Unit 13

Looking Forward: Our Global Experiment

Background

Introduction

Unit 13 is a synthesis of the Habitable Planet course that addresses the effect of humans on planet Earth. The content focuses on solutions to some of our environmental challenges. The emphasis is on how environmental science can help us make informed choices and how these choices can lead to various outcomes. The growing awareness of global environmental issues is considered a positive indication of a developing global ethic that is necessary to prevent major catastrophe. Three themes are discussed in detail: ways to measure and reduce the human footprint, multiple stresses on interconnected Earth systems, and strategies for confronting the climate-energy challenge.

Essential Questions

How can we increase the quality of human life, encourage economic development, and still protect the environment as human appropriation of the natural world becomes larger?

To what extent do we understand that environmental problems on planet Earth are interconnected and that when we affect one part of the system, we affect other parts as well?

Do we recognize that climate change has the potential to make other environmental challenges much more difficult to solve because of the global scale of its impacts?

Content

Unit 13 focuses on Earth as a system—how human impact has affected this system and how environmental science can help provide solutions to many of our global environmental problems. The unit considers Earth's limited capacity in terms of how the dramatic increase in human population over the past several decades has increased demands on natural resources. This trend has affected biological diversity in tropical rain forests and coral reefs. Both the text and video address these issues in detail.

This unit develops the concept of human society's ecological or environmental footprint and asks how we can calculate the footprint for resources such as water and land use, energy consumption, pollution, etc. We present the difficulty in determining society's footprint for the decline in biodiversity and climate change as an example of the difficulty in determining humans' overall impact on Earth's natural resources.

Background

The video features interviews with a wide array of scientists, including excerpts by some who appeared in previous videos and some who helped develop the online text. These experts make the point that we do not understand Earth systems well enough to know what will happen if we continue to stress these systems. We have no real way of predicting the eventual effect on agriculture, spread of human diseases, increase in sea level, loss of species diversity, and overall habitability of planet Earth. They conclude that environmental science can help clarify the consequences of our choices and, we hope, guide society to make better choices in taking care of our habitable planet.

Learning Goals

During this session, you will have an opportunity to build your understanding of the following.

a. Knowledge

   i. Earth as a system functions as an interconnected set of structures and processes that involve the geosphere, hydrosphere, atmosphere, biosphere, and cryosphere.

   ii. Technological advances in the sciences and engineering will increase our understanding of Earth as a system.

   iii. Human population growth and economic development have had a profound impact on our habitable Earth by creating major environmental problems.

   iv. Understanding the components of the coral reef ecosystem allows us to develop models for an interconnected system.

   v. Climate change and human energy demands are interconnected and have an impact on Earth as a system.

b. Skills

   i. Scientists use quantitative, qualitative, experimental, and other methods to understand Earth as a system.

   ii. Calculating our human ecological footprint is one method of considering the effect of humans on the habitable Earth.

c. Dispositions

   i. Awareness of environmental problems and identifying the choices we have in developing solutions for these problems is critical.

   ii. There is a need to develop an environmental ethic to help in recognizing and participating in the solution to environmental problems.

   iii. Environmental science knowledge and skills are subject to change.

Key concepts

Earth System

Ecological footprint

Coral-zooxanthallae

Carbon sequestration

Carbon capture and storage

FACILITATOR: These concepts correspond roughly to the sections of the unit. There are a number of other concepts that could be included. It is best to start with the author's major ideas and then ask for input from the study group for other concepts they would include.

Background

Misconceptions

Throughout the Habitable Planet course, we have focused part of each unit on related misconceptions. Any one of these misconceptions can relate to the overall theme of Unit 13 in some way. In this final unit on our ecological future, two specific common misconceptions should be considered. First, most people believe that there will be technological fixes that will deal specifically with environmental problems. Although there is some truth to this, technological fixes alone will not solve problems such as global climate change or depletion of marine fisheries. Technological advances will contribute to a myriad of approaches to sustain the habitable planet. Technology is an important part of the mix, but it is not the exclusive answer. We must also address everyday consumptive practices and natural resource management and conservation strategies.

Second, there is a commonly held belief that the human race is not subject to catastrophic consequences such as extinction. Young people in particular think that the human race could not become extinct. While the thought of human extinction seems far-fetched, we know that the consequences of environmental degradation and, specifically, ecological tipping points are not predictable. We should not discount our fallibility. Under the direst circumstances, it is possible for any species to become extinct on planet Earth.

The combined collection on common misunderstandings found in the Professional Development Guide to the Habitable Planet course is one of the most complete and comprehensive treatments of ecological misconceptions in environmental science education literature. Educators who take these prior understandings into consideration when teaching ecology or environmental science will find that their students will be forced to reconcile their existing knowledge with recent science information about our planet and its future. This will lead to more meaningful learning and, we hope, changes in behavior.

Getting Ready (45 minutes)

Activity One: Assessing Prior Knowledge, Questions, and Related Experiences

Each person in the group should have three index cards. On the first card, participants should name a single ecological problem. On the second card, participants should write one question they have about that problem. Finally, on the third card, they should describe a direct experience they have had that relates to the problem. For example, an individual might write:

Wild fires are increasing each year in the Rocky Mountains.

What is the cause of all these fires?

The air quality in my city has been terrible because of the nearby wildfires.

Getting Ready

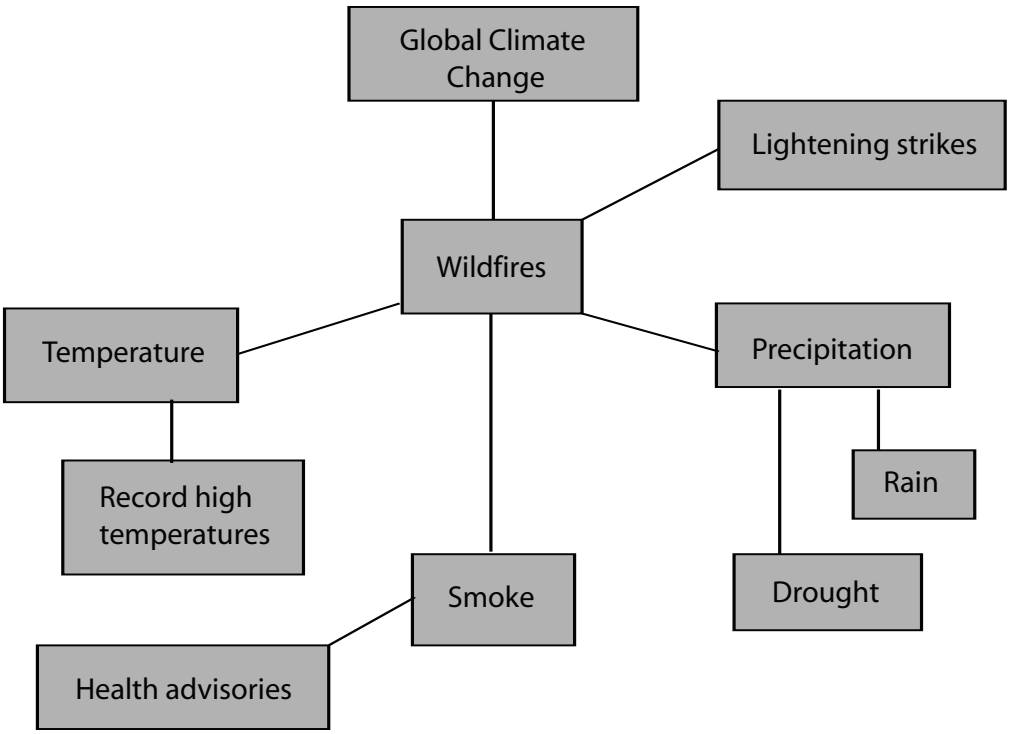


Figure 13.1 An example of a study groups' idea collection, with major subjects identified and the addition of the major focus ideas of the video. This activity links individual pre-existing knowledge with that of other members of the group and the unit content.

Activity Two: Current Events & Editorial Cartoons

Participants will share an article that they have found that relates to the week's topic. All members of the group will share their headlines for the articles. The leader should ask a few people to summarize their articles and ask for comments from others with related articles. As the group discusses the articles, a participant should record key concepts and make a list. (Participants may choose to bring in a cartoon or an editorial related to the week's topic instead of an article.)

Activity Three: Your Ecological Footprint

The ecological footprint measures the amount of renewable and nonrenewable resources that humans use. Earth's resources are needed to support everything that we eat or use, and Earth absorbs the wastes we create. Given the current world population, there are 4.7 biologically productive acres available per person, and this does not include the needs of all the plants and animals.

The ecological footprint calculator calculates the number of acres a person uses given his or her lifestyle. It also calculates how many "Earths" would be required if everyone had the same type of lifestyle. For example, the average person in the United States uses 24 acres; if every person in the world used this much, we would need five planets!

Getting Ready

Facilitator

1. Explain the ecological footprint to participants including what the 4.7 acres per person means.
2. Give participants some examples of ecological footprints:
   a. Pakistan: Less than 2 acres
   b. Italy: 9 acres
   c. Canada: 22 acres
   d. United States: 24 acres

Procedure

1. Predict your ecological footprint.
2. Using the instructions below, calculate your ecological footprint. Start by filling in only the My Score column.
3. After everyone has filled out the form, share your grand totals and find the group's average ecological footprint.
4. What activities scored the highest number of points? Why?
5. What changes can you make to reduce your ecological footprint?
6. Go back to your ecological footprint calculator and fill in the "points I could save" column with the goal of saving "one Earth."
7. Share the changes you made with the rest of the group.

Note: There are also many ecological footprint calculators online that can save time in making final calculations. A simple web search (key words: calculate, environmental, and footprint) will reveal many links to appropriate Web sites.

Ecological Footprint Calculator

Complete each category for a typical day in your home. After completing a category, add your points for a subtotal and transfer this subtotal to the summary chart. After completing all of the categories, add your subtotals together to calculate your ecological footprint.

Water Use			
Question	Answer/Points	My Score	Points I Could Save
My shower (or bath) is:	No shower/bath (0) Short shower 3–4 times a week (25) Short shower once a day (50) Long shower once a day (70) More than one shower per day (90)		
I flush the toilet:	Every time I use it (40) Sometimes (20)		
When I brush my teeth:	I let the water run (40) I don't let the water run (0)		
We use water-saving toilets	Yes (-20) No (0)		
We use low-flow showerheads	Yes (-20) No (0)		
	Water Use Subtotal:		

Getting Ready

Food Use			
Typically, I eat:	Meat more than once per day (600) Meat once per day (400) Meat a couple of times a week (300) Vegetarian (200) Vegan (150)		
All of my food is grown locally or is organic.	Yes (-20) No (0)		
I compost.	Yes (-20) No (0)		
Most of my food is processed.	Yes (20) No (-20)		
Little of my food has packaging.	Yes (-20) No (0)		
On a typical day I waste:	None of my food (0) One-fourth of my food (25) One-third of my food (50) Half of my food (100)		
	Food Subtotal:		

Transportation Use			
On a typical day, I travel by:	Foot or bike (0) Public transit/school bus (30) Private vehicle; 2 or more people (100) Private vehicle; 1 person (200)		
My vehicle's fuel efficiency is:	More than 30 miles/gallon (-50) 24–30 miles/ gallon (50) 17–23 miles/gallon (100) Less than 17 miles/gallon (200)		
The time I spend in vehicles on a typical day is:	No time (0) Less than half an hour (40) Half an hour to 1 hour (100) More than 1 hour (200)		
The car in which I travel on a typical day is:	No car (-20) Small (50) Medium (100) Large (200)		
Number of cars for my household:	No car (-20) Less than 1 car per driver (0) One car per driver (50) More than 1 car per driver (100) More than 2 cars per driver (200)		
Number of flights I take per year:	0 (0) 1 to 2 (50) More than 2 (100)		
	Transportation Subtotal:		

Getting Ready

Shelter Use			
My house is:	Single house on large lot (50) Single house on small city lot (0) Townhouse/attached house (0) Apartment (-50) Green-design house (-100)		
Divide the number of rooms in your home (not including bathrooms) by the number of people living in your home.	1 room or fewer per person (-50) 1–2 rooms per person (0) 2–3 rooms per person (100) More than 3 rooms per person (200)		
I own a second, or vacation home.	Yes (200) No (0)		
	Shelter Subtotal:		

Energy Use			
In cold months, my house temperature is:	Under 59°F (15°C) (-20) 59 to 64°F (15 to 18°C) (50) 65 to 71°F (19 to 22°C) (100) 72°F (23°C) or more (150)		
I dry clothes outdoors or on an indoor rack.	Always (-50) Usually (0) Sometimes (20) Never (60)		
I use an energy-efficient refrigerator.	Yes (-50) No (50)		
I have a second refrigerator or freezer.	Yes (100) No (0)		
I use 5 or more compact fluorescent light bulbs.	Yes (-50) No (100)		
I turn off lights, computers, and televisions when they're not in use.	Yes (0) No (50)		
For cooling I use:	Air conditioning in car (50) Air condition in home (100) Electric fan (-10) Nothing (-50)		
My clothes washer is a:	Top load (100) Front load (50) Laundromat (25)		
	Energy Use Subtotal:		

Clothing Use			
I place my clothes in the dirty laundry everyday.	Yes (80) No (0)		
One-fourth (or more) of my clothes are handmade or secondhand.	Yes (-20) No (0)		
Most of my clothes are purchased new each year.	Yes (200) No (0)		
I sell or give away clothes I no longer wear.	Yes (-50) No (100)		
I buy ____ new pairs of shoes each year.	0–1 (0) 2–3 (20) 4–6 (60) 7 or more (90)		
	Clothing Subtotal:		

Getting Ready

Stuff I Use			
All my garbage on an average day could fit into a:	Shoebox (20) Small garbage can (60) Large garbage can (200) Box smaller than a shoebox (0)		
I recycle everything possible.	Yes (-100) No (0)		
I reuse or repair items instead of throwing them away.	Yes (-30) No (0)		
I try not to use disposable items as often as possible.	Yes (-50) No (60)		
I use rechargeable batteries.	Yes (-30) No (0)		
My house has___electronics (computer, TV, Stereo, etc.).	0 (0) 1–5 (25) 6–10 (75) 11–15 (100) More than 15 (200)		
For outdoor recreating I use ___ equipment. (A lot = boat, snowmobiles, dirt bikes, etc. Very little = soccer, bicycling, etc.)	None (0) Very little (20) Some (60) A lot (80)		
	Stuff Subtotal:		

Summary

Transfer your subtotals from each section to the table below and add them together to calculate your ecological foot print.

Water Use	
Food Use	
Transportation Use	
Shelter Use	
Energy Use	
Clothing Use	
Stuff I Use	
Grand Total	

Grand total _____ ÷ 350 = _____ Earths

_____ Earths X 4.7 acres/Earth = _____ acres

If everyone lived the way I do, we would need _____ Earths for all the people in the world.

Video (45 minutes)

Activity Four: Watch the Video (30 minutes)

As you watch the video, think about the following focus questions.

1. What is the argument for preserving all remaining ecosystems? Where should we pay particular attention and why?
2. How do terrestrial, aquatic, and marine conservation efforts compare? What are the consequences of these efforts.
3. What is an ecological "tipping point" and why is it critical?

Activity Five: Discuss the Video (15 minutes)

Discuss the following questions about the video.

1. "When all else fails men turn to reason." What does this statement mean in the context of your local community?
2. What do you think are the key ecological issues that the public is aware of in relation to environmental degradation. Why is the public aware of these issues and not others?
3. What do you think are the best and worst case scenarios for our human/ecological condition? Why?
4. What are the ecological consequences of human population growth?
5. Why is genetic evolution so important and how do we convince all human beings of its critical aspects?
6. What part do marine environments play in our ecological future?
7. How does the human spirit depend on our ecological condition?
8. Why do scientists believe that climate is the critical ecological factor for the habitable planet?
9. What is the only solution to climate change? What is the economic consequence?
10. What is the most important approach to future environmental quality? Why?

FACILITATOR: Refer back to the misconception section and Activity One: Assessing Prior Knowledge. Has the video contributed to the participants' new understanding of concepts? Are there any changes the participants would make about the arrangement of their cards from Activity One?

Going Further (60 minutes)

Activity Six: What did you eat today and where did it come from?

The future habitability of Earth depends on producing enough food and getting it to people. According to the unit 13 video, rising human population, biodiversity loss, and climate change are issues of primary environmental concern. How do these issues influence your thinking about your daily diet and the source of your life-sustaining nutrients?

In most developed countries, food travels all over the world to make it to grocery stores and subsequently to dinner plates. Most people do not consider the fact that the further your food travels, the more fossil fuels are consumed and the more greenhouse gases created. According to researchers at the University of Michigan's Center for Sustainable Agriculture, an average of over 7 calories of fossil fuel is burned up for every calorie of energy we get from our food. This means that in a 400 calorie breakfast, a person will, in effect, have "consumed" 2,800 calories of fossil-fuel energy. Highly packaged food also consumes more fossil fuels then fresh produce. Meat uses more fossil fuels than plant protein. The production of 1 calorie of animal protein requires more than ten times more fossil fuels than plant protein. In this activity, participants will explore how far their food has traveled for one day and create a "foodshed."

FACILITATOR: Make sure participants have the food record they were asked to prepare for homework. The record should list all food that was eaten and where it came from for one entire day. Participants will need to estimate the distance traveled for each food product.

1. Have the group make two columns and list packaged foods in one and unpackaged foods in the other. Total the distance traveled for packaged versus non-packaged items. Compare the differences in distance traveled and energy consumed. Have each person in the group do the same and compare individual to group results.
2. Have the group make two columns and list all the meat and non-meat products consumed by the group in one day. Total the distance traveled for meat versus non-meat products. Compare the distance and energy consumed. Have each person in the group do the same and compare individual to group results.
3. On a single world map, mark where all the participants' food originated. Use the points of food origin to create a line surrounding the entire area encompassed by the food the group ate in one day. The enclosed area is the group "foodshed." Do the same for each individual in the group and compare the individual to group "foodsheds." Identify the major ecosystems and biomes in which your food originates.

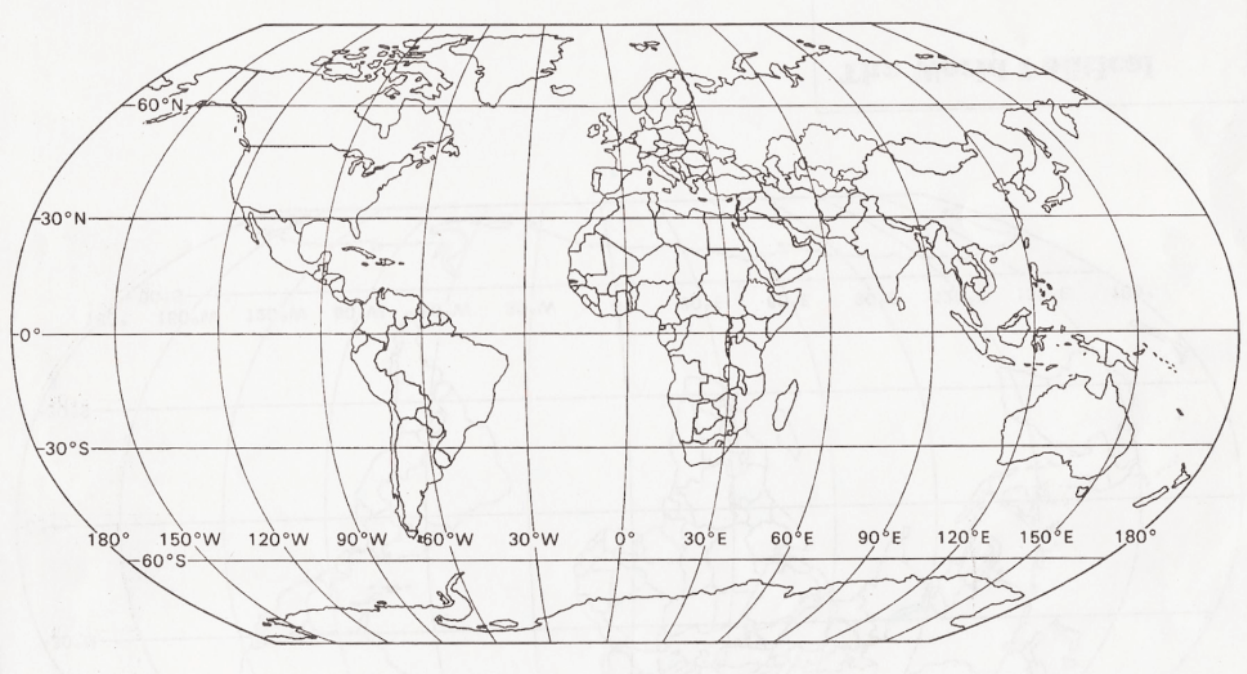
Discussion Questions

1. How does your individual daily food consumption compare to that of the entire study group? Why do you think it is different for different members of the group?
2. The unit 13 video identifies rising human population, biodiversity loss, and climate change as issues of primary environmental concern. How does your daily food consumption affect each of these global issues?
3. How can we reduce the amount of fossil fuels burned when we choose the foods we eat? How can we help reduce the amount of chemicals used to produce our food? How can we reduce the amount of carbon emissions associated with our food production?
4. Given that, according to the video, we are adding a billion people to the Earth every 12–15 years, what can people in your community do to ensure adequate food production and supply?

Going Further

5. In an increasingly affluent society, people have the financial resources to buy better and better products, including food. How does increasing affluence affect diet and food consumption? What are the production, supply, and energy consequences? How might this affect global biodiversity?
6. Many scientists in the Unit 13 video believe fossil fuel impacts are the most critical concern facing people and Earth. How can your daily diet influence fossil fuel impacts?

At the beginning of the video we saw the claim, "When all else fails, men turn to reason." What if our global food production and supply infrastructure were to fail? How will "men turn to reason?" What can be done now to prevent this catastrophic state? Do you have faith that people will use good sense and have the desire to prevent this outcome? Why?



Activity Seven: Return to Essential Questions

The facilitator should draw the attention of the participants back to the essential questions posed in the Background Section of this unit guide. Discuss how the participants' ideas may have changed in regard to the questions. Discuss the most logical and complete answers to the questions.

Activity Eight: Discuss Supplementary Classroom Activities

If the participants in the study group are teachers, the facilitator should draw the participants' attention to the supplementary classroom activities located at the end of this guide. Discuss how teachers would implement these activities in their classrooms and how they would relate them to the topics in this unit.

Supplementary Classroom Activity

Taking Eco-Action

There are five steps to addressing an environmental issue. These are selecting an issue, defining the problem, researching possible solutions, evaluating the options, and taking action. The purpose of this activity is not simply to take action or to have students take action, but to enable students to become rational, thinking human beings who want to see the "big picture" and who are willing to act to benefit everyone. Issues raised by environmental education are often highly emotional and complex, and passionate discussion ensues.

Part 1: Environmental Issues, Problems, and Solutions

Setting the Stage for Action

Educators must create a positive context with students before beginning environmental action activities. Many of the related readings and activities in the Habitable Planet course can be used to develop a context for environmental action. A quick review of the various units in this Professional Development Guide will provide a number of activities that develop understanding, skills, and positive dispositions in relation to a variety of ecological topics. Among the key concepts are biodiversity, population, and climate change. Local newspapers can provide relevant topics for study. Some of the Habitable Planet videos can be used with students to stimulate discussion and elicit relevant thinking and values. No matter what educational materials you are using with your students, what is critical is that you open the students' minds to various perspectives and possibilities regarding environmental issues and actions that might address existing problems.

Step 1: Choosing the Issue. The teacher will lead a discussion to generate ideas with students. Ways to do this include eliciting ideas from the students themselves and taking a field trip to a designated area, such as a wetland, to spark ideas. Students may have their own concerns about a particular area where they have noticed changes due to an increase in use or fluctuations in local climate. Students may choose to interview their friends and family to generate more ideas.

Step 2: Defining the Problem. Students may want to skip this step, as they will be focused on a solution, but this step is the most crucial. Students must actually define a problem to be addressed. They need experience and knowledge to complete this step. An example of a defined problem could be that students have noticed an excess of trash being dumped in a wetland area. To complete this step, they should be able to identify the groups that have an interest in wetlands, know the groups' philosophies, social interests, and values, and identify their own concerns and listen to other points of view with an open mind.

Step 3: Searching for Solutions/Researching Further. In this step, students seek solutions. This may involve going back to step 2, reviewing one or two units in the Habitable Planet online textbook, or using additional resources. Logic activities are useful, as the more students are encouraged to look at things in different ways, the more likely they are to apply this type of thinking to the wetlands issue at hand. Once students understand the design behind the preservation of a wetland area or the concept of land use that was intended when rights to that area were established, they can confidently move on to Part 2 of this classroom activity.

Supplementary Classroom Activity

Part 2: Options and Action

After researching the topic and searching for solutions in Part One, students should now be able to proceed to the fourth step, which involves examining the consequences that will result from the various options that can be taken, and step five, which is taking action.

Step 4: Evaluating the Options. This step is the most crucial for the teacher to facilitate. Environmental education does not simply ask a student to get emotional about an issue and then take action. The students must understand the "big picture" and make decisions that will benefit all involved in the community, region, country, and world. Following the adage "Think Globally, Act Locally" is a good rule of thumb. Questions that can be asked of students include:

What are the values and interests served by this solution?

What outcomes will result from this solution?

What will stand in the way of achieving this solution?

Who wins from this solution? Who loses?

Does this solution actually solve our defined problem?

In the case of a polluted watershed, students may realize that a proposed solution could be to ask a land area's caretakers to post signs discouraging others from dumping their trash or to coordinate a class clean-up day. Such solutions could produce a win-win solution.

Step 5: Taking Action. The class members must decide if they are able to make a meaningful contribution to the solution and what resources will be required of them. (Make sure to indicate that time is considered a resource.) It is important for the teacher to create a context of action for the students. It would be damaging to the students' experience of environmental education and activism as well as their morale if they expect a far greater outcome than they achieve. It is up to the teacher to pave the way for the students so that this is a successful venture for all involved. For example, if students expect the watershed area to stay clean after they have spent one day cleaning it and are not taught that sustainability of a project and continual maintenance of the project is expected, they could be disheartened and discouraged.

Creating opportunities for students to take action, share what they learn, and plan for the next venture is all part of this step. It is important that the teacher encourage students not to let their efforts end with just this project. Supporting the students in other projects, such as volunteering with other organizations or directing their own action projects, is very important and lets the students know that they have power in a situation, their community, their environment, and elsewhere.

Conclusion

These five steps—evaluating an issue found in activities one and two, exploring options, seeing the big picture, evaluating the options and consequences, and taking action—can be implemented anywhere, with any project, with any chapter in this text.

Notes