Sample Lesson Plans

Grades 7-8

Saskatchewan Curriculum

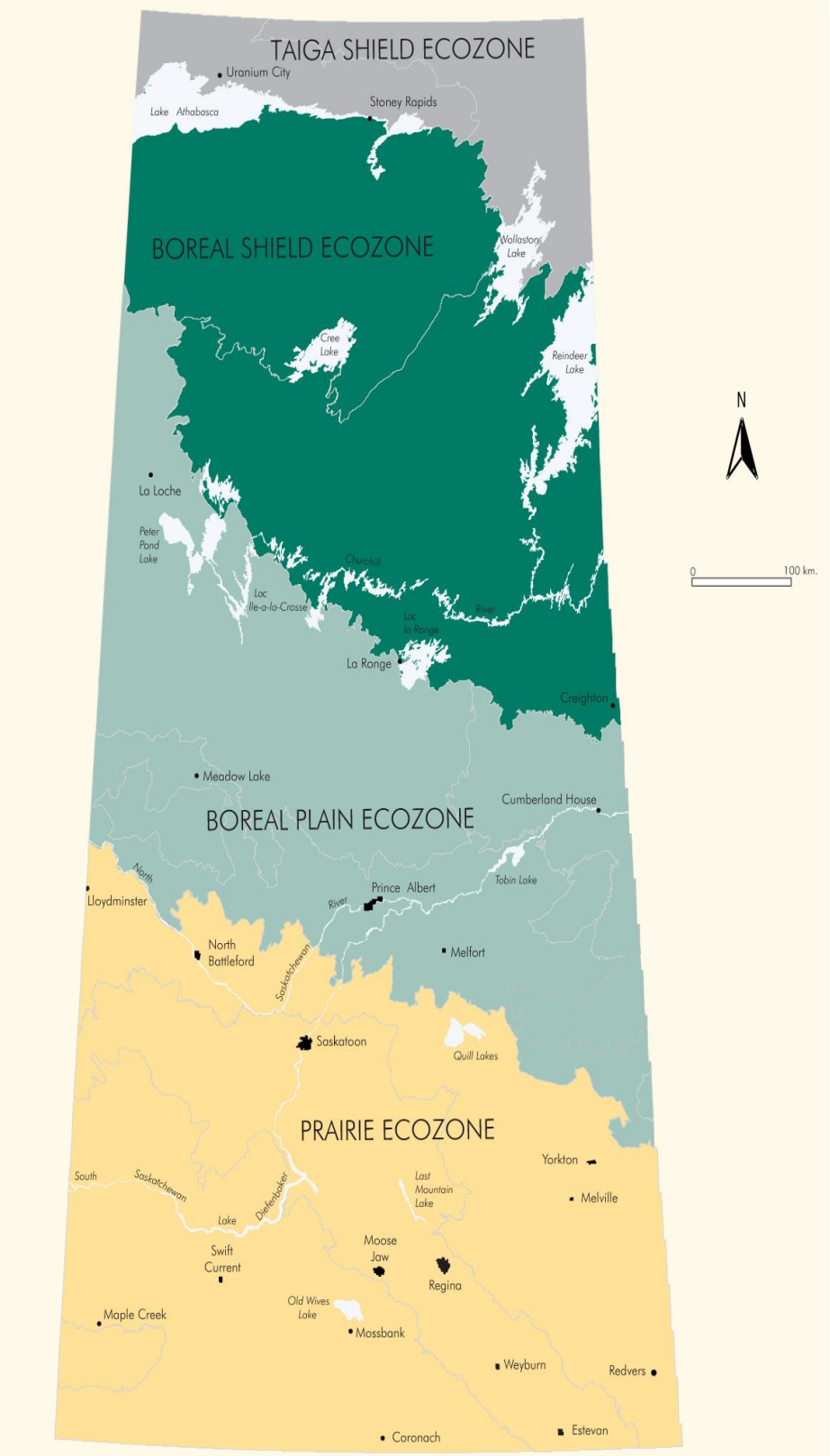
Lessons by Ecozones

Taiga Shield Ecozone
Dilemma Derby
Grade 7-8

Boreal Shield Ecozone
The Western Red Lily
Grade 7

Boreal Plain Ecozone
Where Are the Frogs?
Grade 8

Prairie Ecozone
To Dam or Not to Dam
Grade 7-8



Recommended Materials for Lessons

Dilemma Derby

- *Dilemma Cards*

The Western Red Lily

- Reading resources
- Internet sites
- *Western Red Lily* Worksheet
- *Western Red Lily Resource Sheet*
- *Fire and Feast* article

Where Are the Frogs?

- Paper to make pH labels
- 3 jars with lids
- Lemon juice
- Graduated cylinder
- pH paper
- 3 milk cartons
- Potting soil
- 1 type of seed
- Water
- *pH and Plants Activity Sheet*
- *pH and Plants Observation Sheet*

To Dam or Not to Dam

- Roll playing cards

Dilemma Derby

Grade: 7-8

Subject: Science

Outcome: IE7.4, WS8.1
Analyze how ecosystems change in response to natural and human influences, and propose actions to reduce the impact of human behaviour on a specific ecosystem.

Analyze the impact of natural and human-induced changes to the characteristics and distribution of water in local, regional, and national ecosystems.

Duration:
Preparation:
30 minutes

Activity time:
50 minutes

Setting: Classroom

Skills:
Analyzing; Interpreting (translating, relating)

Vocabulary:
dilemma

It's a hot August afternoon and your city is rationing water. You're on your way to an appointment, and running late. Suddenly, you see a fire hydrant gushing water onto a street corner. Should you 1) take the time to report it and possibly miss your appointment; 2) proceed to your appointment and assume someone else will report the situation; 3) forget the appointment and play in the water? Or 4) …?

Summary

Students debate the pros and cons of different solutions to water management issues.

Objectives

Students will:

- Outline reasons why managing water resources can create dilemmas.
- Identify, analyze, and select actions related to a water resource dilemma.

Materials

- *Dilemma Cards* (These can be glued on index cards and laminated for extra durability.)

Making Connections

People confront dilemmas daily. Students may have weighed the pros and cons of completing a homework assignment versus taking the time to visit with friends. Students may also be familiar with water resource issues such as nonpoint source pollution, water shortages, and wetland restoration. As students investigate problems involving people and water, they will recognize the complexity of managing and protecting water resources.

Background

A dilemma is a problematic situation that requires a person to choose from two or more alternatives, each of which can produce desirable or undesirable effects. Managing water resources often creates dilemmas. As with most dilemmas, water resource management can involve conflicts between what one wants to do versus what one believes should be done. For example, disposing of motor oil by dumping it on the ground is easier than the environmentally sound, but more time consuming, alternative of recycling it. Taking a long, hot shower is relaxing, but a short, warm shower—though less comforting—conserves resources. Not taking the opportunity to make a presentation to municipal council on an issue that would allocate tax money for water supply projects requires less effort than researching the potential impact of the projects.

People use various approaches to determine a course of action when confronted with a dilemma. These range from flipping a coin to conducting extensive research and attending high powered meetings. However, a prudent method consists of listing the alternatives, identifying the pros and cons for each, and projecting possible outcomes. Factors to consider include cost (monetary and environmental), time, energy, persons likely affected, personal values, etc. Emotions and instincts also influence which alternative is chosen. Friends and family can help with the decision making process as well.

Decision making and problem solving are critical thinking skills, necessary for productive and responsible citizenship. Although confronting dilemmas may not be easy, the experience (whether the outcome is positive or negative) helps people deal with similar conflicts in the future.

Procedure

Warm Up

Provide students with the following scenario: Your friends have invited you to go out in their boat for an afternoon of

Dilemma Derby

Water-skiing, swimming, and fishing. You're really happy to be included. However, when you get to the dock and ask for your lifejacket, your friends tell you that they forgot to pack the lifejackets when they loaded the equipment early that morning. You are not a very good swimmer and you know it is illegal to go out in a boat without a lifejacket. Still, you don't want to miss out on the fun. What are you going to do?

Tell students that this is a dilemma. Ask them to list reasons why it is a dilemma. Have students describe approaches they have used to resolve similar situations. Inform them that managing water resources can also be a dilemma. What situations related to water can students recall that could be classified as dilemmas? Tell them they are going to do an exercise that introduces them to a few water-related dilemmas and test their skills at addressing them.

The Activity

Divide students into small groups and give each group one or more Dilemma Cards. Provide the groups with the following instructions:

- One member of the group (the reader) selects a card and reads the situation aloud. Group members identify reasons why this situation is a dilemma.
- The reader presents the list of options to the group. Group members discuss the situation and decide what to do and why. They must select one of the available options or identify an alternative course of action. One approach to making a decision is to rate each option. Rank them on a scale of 0-10, with 0 being total disagreement and 10 being total agreement. A rating of 5 indicates "no opinion" or "needs more information."

Wrap Up

Instruct one member of each group to report their dilemma(s) to the class. He or she should identify why it is a dilemma and identify the course of action favored by the group. Students should describe the considerations involved in making their decision. Ask the class to evaluate the option that was selected, and, if applicable, provide alternatives that might be better. Do students think they will change the way they will react to real-life water dilemmas? If so, how?

Assessment

Have students:

- Use a ranking system to select a course of action to solve a water-related dilemma (*The Activity*).
- Decide upon a course of action to resolve a water-related dilemma and present reasons for their choice (*Wrap Up*).
- Explain why the management of water resources can create dilemmas (*Wrap Up*).

Upon completing the activity, for further assessment have students:

- Identify water-related dilemmas in their community and present alternative courses of action, citing pros and cons of each.

Extensions

Have students research the dilemmas presented in the activity and determine if this additional information causes them to change their course of action.

Invite a community planner or water resource manager to speak to the class about a local water-related dilemma and to discuss the processes involved in addressing the dilemma.

Resources

Miller, G. Tyler, Jr. 1991. *Environmental Science. Sustaining the Earth*, 3rd ed. Belmont, Calif.: Wadsworth Publishing Company.

Polesetsky, Matthew, ed. 1991. *Global Resources: Opposing Viewpoints*. San Diego, Calif.: Greenhaven Press, Inc.

Project WET. 2002. Montana State University. Bozeman, Montana .

Images

Retrieved from http://www.npwd.org/images/Misc/large%20water%20drop%20clipart.jpg on (12/09)

Retrieved from http://mozy.com/blog/wp-content/uploads/2009/04/question-mark.jpg on (12/09)

Dilemma Cards

DILEMMA 1: You've changed the oil in your car. You know the hazards of oil seeping into ground water, yet you are in a hurry to attend a meeting. How will you discard the used oil?

1. Put it in the back of the garage.
2. Place it in a garbage can for disposal in the city/country landfill.
3. Pour it on the ground somewhere out of sight while no one is looking.
4. Burn it.
5. Take it to an approved oil-disposal facility in your area.
6. Other?

DILEMMA 2: You are the mayor of a city which has an area known to flood. A developer wants to build houses on the floodplain. These houses will have a great view of the river, will be conveniently located near the business district, and will entice prosperous people to move to your struggling community. You must make the final decision on the developer's request. Which option will you choose?

1. Inform the developer no building will be allowed.
2. Let the developer build in the flood area.
3. Insist the developer elevate the houses on piles of gravel in hopes of avoiding flood damage.
4. Instruct the developer to find an alternative building location out of the floodplain.
5. Other?

DILEMMA 3: You own a cabin on a lakeshore and there are 400 other cabins facing the lake. Several residents around the lake have been complaining because they think the lake's water quality is poor. (There has been an increase in algae growth and unpleasant odors.) A public service announcement informed the community that these problems likely are caused by septic tanks leaking sewage into the ground water that feeds into the lake. The announcement advised that septic systems should be checked every three years. It has been almost ten years since yours has been checked, and you know other cabin owners have not checked theirs recently either. Checking your septic tank and fixing the problem could be costly. A fine could be imposed if your septic tank is found to be defective, although it is not likely the tank will be checked. What are you going to do?

1. Sell the cabin.
2. Do nothing, your tank probably isn't leaking—and if it is, the fine can't be that bad, and you can appeal it.
3. Have your septic tank checked, and if it's leaking, pay to have the sewage pumped and hauled to a safe place.
4. Have your septic tank checked, and if it's leaking, sell the cabin.
5. Have your septic tank checked; fix it if it's leaking, and form a homeowner's association to encourage everyone else to check their tanks, too.
6. Rally the public works system to develop a community water and sewage system and pay to have your cabin hooked up.
7. Other?

DILEMMA 4: You and a friend are hiking, and you see someone dumping a 55-gallon (209-l) drum of a dark liquid into a shallow stream. What should you do?

1. Go over and ask what is going on.
2. Run home and call the police.
3. Wait until the person leaves, then investigate by smelling and feeling the liquid.
4. Take down the license plate number of the nearby truck and report the situation to the fire department.
5. Other?

DILEMMA 5: You are the premier of your province. Many streams are drying up because of drought conditions and water is being fully utilized by licensed municipal, industrial and irrigation users. This has resulted in fish kills. Furthermore, people who like to canoe, raft and kayak have sent letters of complaint. Industry and agriculture are major sources of income in your province, but you also like its reputation of being a 'quiet place' where people can explore scenic rivers. What action will you take?

1. Ask water users to stop using water.
2. Locate and publicize other rivers around the province where people can fish and canoe.
3. Establish a committee to study the problem.
4. Propose constructing a dam and reservoir to store water for release when needed.
5. Buy out the water users so they will have to move to a new location.
6. Ask Sask. Water to establish a water conservation program with incentives.
7. Other?

DILEMMA 6: Your friends have spread a plastic tarp on a hill and are spraying it with a hose. This creates a great water slide. However, sliding repeatedly kills the vegetation on the hillside and large amounts of water are consumed during the game. Your community has experienced water shortages but there have been no notices about conserving water for almost a year. You have been invited to take a dive down the hill. What should you do?

1. Report the game to the local authorities and have them cut off the water supply.
2. Change into your bathing suit and join the fun.
3. Try to encourage your friends to do something else, like play basketball or go skateboarding.
4. Join the activity but only for a short while, encouraging your friends to stop with you.
5. Refuse to join in and go home to watch television.
6. Lecture your friends on the reasons not to waste water.
7. Other?

DILEMMA 7: You are the head of a household. You are trying to save money; because your water bills have been large, you have decided to practice water conservation methods to reduce water consumption by family members. Although you have installed low-flow faucets on your showerheads and sinks, your family still insists on taking long, hot showers (sometimes over 20 minutes). What are you going to do?

1. Hold a family meeting to discuss why conservation is important and ask that shower times be reduced?
2. Order family members to cut down their shower times to five minutes or else you will turn the hot water heater down or off.
3. Figure the cost of water per litre and how many litres flow out of the showerhead each minute. Tell the family you will time their showers and they will be charged (or their allowances reduced) for each minute over five minutes they shower.
4. Tell family members that you will compare monthly water bills and if a bill is lower than the previous one, the money saved will go toward a family trip or entertainment event.
5. Nothing. Your family has a right to bathe for as long as they want.
6. Other?

DILEMMA 8: You are a city council member for a community located adjacent to a large, privately owned wetland. The wetland is home to rare wildlife and migratory birds; some wetland managers indicate the wetland helps control surface run-off. The owner has decided to sell her land and move to a new location. The land is in an area surrounded by lucrative business, where land prices are high and parking is an issue. What should you encourage the council to do?

1. Provide tax incentives to a local development consortium to help them purchase the land around the wetland and seek permits to develop it for business.
2. Launch an initiative to have the city purchase the land. This will require new taxes and protect the wetland forever.
3. Apply for a permit to fill the wetland with soil from a local hill, developing the wetland into a parking garage and community park.
4. Leave the fate of the wetland to the desires of the community's special interest groups.
5. Wait and see who buys the wetland and then decide what to do.
6. Other?

DILEMMA 9: You have moved across country. You love to fish and you are known for your sill at catching a particular species. This species is not found in lakes and streams around your new home. A friend from your old neighborhood has offered to bring a tank of these fish to introduce into one of your local streams. You have heard that introduced organisms (such as starlings, zebra mussels and purple loosestrife) are competing with native species for resources. However, you have not found the local fishing practices appealing. How should you respond to your friend's offer?

1. Tell your friend to bring the fish, you can't wait to get a population growing.
2. Tell your friend you are already learning how to catch a new species of fish so not to bother.
3. Check with a local fish and wildlife agent to learn if the introduced fish will compete with native fish.
4. Tell your friend to bring the fish, fry up a few and release the rest- they'll probably die anyways.
5. Other?

DILEMMA 10: You are a taxpayer in a province that has supported drainage of land which was historically wetlands. Through engineering works, the land has been drained for agricultural crop production. These land improvements have resulted in increased agricultural production which in turn resulted in increased crop export revenues for farmers, increased community development and increased tax base for government revenues. However, waterfowl and shorebird population have been greatly reduced. There is a proposal to restore the wetlands in some of these areas. This action will increase your taxes to compensate farmers for the reduced land in crop production. What should you do?

1. Support the proposal; a restored, healthy ecosystem is good for everyone.
2. Oppose the proposal; you pay enough taxes already.
3. Oppose the proposal because farm communities will be negatively affected.
4. Support the proposal because your best friend says you should.
5. Other?

The Western Red Lily

Grade: 7

Subject: Science, ELA

Outcome: IE7.2
Observe, illustrate, and analyze living organisms within local ecosystems as part of interconnected food webs, populations, and communities.

Duration:
Preparation:
No preparation

Activity time:
60 minutes

Setting:
Classroom/Outdoors

Skills:
Gathering information (measuring, collecting, observing); Organizing; Analyzing (comparing and contrasting); Applying (predicting, experimenting); Presenting (communicating); Cooperative learning; Technological literacy

Vocabulary:
Lilium philadelphicum, propagation

The Western Red Lily is Saskatchewan's provincial floral emblem. It grows in wet places all over Saskatchewan and has been used in a variety of ways by Aboriginal people. The Western Red Lily is a beautiful reddish-orange color and blooms from late June to mid July.

Summary

The Western Red Lily has been used for medicinal purposes, it has been eaten, and it has also been used for aesthetic purposes. It is now protected by law in Saskatchewan and is illegal to pick. Students will explore the history, culture, and ecology of the Western Red Lily through this lesson.

Objectives

Students will:

- Identify historical, ecological and cultural aspects of the Western Red Lily
- Gain an understanding of the present and past role of the Western Red Lily on the Boreal Shield Ecozone

Materials

- Reading resources
- Internet sites
- *Western Red Lily* Worksheet
- *Western Red Lily Resource Sheet*
- *Fire and Feast* article

Making Connections

The Western Red Lily can be found all over Saskatchewan as it lights up fields, ditches, and wooded areas with its bright reddish-orange colors. It has been used by Aboriginal people for food, medicinal purposes and aesthetic purposes.

Background

The Western Red Lily was chosen to be Saskatchewan's provincial floral emblem in 1941 and is represented on the Saskatchewan flag. "The Western Red Lily copes with unsuitable growing conditions like drought by delaying flowering, sometimes for up to 6 or 7 years, surviving off the food stored in its roots and bulbs."

Procedure

Warm Up

- Display an overhead of the Western Red Lily plant or show the class an actual lily plant outdoors
- Ask prompting questions: Has anyone ever seen this plant before? What is the name of this plant? What could this plant potentially be used for? (medicinal purposes, edible, esthetic)

The Activity

Part I

1. Brainstorm with students about prompting questions.

2. Explain to students that they will be finding information on the Western Red Lily. They will be focusing on the provincial history, native cultural history and ecological relationships of the Western Red Lily.

3. Divide the class into groups of 2 to 3 students.

4. Handout *Western Red Lily* worksheets to each student.

   Give group one the *Western Red Lily Resource Sheet*. Ask this group to find the native uses and ecological aspect of the lily.

   Give group two readings from *Fire and Feast: The Western Red Lily.* Ask this group to find the ecological and native uses of the lily.

   Give group three internet sites on the history of the provincial emblem. Ask this group to find the provincial history of the lily.

The Western Red Lily

5. Remind groups that near the end of the class all groups will share their information.

6. Give adequate time for reading and internet searching.

Wrap Up

Re-group and fill in the common worksheet using the overhead. Supplement discussion with overhead pictures.

Assessment

Have students:

- Present on the information they have gathered to other groups or the rest of the class.
- Write a one page summary of the Western Red Lily.

Extensions

Have students extend their learning by switching groups and allowing each group to complete all three sections of this lesson. Take the class outdoors to view the Western Red Lily in their natural environment. Use digital cameras to take pictures of the different parts of the flower and keep an observation sheet of the information you gather.

Resources

Royal Saskatchewan Museum retrieved from http://www.royalsaskmuseum.ca/about/community/prairie_garden/western_red_lily.shtml on (12/09)

The Western Red Lily retrieved from http://www.usask.ca/education/coursework/mcvittiej/resources/redlily/middleyears/lesson1.html on (12/09)

Images

Retrieved from www.ops.gov.sk.ca/adx/aspx/adxGetMedia.aspx on (12/09)

Retrieved from http://static.howstuffworks.com/gif/willow/geography-of-saskatchewan3.gif on (12/09)

Retrieved from http://www.slopcshop.com/images/computer.jpg on (12/09)

The Western Red Lily Internet Sites

Hand out this sheet to group three and ask this group to find the provincial history of the lily.

http://www.saskschools.ca/~gregory/canada/emblems/sk.html

http://www.interactive.usask.ca/ski/factfig/emblems.html

http://www.insask.com/pops/lily.shtml

http://sd71.bc.ca/sd71/Edulinks/Canada/saskindex.htm

http://www.parl.gc.ca/information/about/education/CanSymbols/galleries/flowers/flowers-e.asp

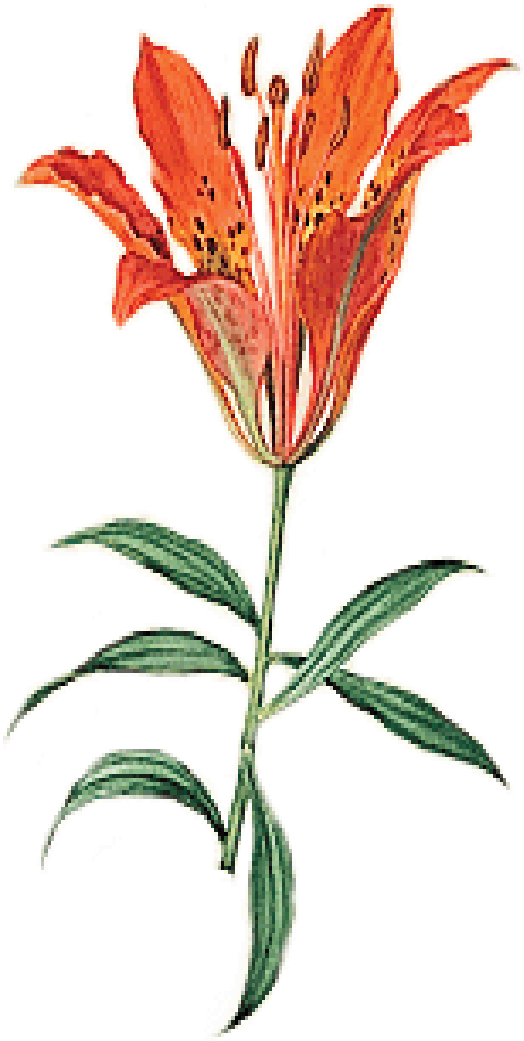
http://www.naturesask.com/acronyms.html

http://www.geocities.com/girlfromals/skemblems.html

http://www.geocities.com/mycanada_1/Sask.html

http://www.mts.net/~mxdgrass/wtp/lily.htm

http://eureka4you.com/sk/skindex.htm



Western Red Lily Work Sheet

Provincial History:
provincial emblems and year of recognition:

the society that recommended the lily:
appears where in Ottawa:

Ecological status:

Native Uses: food preparation and medicine
bulb:

root:

flowers:

Cree named the plant:

Ecology : Scientific Name: Common names:

Plant description:

color:

height:

seeds:

bulb:

What areas does it grow? What type of habitat does is prefer?

Relationships with butterflies, bees, vole, gophers, and deer:

Relationship with prairie fires: (why fire is important)

Factors influencing the future of the western red lily:

Western Red Lily – Lilium philadelphicum

Cree Name – **wakican**

Saskatchewan's floral emblem! The most dramatic and exciting lily of all with the orange-scarlet blooms contrasting with its purple-brown spots.

Description

The native lily is a protected wildflower and is therefore protected from picking in the wild. The flowers bloom from mid June through July displaying vivid reddish-orange blooms with dark purple spots. The plant stem grows 1 – 2' tall. Linear leaves alternate along the bottom of the stem with the upper leaves forming a whorl below the flower. Lilies prefer moist areas in sun or partial shade with slightly acidic soil.

Native uses

The bulbs were dug when the flowers opened. They were roasted in the hot ashes, steamed or boiled. When boiled, this bulbous, walnut-sized root tastes rather like a potato. With its high nutrition and sweetness it was well worth the effort of grinding into meal for bread. The root was made into a tea for stomach disorders, consumption, coughs, and fevers. The crushed or chewed flowers were applied directly to the bite of a small brown, poisonous spider.

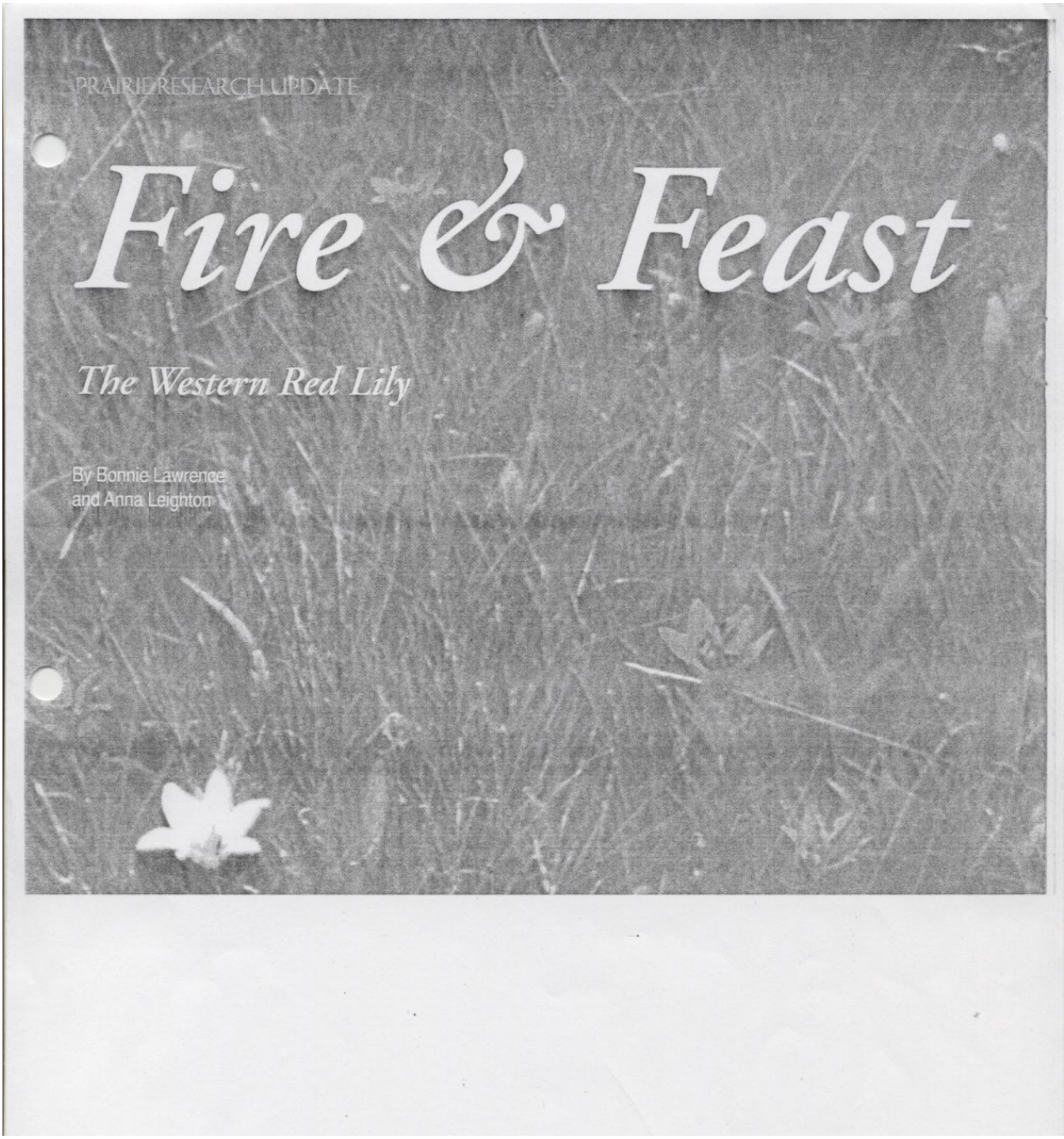
Propagation

When grown from seed, lily plants germinate the second year after sowing. Flowers do not appear until the 3rd or 4th year. Bees and butterflies transport the pollen from one flower to another, pollinating the plant so that it will form new seeds, eventually growing into new plants.

The lily plant is also propagated from scales taken from the base of the bulb. Prairie voles and gophers often act as prairie gardeners. They like to harvest the bulbs and store them in a winter cache. But they are messy little animals and tend to drop scales from the bulbs on their way to their hiding places. These dropped scales often grow into new lily plants.

Lily bulb

Lily scales removed from the bulb



Lawrence, Bonnie and Anna Leighton (1999). Fire and Feast: The western red lily. *The Gardener for the Prairies*, Winter 1999, 34-36.

What is the relationship between a vole preparing for winter, a grass fire, and the number of wild lilies you're likely to see one or four years hence?

The Western Red Lily Project is seeking answers to these questions. It began with the simple procedure of tagging flowering plants in wild populations and noting whether they set seed or not and whether they reappeared year after year.

It quickly became obvious that in order to understand this native plant we would have to observe the various vegetative forms over time, examine the growth of the plants through the growing season, and try to understand the structure and function of the underground bulb as well as that of plants started from seed and bulb scales.

We set up field plots to examine the impact of "disturbance events" such as fire and grazing, took note of other biological factors such as animals that ate the plants (and at what stage), competition from other plants, reliance on pollinators, and the importance of environmental conditions such as moisture and soil characteristics.

A Basic Biology

The western red lily *(Lilium philadelphicum)* has upright red flowers and is widely distributed in North America. Both the eastern *(philadelphicum)* and western *(andinum)* varieties of *Lilium philadelphicum*, as well as hybrids of the two, occur in Saskatchewan. Alberta has only the western variety. Manitoba has a mixture of varieties that are probably hybrids.

The two varieties can be distinguished by the arrangement of leaves on the flowering stalk. In the eastern variety, most leaves occur in whorls on the stem. In the western variety, most leaves are scattered singly along the stem, with one to three whorls at the top. The eastern variety has wider leaves, flowers that tend toward orange rather than red, and prefers woods and clearings within woods, earning it the common names wood lily and red-orange lily.

The western variety has even more common names: western red lily, prairie lily, wood lily, and tiger lily. It also occurs in woods but is more abundant on open prairie habitat, in moist, well-drained sites such as meadows, wetland margins, and ditches. The extensive North American distribution of *Lilium philadelphicum* is largely due to the western variety's tolerance of different habitats, including Canada's boreal forest, the western plains, the Rocky Mountains, along the railway to Churchill, Manitoba, and even coulees in Texas's Guadeloupe Mountains.

This lily is a delight to find in the woods, but masses of this species in bloom on the prairie are truly impressive. Nineteenth century botanist John Macoun described lilies at the north end of Last Mountain Lake as "so abundant that they cover an acre of ground bright red." In 1859, the Earl of Southesk, an Englishman who spent that year in western Canada for "travel, sport, and adventure," compared the Saskatchewan prairie covered with blooming *Campanula rotundifolia* and *Lilium philadelphicum* to a "vast oriental carpet thrown upon the plain."

About the turn of the last century, masses of these lilies flowering in Massachusetts caught the eye of Mrs. Norman Henry, a Philadelphia lily grower, who subsequently collected and named over 20 colour varieties.

Pollination and Proliferation

The western red lily forms a walnut–sized bulb, 8 to 10 cm (several inches) beneath the soil surface. In addition to the current year's flower stalk, these bulbs consist of a resting shoot and several dozen bulb scales, many of them jointed. This species is not truly stoloniferous—the new shoot arises along side of the old one.

Lilium philadelphicum is a prolific seed producer. Six of ten pods examined in 1996 contained over 300 viable seeds each, and two had just over 280. The remaining two contained mostly chaff, with fewer than 50 viable seeds. Plants with multiple heads have tremendous potential as seed producers. However, a plump pod from a lily with five such pods had only 144 filled seeds and 280 chaffy ones. Multiple-headed plants may not reach their full potential as seed producers because of insufficient pollination.

Pollination remains a puzzle. The western red lily is reported to be an "obligate outcrosser": each flower must receive pollen from a different flower for it to produce viable seed. Large butterflies—both swallowtails and monarchs—as well as sweat bees have been observed to carry out pollination in Michigan. In Saskatchewan, we have seen very few pollinators visiting lily flowers and wonder if this species might self–pollinate here or be apomictic (able to produce seed without pollination). Only on two occasions have we observed pollinators: both were swallowtail butterflies, which are quite common when lilies are flowering. The swallowtails knock the tips of their wings against the anthers while walking around the inside of the flower to feed at each of the three nectaries; at the next flower they visit, they knock their wings against the stigma, transferring pollen.

Seed germination, mimicking nature, requires a cold period. Placing the seeds in a freezer for six to eight weeks before sowing them in a greenhouse in December resulted in about 75 percent germination in the first several weeks after sowing. Generally, germination is spread out over many months, and some seeds seem to require complete darkness before they germinate.

It usually takes at least four years for the western red lily to flower when started from seed or bulb scales in a greenhouse and subsequently planted back into the wild. In the first year, they produce small, oval leaves less than 2.5 cm (1 in.) long; in the second, the leaves

are 5 cm (2 in.) long and strap–shaped; in the third, the plants produce an upright stem about 10 cm (4 in.) long; they may flower in the fourth year. Depending on growing conditions, each of the vegetative stages may last more than one year.

Flowers bloom at the earliest sites in mid June and at the later ones by mid July. Mature plants do not necessarily flower every year; they may revert to a vegetative form or show no growth above ground at all for a year or two. Flower production of a particular plant can increase or decrease from one year to the next, and it seems that any sequence is possible: a three-headed lily may become a single flower, a two-headed lily producing five. Or the stalk may bear a tiny, underdeveloped or aborted flower bud. These are common in some years, such as 1998, which had unusually hot, dry spring weather.

Fire

The prairie landscape was a fire-adapted environment before an extensive road system and settlement precluded natural fires. Fires probably occurred every three to five years in many grassland habitats, started by lightning or Native peoples as a means of managing herds of bison.

To study the effect of fire on wild lily populations, we established a number of research plots at the north end of Last Mountain Lake National Wildlife Area, where the Canadian Wildlife Service has been using prescribed burning since 1982. We have observed several general trends of the effect of fire on lily populations. A spring fire that removes thatch facilitates lily growth as measured by the total number of plants in the plots. There is a significant increase in the number of plants that produce a flowering bud after a spring burn. The number is also high, if not higher, the year following the burn. Seed set may be significantly higher following a burn.

One of the obvious effects of fire is a subsequent decrease in the eating of lilies by small mammals, who have lost their protective plant litter. Vegetative regrowth is influenced by the intensity of the fire, moisture availability, and competition among plants.

Feast

The western red lily is completely edible at all stages of its growth. As the young shoots emerge in spring, they are chewed by small mammals. This phenomenon was particularly noted in 1997 when meadow vole populations peaked dramatically.

Deer target plants when the mature, coloured buds are about to or have just burst open. Other small mammals such as pocket gophers and voles may begin gathering at this time but seem to show a greater appetite for the mature, plump, but still green pods. Typically, we have found a 5 to 10 cm (2–4 in.) stalk base and a number of stalk pieces chewed to about matchstick lengths left at the base of the plant. The bulbs are harvested in the fall by the subterranean activities of pocket gophers and voles. The fragile jointed scales are often broken off and dispersed along the foraging route.

Herbivore browsing can significantly decrease seed production, but do lilies that were chewed off after they flowered reflower the following year? Our study showed that approximately 30 percent of chewed plants reappeared as flowering or aborted plants, 25 percent as clusters of plants, and 21 percent as vegetative plants. In contrast, 65 percent of flowering plants that were not chewed reappeared as flowering or aborted plants, 3 percent as clusters and 9 percent as vegetative plants.

In the fall of 1993, at one of our study sites east of Saskatoon, a pocket gopher tunnelled extensively throughout a plot of tagged lilies. In 1994, none of the tagged lilies flowered again, although other flowering lilies did appear in the plot. By 1995, there was an explosion of vegetative and small flowering lilies, with density per square meter increasing from 1 in 1994 to 7.3 in 1995. Four years later we are still tagging new plants in this plot. The effect of the disturbance by tunnelling thus appears to be a tremendous production of young plants. We speculate that the pocket gopher, in the process of eating and transporting the bulbs underground, managed to detach and disperse bulb scales that, once separated from the main bulb, grew into new plants. These same small mammals that dine on lily buds and pods also have a role as gardeners.

What can be concluded about the effects of fire and small mammals on reproduction within wild lily populations? Fire is important for maintaining genetic diversity through release of dormant bulbs and enhancing seed set by lowering competition with other plants and removing cover for small mammals. Sexual reproduction by cross-pollination is very critical to maintaining species diversity within a population. Small mammal activity is important in dispersing vegetative propagules and stimulating production of clusters of young plants by chewing. Conversely, eating flowering stalks also decreases the number of potential seeds available for future population regeneration and therefore acts against genetic diversity.

The Western Red Lily Project has received funding from Nature Saskatchewan, Friends of the Environment, and the Saskatchewan Heritage Foundation. The University of Saskatchewan and the Canadian Wildlife Service (Last Mountain Lake National Wildlife Area) provide logistical support.

Bonnie Lawrence is a biologist who lives and gardens east of Saskatoon. Curiosity about the abundance and distribution of the wild lilies that grow on the family homestead initiated this study.

Anna Leighton is a plant taxonomist with an interest in wildflower ecology.

Where Are the Frogs?

Grade: 8

Subject: Science

Outcome: WS8.3
Analyze natural factors and human practices that affect productivity and species distribution in marine and fresh water environments.

Duration:
Preparation:
Part I: no preparation
Part II: 50 minutes
Part III: 15 minutes

Activity time:
Part I: 15 minutes
Part II: up to 1 month
Part III: 30 minutes

Setting: Classroom

Skills:
Gathering information (measuring, collecting, observing); Organizing (matching); Analyzing (comparing and contrasting); Applying (predicting, experimenting); Presenting

Vocabulary:
Acid precipitation, acid, base

Every spring you look forward to hearing the frogs at dusk. One year you notice the evenings are silent. What happened to the frogs?

Summary

Through experimentation and a simulation, students learn how acidic water has endangered the quality of aquatic life in some parts of the country.

Objectives

Students will:

- Illustrate the meaning of pH.
- Analyze the effects of acidic water on plant and animal life.
- Describe how acid rain can affect ecosystems.

Materials

- Paper to make pH labels

To monitor pH and plant growth, each group will need the following:

- 3 jars with lids
- Lemon juice
- Graduated cylinder
- pH paper
- 3 milk cartons (Remove tops and punch drain holes in bottom of cartons.)
- Potting soil
- 1 type of seed (e.g. marigold, tomato, bean)
- Water
- Copies of *pH and Plants Activity Sheet*
- Copies of *pH and Plants Observation Sheet*

Making Connections

The topic of acid rain frequently appears in the news, especially in eastern Canada. Students may have seen pictures of statues, forests and lakes damaged by acid precipitation. Learning about acid precipitation helps students appreciate the connections between air and water quality.

Background

Water molecules are composed of two hydrogen atoms and one oxygen atom (H_2O). Sometimes the water molecules separate or dissociate. This is called ionization. Ions have unequal numbers of protons and electrons. If an ion has more protons than electrons, it will have a positive charge; if it has more electrons, its charge will be negative. The hydrogen ion has lost its electron to the hydroxide ion; therefore, the hydrogen ion has a positive charge, while hydroxide has a negative charge. Very few water molecules ionize, but life processes depend on the small number that do.

When water dissociates, it produces an equal number of hydrogen ions and hydroxide ions. When another compound that ionizes is introduced, the ions of water and of the compound will react or combine with each other. Sometimes, hydrogen ions react more, other times hydroxide ions do.

If a solution (of water and another compound) has more unattached hydrogen ions than hydroxide ions, it is acidic. If more hydroxide ions remain, the solution is basic or alkaline. The level or amount of hydrogen ions in solution is measured by a pH (potency of hydrogen) scale. The scale ranges from 0 to 14. A solution with a pH of 7 is said to be neutral, because it has equal amounts of hydrogen and hydroxide ions. Bases have pH levels ranging from 8 to 14. A pH of 12 indicates a very strong base. Acids have a pH ranging from 1 to 6; a 2 is very strong acid.

The relative levels of hydrogen and hydroxide ions are critical to organisms because of their effects on chemical reactions. Systems within the human body function to maintain pH balance. The pH of blood is about 7.4, gastric juices are about 2, and saliva is about 6.5.

Where Are the Frogs?

Rainwater is slightly acidic, with a pH of approximately 5.6-5.0. This modest amount of acidity comes from the absorption of carbon dioxide and other material of natural origin. In some areas, the pH value of precipitation may exceed 5.6, as in the prairie provinces, where wind-blown alkaline soil materials actually reduce the natural acidity levels.

However, precipitation over eastern North America, and much of Europe as well, has been found to be 10 times more acidic than normal, largely because of the incorporation of airborne sulphur dioxide and nitrogen oxides. These human-caused gases react in complex ways to form sulphuric and nitric acids in the atmosphere- in rain, snow, and cloud droplets. Oxides of sulphur and nitrogen may reach the earth directly as gases or dry particulates and react to create acidic conditions. Thus both pollutants add acidity to the clouds and precipitation; cloud drop-lets have had pH levels as low as 2.6 when measured at Whiteface Mountain in New York state (Castillo 1979).

Procedure

Warm Up

Show students a glass of water and ask them to imagine what the water molecules look like. Have them create a quick sketch. Confirm that students ' molecules have two hydrogen and one oxygen atom each. Do they believe that water molecules always remain intact? What would happen if the water molecule was split?

Inform students this happens all the time. However, when the balance of the parts in the molecules becomes uneven, the quality of water changes. In some situations this imbalance is necessary for life (e.g. gastric juices for digestion). In other cases, it can produce detrimental effects, like acid rain.

Tell students that they will be acting out the splitting of a water molecule.

The Activity

Part I

1. Tell students they are going to demonstrate a special characteristic of water.

2. Divide the class into thirds. Indicate that students in one group are oxygen atoms, and those in the second and third groups are hydrogen atoms. Have the hydrogens write the letter "e" on pieces of paper and pin them to their shirts (or place them in their pockets). The "e" represents the hydrogen's electron.

3. Tell students to form groups of three to represent water molecules (two hydrogens and one oxygen). Ask the "hydrogens" to stand on either side of the "oxygen" to illustrate a water molecule. The class now represents water that has all molecules intact.

4. Explain that water molecules do not always stay complete; sometimes molecules will break apart or dissociate. Have two or three of the groups break up into hydroxide and hydrogen ions. One student will be a lone hydrogen ion, and the other two students will be joined as oxygen and hydrogen in a hydroxide ion.

5. Instruct each lone hydrogen ion to give his or her "e" to the hydroxide ion. This represents an electron that has been lost by the hydrogen ion and gained by the hydroxide. Explain that hydrogen is a positive ion (possessing one proton and no electrons) and hydroxide is a negative ion (possessing an extra electron).

6. Inform students that this represents a neutral water sample, because there are equal numbers of hydroxide and hydrogen ions. Tell students who split apart to recombine (back to water) and have another two or three groups dissociate; the solution still remains neutral.

7. Tell students that a compound that attracts the hydroxide ion has been added to the solution. Remove three or four hydroxides from the mix. Tell students that now there are more hydrogen ions than hydroxide ions. Explain that this makes the solution acidic. Have the hydroxides go back in solution, this time removing the hydrogen ions to make a basic solution.

8. Describe the pH scale to students, and explain which levels are neutral, acidic, and basic. Show students pH test paper and explain how to use it.

Where Are the Frogs?

Part II

1. Read students the following paragraphs: Although Jane now lives in another part of the country, she grew up in southern Ontario. She remembers enjoying beautiful fall seasons and playing in the snow. But her favorite time of the year was spring.

   In spring, snows melted, green buds erupted from trees, and plants blossomed. With warm feelings, she remembers sitting on the screened porch at dusk with her parents, listening to the sound of frogs.

   Now, after many years, Jane is returning home. It is spring. Although the town has grown, the flowers and budding trees still make her smile. Everything smells new and fresh. In the early evening, she sits with friends on the front porch and shares memories. But as the night grows darker, Jane feels that something is not quite right, something is missing… then she remembers. Where are the songs of the frogs?

2. Ask students what they think happened to the frogs. Tell them that in some parts of the country, especially in southern Ontario and southwest Quebec, populations of frogs and other aquatic species are declining. Explain that portions of southern Ontario as well as other sections of Canada are affected by acid rain.

3. Ask students to share what they know about acid precipitation. Supplement student responses with background about acid precipitation. Explain that acid rain harms trees and other sensitive organisms, such as frogs. Students may want to collect samples of rain and snow from their area and measure the pH. Do they think their area has a problem with acid precipitation? Could their area be a source of the pollutants that cause acid precipitation?

4. Hand out *pH and Plants Activity Sheets* to groups of students and have them conduct a simple experiment to investigate the effects of acidic water on the germination and growth in plants. Have students make weekly or biweekly observations and record them on the *pH and Plants Observation Sheet*.

5. After students have conducted the plant/pH experiment, have them discuss the following questions:
   - How did the plants react to the different types of water?
   - How do the results compare with your predictions?
   - How did the control plant help you determine if and how acid water affected the other plants?
   - Why was it important to make sure each plant was treated the same in every way except the type of water used?
   - How do your results compare to a group who used the same plant as yours? What could be reasons for any differences?
   - How do your results compare to a group who used a different plant? What could be reasons for any differences? You may want to research the best growing conditions for the plants used by the class. Can some plants tolerate acidic conditions better than others?

Part III

1. To further students' understanding of the effects of acid precipitation, have them participate in the following activity.

2. Describe the following two lakes (Lake A and Lake B) to students.

   Two lakes are the same size and depth. Lake A has clear water; you can see the bottom. The water in Lake B has a greenish color, and you can't see to the bottom.

   Ask students which lake they think would be best for fishing or for observing aquatic wildlife. What else would they like to know to help them make a choice? Respond to their questions with the following information. If necessary, provide clues.

   Lake B has six species of fish and a variety of amphibians, including salamanders and frogs. The fish and frogs eat aquatic insects and small organisms that live in the water. An abundance of aquatic plants provides organisms with shelter and food. Lake A has none of these. The pH of Lake A is 4.2, the pH of Lake B is 6.3. Both lakes

are in areas where the pH of rainfall is approximately 4. The earth around Lake B contains limestone, while Lake A is surrounded by granite.

3. Have students participate in the following demonstration to show what has happened to Lakes A and B.

4. Divide the class in half. Tell one half they represent surface water running into a lake and the other half that they are aquatic organisms. (If the number of students is uneven, the extra student should be in the water half.) Distribute pH labels for aquatic organisms to students representing aquatic organisms. (Have students hold labels in front of them.) Explain that the pH value represents ranges of pH in which the animals can live.

5. Designate a portion of the room as a lake and have the organisms "swim" or move around within the boundaries. Arrange tables or chairs in a group around the lake to symbolize soil through which water filters as it makes its way to the lake. Water students should stand on the other side of these desks.

6. Tell students Scenario 1 takes place in an area that does not receive acid rain. Distribute pH labels to students representing water (pH 6.5). Inform students that rain has recently fallen (or snow is melting).

7. The students representing water should move through the desks or chairs. When they arrive in the lake, the aquatic organisms should try to match up with water students who are with within their pH range. (All aquatic organisms should find a match.)

8. Tell students to separate into two groups again. Scenario 2 takes place at Lake B; the area receives acid rain. Distribute pH values in water students (pH 4.5 should face out). What do students think will happen to aquatic organisms?

9. Explain that Lake B is surrounded by thick soil that contains a rock called limestone. The rock acts like a buffer, and will reduce the acidity of solutions. Show water students how they can flip their paper to make a new pH value of 6.

10. Instruct the water students that their beginning pH is 4.5. They filter into the lake as before, but sometime during the process they flip their cards, so that their pH value changes to 6. Once again, the aquatic organisms should find a match.

11. Explain that now students are at Lake A (Scenario 3). The soil around Lake A is thin and comes from a rock called granite, which does not act like a buffer.

12. Distribute pH values to the water students (pH 4.5). This time, after they filter through the soil, their pH will not change. Many of the organisms will not find matches. What do students think will happen to the aquatic organisms? Explain how acidic water affects some aquatic organisms.

Wrap Up

Have students summarize how acid rain affects living organisms and ecosystems. Have them describe what they believe a healthy lake (e.g., a lake providing optimum conditions for organisms) would look like. What would a lake with a pH of 4 look like? Describe the irony of a crystal clear blue lake that appears "healthy," but is actually biologically dead. They should supplement their descriptions with findings from their experiment and results of the simulation. Have students search magazines and newspapers for information about acid precipitation and create a collage that presents the impacts. They may want to contract their legislations or local industry representatives to learn about air pollution regulations designed to limit acid precipitation. They could write a letter to these parties expressing their views about the issues of acid precipitation.

Discuss with students the importance of frogs to Aboriginal people. Frogs were used by Aboriginal people to tell the seasons. What affect does acid rain have on frogs for Aboriginal people? How can this affect people in Saskatchewan?

Assessment

Have students:

- Demonstrate the difference between acidic and basic solutions (*Part I*, steps 4-7).

Where Are the Frogs?

- Conduct an experiment showing how plants are affected by acidic water (*Part II*, step 4).
- Identify the role of a control in helping to analyze the results of an experiment (*Part II, step 5*).
- Compare and contrast their predictions with the outcomes of their plant/pH experiment (*Part II, step 5*).
- Explain why a clear lake may not be a healthy lake (*Wrap Up*).
- Create a collage that displays the effects of acid precipitation on living and nonliving things (*Wrap Up*).

Extensions

To study the buffering effects of various types of soil, pour water of various acidic levels through a container filled with calcium carbonate. Record the pH of the water before and after.
How do plants react to basic conditions? Have students repeat the plant experiment, using a basic solution.

Resources

Acid Rain Foundation, Inc. 1410 Varsity Dr., Raleigh, NC 27606. (919) 828-9443.

About Acid Rain. 1988. South Deerfield, Mass.: Channing L. Bete Co., Inc. Booklet. To order, phone (800) 628-7733 and request booklet number 45047.

Miller, Christine G., and Louise Berry. 1986. *Acid Rain: A Source Book for Young People*. New York, N.Y.: Messner (Simon & Schuster Trade).

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pH Labels for Aquatic Organisms

(Write these labels on notebook-sized paper or index cards; make enough copies for half of the students in the class.)

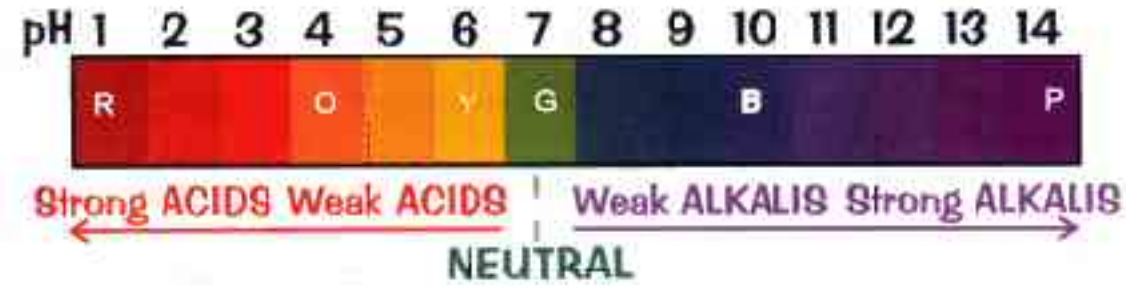
DAPHNIA pH RANGE 8 to 5.5	CLAM pH RANGE 8 to 5.5	WALLEYE pH RANGE 8 to 5.5	BROOK TROUT pH RANGE 8 to 5.5	MAYFLY pH RANGE 8 to 5.5	SALAMANDER pH RANGE 8 to 5.5
FROG pH RANGE 8 to 5.5	LAKE TROUT pH RANGE 8 to 5	NORTHERN PIKE pH RANGE 9 to 5	CRAYFISH pH RANGE 8 to 5	YELLOW PERCH pH RANGE 8 to 4.5	WATER BEETLE pH RANGE 8 to 4.5

pH Labels for Water

(Make enough water labels for each student.)

For the first scenario, all waters should have labels reading 6.5. For the second scenario, make labels that read 4.5 on one side and 6 on the other. The pH for the third scenario is 4.5.

pH Scale



pH and Plants Activity Sheet

Name _____ Responsibilities: _____

Name _____ Responsibilities: _____

Name _____ Responsibilities: _____

Name _____ Responsibilities: _____

You will need: ❒ 3 jars with lids ❒ Lemon juice ❒ Graduated cylinder ❒ pH paper ❒ Potting soil
❒ 3 milk cartons with tops removed ❒ 1 type of seed (e.g. tomato, bean, marigold)

How do you think plants will grow when they are watered with acidic water? Select seeds of one plant type and predict how they will react to being watered with acidic water.

Plant name: _____

Prediction: _____

Prepare the testing water you will use for watering your plants.

Get three jars and fill each with 100 ml of water. Label one jar "strong acid," the second "weak acid," and the last "regular water (control)." To the first far add 10 ml of lemon juice, and to the second add 1 ml of lemon juice. Measure the pH of each jar with pH paper. Put a lid on each of these jars and set aside.

pH of jar 1: _____

pH of jar 2: _____

pH of jar 3: _____

(If your pH paper indicates the pH level numerically, write that down. If not, describe the color of the test paper and tape it to this sheet.)

Label one milk carton "strong acid," the second "weak acid," and the third "regular water (control)." Place soil in each milk carton. Try to put the same amount of soil in each.

Moisten the soil in each carton with tap water and plant seeds according to directions on the seed package. Put the same number of seeds in each carton. If another group is testing the same plant as your group, set up your experiments identically, so you can compare results.

Put the plants in a sunny place. Check plants every day; make thorough observations every third day. When the soil is dry, use water stored in jars (water plant 1 with water from jar 1, etc.). Water all plants at the same time and with the same amount of water. If you run out of water in any of the jars, mix more using the same proportions as before.

Date watered	Amount watered

pH and Plants Observation Sheet

(Make a copy for each day you make observations.)

Name _____ Responsibilities: _____

Observations DATE:	Plant watered with strong acid	Plant watered with weak acid	Control
Height			
Number of leaves			
Color			
Other observations			
Drawing or photograph			

To Dam or Not to Dam

Grade: 7-8

Subject: Science, Social Studies, ELA, Arts Ed.

Outcome: IE7.4, WS8.1
Analyze how ecosystems change in response to natural and human influences, and propose actions to reduce the impact of human behaviour on a specific ecosystem.

Analyze the impact of natural and human-induced changes to the characteristics and distribution of water in local, regional, and national ecosystems.

Duration:
Preparation:
5 minutes

Activity time:
90 minutes

Setting: Classroom

Skills:
Analyzing, classifying; communicating; evaluating; interpreting; listening; observing; speaking; reading; synthesizing; writing

Vocabulary:
dam, river, costs, benefits, trade-offs

Dams can be very useful for several reasons. However, there are some pros and cons to building a dam. They can be a great source of energy, but sometimes at the expense of the ecosystem they are situated in.

Summary

Students role play individuals representing differing perspectives and concerns related to a complex issue.

Objectives

Students will:

- Evaluate potential positive and negative effects from constructing a dam on a river.

Materials

- Role playing cards

Making Connections

Saskatchewan presently has 45 large dams throughout the province and several small ones as well. Some communities may experience the advantages or disadvantages of these dams in various ways.

Background

Canada now ranks as one of the world's top ten dam builders. Although the Register of Dams presently reports 618 large dams- higher than 10 meters- in the country, there are many thousands of small dams.

Large dams are used primarily for hydroelectric power generation and for irrigation purposes. Quebec has proportionately more large dams (189) than any other province. British Columbia is next, with 89 large dams.

During 1987, over 60% of the total power generated in Canada came from hydroelectric sources, but it varied from highs of over 94% for Newfoundland and Labrador, Quebec, Manitoba, British Columbia, and the Yukon, to lows of 10% for Nova Scotia, 3.9% for Alberta, and 0% for Prince Edward Island.

In 1985, the United Nations ranked Canada as the world's largest hydro-electric producer, with 15% of the global output.

Hypothetical situation: The town of Rocksburg, population 900, is located along the scenic Jones River approximately 100km from the closest big city. The mayor and city council of the big city have proposed that a dam be constructed five kms upriver of Rocksburg. In the Environmental Impact Statement written by the city engineers, the following information was identified.

The dam would meet the area's electrical power demand for ten or more years in the future. It would provide some water for irrigation and would help with flood control problems downriver. Construction would be of rock-earth fill, 25 m high and 100 m across. Ten km of river would be turned into a lake.

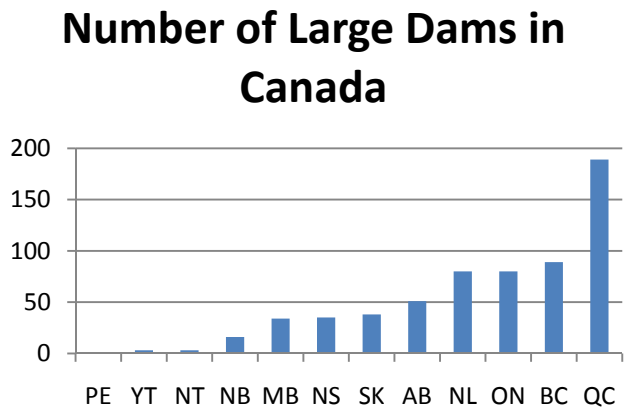
The dam construction would take five years to complete and would employ over 2,000 workers. After the dam was finished, approximately 100 workers would be required to keep the plant running.

Wildlife would be affected in the following ways:

- 15% loss to the deer herd that browses the lands alongside the river due to lost forage
- 20% loss to small mammals living in the river valley due to loss of habitat
- 20% loss to the area's songbird population due to lost river-bank nesting sites
- Blockage of the upstream and downstream movement of fish that live in the river due to the creation of the lake and dam

To Dam or Not to Dam

- Reduction of the area's wintering population of bald eagles due to the loss of river-bank trees where the eagles commonly roost while feeding on the fish; the eagles winter in the area and disperse to other areas in and out of the province to nest
- Development of suitable habitat for bass, carp and other spiny-ray warm-water fish due to the creation of the lake; the lake water tends to be warmer than the flowing river water
- Loss of 1,000 hectares of prime timber growing land and wildlife habitat



The people in Rocksburg are concerned about the problems and benefits from the number of people that would come to their town during and after the construction of the dam. For example, they project the arrival of 2,000 workers plus their families during construction for five years and that 100 permanent workers plus their families would stay after the dam was finished. They are concerned about effects on schools, sewage disposal, roads, homesites, property values, and the rural atmosphere, as well as police, fire, and hospital emergency capacities. They see some potential benefits from the development, such as new recreation opportunities for the people of Rocksburg and the city which is only about an hour away (water skiing, sail boarding, motor boating, swimming, fishing, camping, picnicking, and other lake-related sports).

Other impacts could include:

- Loss of drinking water quality locally and in the metropolitan area
- Flooding of native archaeological sites
- Cultural changes for local native people who have fished the river for generations
- Water for irrigation at a lower monetary cost
- Potentially less (monetarily) expensive power when compared to other forms of power production, e.g. nuclear, coal, oil, fossil fuels
- Potentially more (monetarily) total power bills that may be necessary to pay for construction of the dam
- Loss of ten kilometers of prime whitewater; private and commercial raft, kayak, and canoe trips would be gone

Procedure

1. Provide students with the background information. Generate an initial discussion with them about some of the possible costs and benefits from the construction of this dam, considering it from a variety of perspectives.

2. Ask each student to choose the role of an individual to become or represent for the purpose of this activity – or assign roles randomly. Examples of roles are included. Establish a balanced variety of roles, with people having conflicting values and concerns relating to the potential impacts of this dam construction.

3. Ask students to prepare for their role, developing a short position paper for use as background for the dramatization of their role.

4. Arrange the classroom to represent a meeting room for the county council in the area in which the town of Rocksburg is located. Students will role play their position and make a presentation to the five-member Rocksburg County Council. This council will ultimately make a recommendation to the National Energy Board on a siting permit for the dam.

5. After all the students have made their presentations, ask the county council to render a decision.

6. Following the council's decision, have a brief class discussion to summarize the "pros" and "cons" that emerged from the students' presentations. Identify and list the benefits, if any, and costs or liabilities, if any, as a result of building the dam include effects on people, plants, and animals. The list of "pros," "cons," and effects can be listed visually on a chalkboard.

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The Activity

Choose five people as members of the County Council:

- A representative of the local farmers' coalition interested in the irrigation potential of the dam.
- A lobbyist for the municipal electrical power company interested in developing the dam.
- A kayaker concerned with the loss of the whitewater stretch for canoeing and kayaking.
- A local sporting goods store owner and avid fisherman concerned with the loss of migration routes of fish on the river.
- The president of the "Save Our Native Plants and Wild Animals" organization.
- An Archaeology professor from the local university who had done extensive research on the archaeological sites of native fishing camps along the river.
- The director of the municipal water quality authority responsible for providing quality drinking water for the city and attracted to the dam's potential for providing a reservoir of high quality water usable during long hot summers.
- A representative for all homeowners in the river valley below the dam who would like to see more flood control.
- The local chief of police concerned about maintaining police protection, peace, health and safety with only a one-person staff as the sole legal authority in the region.
- The owner of a lumber company whose land would be inundated by the dam.
- An owner of a whitewater rafting company who uses the river for commercial rafting. Concerned about loss of the "best ten kilometers of the river", you argue that the best rapids would be submerged by the lake.
- The president of the local bird club who has organized bird-watching trips to the river every winter for the last 15 years.
- An avid water skier who sees the new lake as a real boon to skiing interests.
- A local representative of the grey panthers, a group of retired people who are concerned about any rise in power bills.
- An older fisherperson who enjoys throwing the boat on the top of the car and putting in at the closest float spot – especially lakes!
- A long time resident who champions the purity of fly fishing and insists on pristine habitat, noting the necessity of white water riffles.
- The president of "More Moose Now" who believes that with the lake behind the dam, more moose habitat will be created.
- The president of Watch Our Waves.
- A respected biologist who is prepared to testify about potential effects on wildlife from the building of the dam.
- A salesperson for motor boats, water skis, and other recreational equipment.
- A trained forester who has worked in the woods in the area for more than 50 years.
- A tribal leader who is concerned about loss of native heritage from flooding region for the dam.
- A local businessperson who is concerned about the long-range business potential of the area.
- A wealthy land developer who has architects working on designs for lakeside condominiums and resort homes.

And so on! Create any additional roles which serve to illustrate a variety of major perspectives and interest.

Wrap Up

After the role play and class discussion, ask each of the students to write a brief essay describing his or her own personal recommendation on whether or not to build this dam. The students might expand their position papers, or "start from scratch" in writing their essays.

Assessment

- Name two or more possible benefits to people if a dam were constructed on a river. Name two or more possible negative consequences to people if a dam were constructed on a river.
- Describe possible positive and negative effects on a variety of different kinds of plants and wildlife under each of the following conditions if these conditions existed as a result of the construction of a dam: water levels in the area below the dam are low for at least part of the year; water going over the dam drops a long way; very cold water is taken from the bottom of the dam and released into the river below.

Extensions

- Change roles and conduct the council meeting again. Note any differences in the results, as well as your perception of the process and experience.
- Find out if there are any proposals to create new dams or any other proposals that will affect wildlife habitat in your region. If so, investigate "pros and

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cons" of one or more of these proposals, from your perspective.

- Is there a dam in your area? Visit it. Find out about its effects on people, plants, and animals – both positive and negative, if any.

Resources

Project WILD. 1995. Western Regional Environmental Education Council. Canada.

Images

Retrieved from http://www.fotosearch.com/bthumb/UNC/UNC184/u28126167.jpg on (12/09)