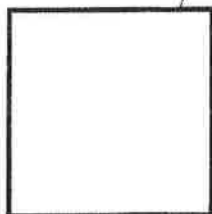
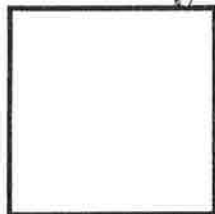
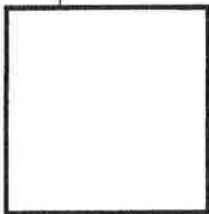
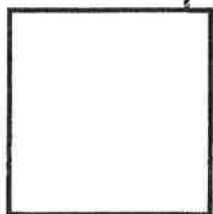
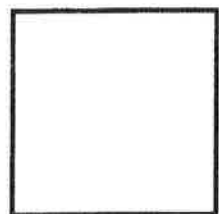
Use your information to help your group put the labels on the right places on the mat.

The Salt Marsh

Alkali heath and other halophytes grow in the uppermost level of the intertidal zone, where the highest tides wet the soil only a few times a year.

The marsh hawk hunts from the sky, gliding along on its four-foot wingspan.

Wetlands Profile



high tide

low tide



Salt Grass



Pickleweed



Marsh Hawk



Alkali Heath



Great Blue Heron



Copepod



Cord Grass



Where Do They Grow?

The height, steepness, temperature, moisture, and other characteristics of the land influence the species that live there.

Ranchers raise cattle and sheep in the shadscale shrub area between 3000 and 6000 feet elevation.

It gets colder and the growing season gets shorter, the higher you go.



Where Do They Grow?

No trees, only small plants grow in the alpine fell fields, a harsh environment with ferocious winds, rocky soil, and thin air.

The mixed coniferous forest has a great variety of trees in broad canyons with 30-60 inches of precipitation and a growing season of 2 1/2 to 3 1/2 months.



Plants can be grouped according to the communities where they are usually found.

Whitebark pine grows in broad glacial basins, near the high mountain lakes and the rocky ledges of the subalpine forest where the growing season is 7 to 9 weeks.

Where Do They Grow?

The Jeffrey pine can grow to 180 feet tall. Its needles come in threes, and it thrives where the growing season is about three months.

The bright blue sky pilot grows far above the Jeffrey pine in a place of heavy snow, gale-force winds, and a growing season of only 4 to 7 weeks.

Where Do They Grow?

Mojave rabbitbrush and bitterbrush grow in areas where deer are plentiful.

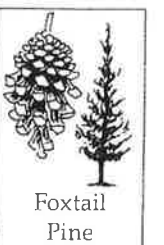
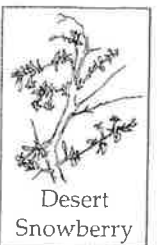
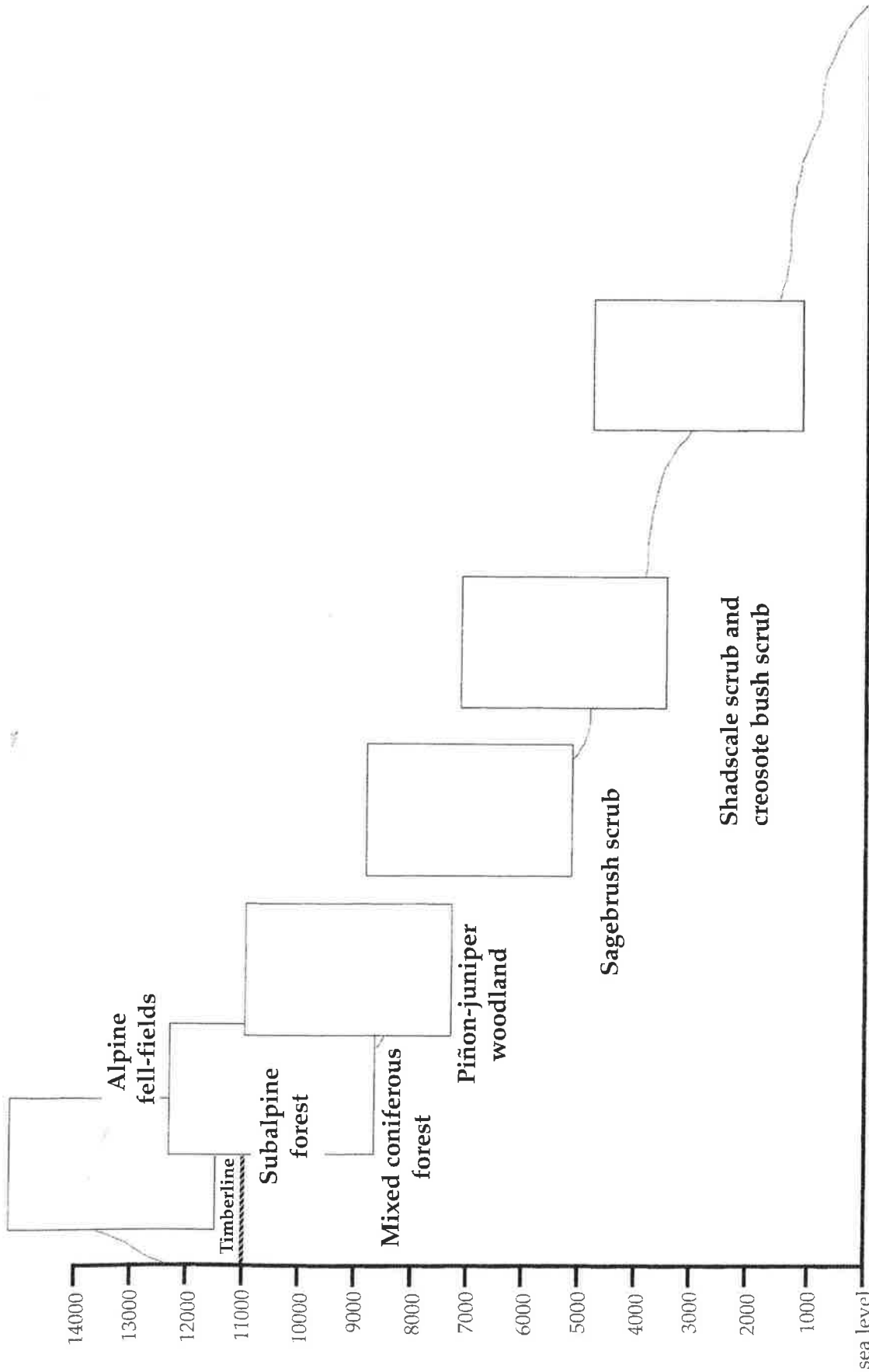
The lodgepole pine and the whitebark pine share the same areas as the alpine columbine and the foxtail pine.

Use your information to help your group put the plant labels on the right places on the mat.

Where Do They Grow?

The desert snowberry grows above the Mojave rabbitbrush in an area that gets some snow and has a growing season of five to eight months.

Cattle and sheep graze on spiny hopsage in an area with heavy soil and warm air—but limited water.



Where Do They Live?

The porcupine ranges widely, but prefers forests such as lodgepole pine and fir.

In the Alpine Arctic zone, snow covers the ground to a depth of 40 or more feet and lasts seven to nine months.

Find the preferred zone for each animal.

Where Do They Live?

Canadian Zone trees include a two-needed pine called "Lodgepole" and two species of fir tree, the red and the white firs.

The black-tailed jackrabbit lives in a zone much lower than the pika.

Find the preferred zone for each animal.



Where Do They Live?

The Jeffrey pine forests are in a zone immediately below the Lodgepole pines.

The white-tailed antelope squirrel is able to live in the open desert prairie country where temperatures are very high. It does not live in any higher, cooler zone.

Find the preferred zone for each animal.

Where Do They Live?

The least chipmunk eats seeds, grains, and the greenery it finds in the Jeffrey pine forest.

The Sierra marmot lives in the highest mountains. Marmot signs have been found on the top of a 13,000 foot peak.

Where Do They Live?

The hot desert of the lower Sonoran zone is suited to prairie plants such as spiny hopsage.

The pika spends its short summer cutting and collecting stems of plants such as alpine columbine. It leaves this "hay" to dry, and then gathers it into a protected area for use during the long snowy winter.

Find the preferred zone for each animal.

Where Do They Live?

The pika (also called "cony" or "rockrabbit") lives in the high rock slides near the timberline.

Black-tailed jackrabbits can leap two or three yards at a bound, touching only their toes to the high desert ground.

Find the preferred zone for each animal.

