

E. Angus Powell Endowment



Economics Addendum For The Chesapeake Bay Foundation Lesson Plans

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Glossary

Choices	act of choosing
Cost	price; involve as a loss or sacrifice
Cost/benefit	assessing the cost of an operation and the value of the resulting benefits
Economics	the study of how a society uses its resources to provide for needs and wants of the individuals
Environmental	having to do with the surroundings in which a community is located - including air, water, land, animals and plants
External costs	costs relating to a transaction not paid for by the parties involved in the transaction. For example when a company pollutes and does not pay for the clean up or new businesses cause an increase traffic requiring improvements in roads.
Externality	a result from a transaction that is not included in the cost OR the effect of a transaction on a person other than one involved in the transaction - an externality is positive when the effect benefits the other parties or negative when it costs the other parties
Factors of production	another name for the production resources of land (natural resources), labor, and capital (machinery and buildings)
Incentives	a motivation to undertake an action or to refrain from undertaking an action. In a market economy profits are the incentive to produce
Interdependence	the way parts of a community are dependent on other parts of a community and vice versa
Market value	how much a person should be able to get for something they wanted to sell.
Opportunity cost	the second most valued choice, given up when the first choice is selected
Prices	the amount of money or goods for which a thing is bought or sold
Product	a good or service people produce
Productivity	denotes the efficiency with which resources (people, tools, knowledge and energy) are used to produce goods and services.
Resource allocation	the way that resources and services are distributed to members of a community
Scarcity	a situation where there is more demand for a resource than is available
Supply	the relationship between the quantities of a good or service that sellers wish to market at any particular time and the various prices that can exist for the good or service
Trade-off	giving up one choice to have another which seems more desirable

Fifth Grade

Lesson Title: Bay-Sic Ratios

Connections to VA History and Social Studies Standards of Learning in History and Social Science:

- CE 9a – scarcity, resources, production
- GOVT 14 c – productivity
- GOVT 15 c – factors of production
- GOVT 15 f – global economic trends
- GOVT 16 c – environmental economics

Economics Concepts and Vocabulary:

- Scarcity
- Resources (factors of production)
- Productivity

Note: The uniqueness of Chesapeake Bay, so clearly portrayed in the *Bay-Sic Ratios* activity, is important not only biologically, but also economically. The Chesapeake is a **resource**; one of the “gifts of nature,” that economists call **land**. The fundamental economic concept of **scarcity** is based on the reality that all resources are limited. Students sometimes find it difficult to imagine that resources are limited, probably because we refer to them in general categories. This activity, by demonstrating the uniqueness of the Chesapeake watershed, makes the reality of limited resources much more concrete.

Resources are also called **factors of production** because they are the building blocks used to produce the goods and services to satisfy our wants – not just our material wants, but also our demand for wildlife, recreation, and other environmental amenities. Since production is limited by the quantity and productivity of resources, the characteristics of the Bay are important; its vulnerability to pollution illustrates the economic dimension to environmental issues.

Use *Bay-Sic Ratios* to review the factors of production (land, labor, capital, and entrepreneurship). Then, consider how and why pollution may impact the **productivity** of the Chesapeake Bay resource.

Suggested Lesson Modifications:

Add the following to question 11:

- 11 a. Economists identify 4 categories of resources or 4 factors of production: land, labor, capital, and entrepreneurship. Which type of resource is Chesapeake Bay? *Land*
- The “Chesapeake Bay” as a resource includes many specific resources. Make a list. *As the teacher background notes, the 3 most important resources to the economy of Virginia are oysters, fish, and underwater grasses, but expect and encourage students to lengthen their list. The economic category “land,”*

includes all the gifts of nature the Chesapeake has to offer: sunshine, water, birds, etc.

11b. Resources are used to produce goods and services. What do we produce using the Chesapeake as a resource? *Students may begin by thinking of traditional products – like oysters, for example. Encourage them to broaden their thinking to include such things as recreational opportunities and our enjoyment of bird habitat, beautiful views, and other environmental amenities.*

11c. What characteristics of the Chesapeake help to determine its **productivity** (its ability to provide the goods and services you listed in 11b)? *The reading tells us that the shallowness of the Bay lets light penetrate, improving submerged aquatic vegetation which provides food and habitat for a large variety of animals – some of which we “consume” by eating, others by our enjoyment of their presence.*

11d. The economic concept of scarcity teaches us that all resources are limited. In what ways is the Chesapeake resource limited? *Students have a great deal of information from this exercise about the size of the Chesapeake watershed. More importantly, however, they learned about the Bay’s unique susceptibility to pollution, a serious limit to its productivity.*

Lesson Title: What’s News in Town?

VA History and Social Studies Standards of Learning:

- CE.9a scarcity and choice

Economics Concepts and Vocabulary:

- Cost / benefit analysis

Note: Investigation of environmental issues offers an opportunity to apply **cost / benefit** analysis and to emphasize the subject nature of **cost**. Current events help students to understand that costs aren’t just “out there,” somewhere. Costs are **to** someone; they are borne by people, and because individuals’ values differ, they perceive costs and benefits differently. Through cost/benefit analysis from a variety of perspectives, students come to appreciate that as issues become more complex and involve more stakeholders, it becomes increasingly difficult to reach agreement on which benefits are worth bearing which costs!

Suggested Lesson Modifications:

After students read and discuss their issues in groups, ask them to work with a partner from their discussion group to complete the following handout:

People's Perspectives Reflect Cost/Benefit Analysis

1. List the stakeholders in the _____ issue. (Fill in a name or description of your issue.) Stakeholders are people who will be affected by or have an interest in the outcome of the controversy. (Check your graphic organizer. Who were the key people identified in your article or in the articles of others in your discussion group?)

2. List the various courses of action or solutions that have been proposed to deal with the controversy. (Again, check the last question in your graphic organizer. If no alternatives have been proposed, generate a list of possibilities you see as a result of your group discussion.)

3. Choose one of the items on your list in question #2 above. (Hint: It will be easier if you choose the alternative that has generated the most controversy, because the news articles are likely to give you more of the information you need to complete this worksheet.) Enter the proposal in the grey box at the top of the chart below.

4. Choose 2 of the stakeholders from opposing sides of the issue you listed in question #1 above. Enter them in the stakeholder column in the chart below.

Proposed Course of Action:			
Stakeholders	Benefits of taking this course of action:	Who will receive these benefits?	Benefits of NOT taking this course of action:

5. Fill in the column entitled "Benefits of Taking This Course of Action." (Remember that benefits don't have to be monetary and frequently are not.) Use the news article to

figure out what each stakeholder would enter in the chart. List the benefits in order of importance to the stakeholder, with the most important at the top of the list.

6. Who does the stakeholder believe will receive the benefits if this course of action is taken? List individuals or organizations in the column on the chart.
7. To what degree do the stakeholders agree on the benefits and who will receive them? Is their disagreement on what the benefits are or on the relative importance of the various benefits?
8. Repeat directions #5-7, but this time as they apply to NOT taking the identified course of action.
9. Look over the chart. Do you think the disagreement between the 2 stakeholders is based mainly on a differing perception of the benefits, with dissatisfaction over who receives the benefits, or both? Explain.

Lesson Title: Bay Critter of the Year

VA History and Social Studies Standards of Learning:

- CE.9a – price, supply
- GOVT.15d – supply and demand
- GOVT.15f – impact of technological innovations
- GOVT.16c – environmental issues

Economics Concepts and Vocabulary:

- Supply
- Supply shifters

Note: Use the resume of bay critters harvested as food to review and enhanced students' understanding of the role of **supply** in determining the **prices** of products we purchase or to introduce **supply shifters**.

Suggested Lesson Modifications:

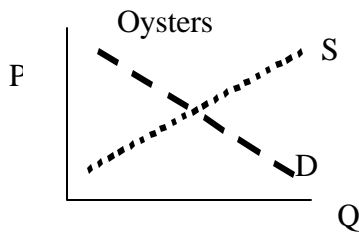
1. Choose one of the bay critters whose population has changed dramatically – either increased or decreased – over time. (Alternative: Have the entire class use the oyster timeline on page 83 of the “Oysters and a Clear Bay” activity.)
2. As a class, create a rough “timeline” showing the changes that have taken place in the critter’s population and include a brief description of the causes of those changes. This timeline can be created during a general discussion in which students share knowledge that they may have as a result of earlier studies of Virginia history or their knowledge of their own families’ stories. Alternately, the timeline can be constructed through a formal

assignment in which student groups research, or are asked to read handouts on, the history of Virginia’s Bay critter-related industries – fishing, crabbing, oystering, etc.

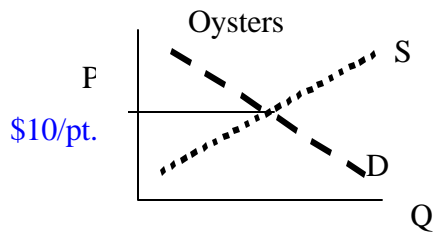
3. Display on the board, poster board, or overhead, a supply and demand graph, with price and quantity axes labeled but no curves drawn in.



Review with students the components of a supply and demand graph as you draw in a fictitious demand curve and supply curve of the Bay critter in question. (Note: The following examples use the information from the timeline on p. 83 of the “Oysters and a Clear Bay” activity.)

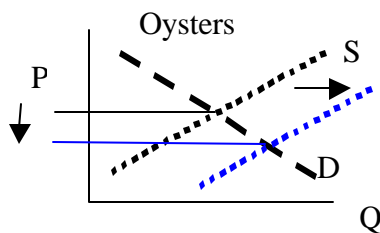


Come to an agreement on the current price of oysters and enter that price on the graph.



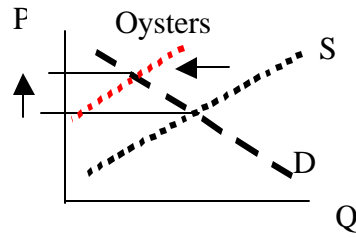
4. Then, using the events on the timeline, shift the supply curve to show increases and decreases and to predict the accompanying price changes.

Examples might include:



What happened to the supply and price of oysters when oystermen started to use dredges in the 1860s?

Because oysters were easier to harvest, the supply increased and the price fell.



What happened to the supply and price of oysters when MSX and Dermo entered the Bay in the 1980s? or in 1941 when many watermen joined the armed forces after Pearl Harbor?

Even though the technology had improved, the diseases made it more difficult for the oystermen to make a living, so many of them left the business for other kinds of work. The supply decreased and the price rose.

5. (optional) Finally, present students with a list of the supply shifters and ask them to put the time line events that changed supply into the categories on the list:

Supply Shifters	Examples: Causes of Shifts in the Supply of Oysters
Changes in the number of suppliers	
Changes in the prices of other things suppliers could produce (crabs, shad, etc.)	
Changes in the availability of resources	
Changes in technology	

6. Note that while this is a good opportunity to use graphs, the graphs are not necessary. The concept of shifting supply and the accompanying price changes can also be developed in words or pictures. Ask students to tell you a reasonable story about what happened to the supply and the price as a result of each of the events in the timeline of their bay critter.

Lesson Title: Fabulous Bay Grasses

VA History and Social Studies Standards of Learning:

- CE.9a - resources

Economics Concepts and Vocabulary:

- Resources: land (natural resources)

Note: It is possible to modify the lesson to incorporate marginalism if students are instructed to keep detailed enough data to analyze the effects of incrementally increasing amounts of the variables added to the water.

For example, a student might set up the sediment experiment with several jars, each containing one more tsp. of sediment than the last. The student could then be asked to explain results in terms of the effects of each additional (**marginal**) unit of sediment.

However, practice with **marginal analysis** is more easily incorporated in the “How Hard Is Your Yard” lesson and may be more appropriate to older students.

Suggested Lesson Modifications:

The Extension activity on p. 121 suggests a potential tie-in to economics. Submerged aquatic grasses fall into the economic category of “land” resources. Students may not immediately think of SAV as a resource because they don’t immediately consume it and they may not associate it with supplies sent to a factory to be turned into goods and services. The role of grasses as a resource may not be as visible to them.

Ask students to create a ripple diagram with their grass in the center. In the first ripple, list all the other plants and animals that are affected by, consume, or use the grass. In the second ripple, list those affected by the first ripple. See how many ripples it takes before you list something directly consumed by humans. For some grasses, like eelgrass, it may only take one ripple, but for others it may take several.

Lesson Title: Submerged Aquatic Education

VA History and Social Studies Standards of Learning:

- CE.9a – resources, production
- GOVT.15c – factors of production

Economics Concepts and Vocabulary:

- Production
- Resources

- Land
- Labor
- Capital
- Entrepreneurship

Note: While it might seem that the environment should be characterized as a **resource** – a gift of nature – our demand for improved environmental quality means that from an economic perspective it is also a **product**. Many of the WAVE lessons help to raise student awareness of actions humans can take to produce more and/or improve the quality of environmental amenities. Like the production of anything else, the **production** of environmental “goods” requires the use of resources and thus entails an **opportunity cost**, because those resources could be used to produce something else. Use the study of Bay grasses in this lesson (and in “Fabulous Bay Grasses”) to introduce students to the idea that resource inputs are used in production because we anticipate benefits from their use and to help them recognize increasing bay grasses requires a conscious **choice** to use the necessary resources for that purpose.

Suggested Lesson Modifications:

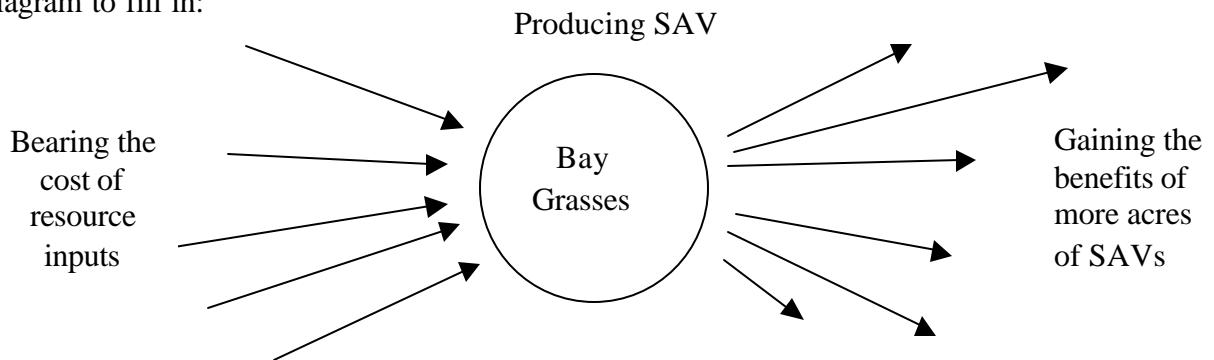
After students have completed their mobiles:

1. Explain to students that the next step in the activity is to consider the resources that must be used to increase the production of bay grasses.
2. Using the data table and map, identify areas in which underwater grass acreage has been increasing. Make a list of characteristics of the areas surrounding the tributaries for those sections. *(This “list” may be very general, based on students’ knowledge of their state. The purpose of the list is to get them to think about some of the things that might have caused the decline of bay grasses and what might have happened to reverse the decline.)*
 - What kinds of activities do you think might have caused the decline in grass acreage after 1900?
 - Are there rural areas with agricultural operations that might affect the bay grasses?
 - Are there urban areas with run-off and/or industrial use that might affect the bay grasses?
3. Make a second list of actions that might have been taken in recent years (or could be taken) to increase bay grass acreage. *(Again, this can be a general list, based on students’ general knowledge.)*
4. Review the definitions of the following terms: resources, land, labor, capital, and entrepreneurship.
 - What resources were used (or could be used in future efforts) to produce more bay grasses?

- Sort the items on your list into categories: land, labor, capital (and entrepreneurship – optional)
- Speculate on the other things that could have been produced using these resources.

5. Remind students that whenever we use resources to produce something, we can't use those same resources to produce something else. Therefore, we only use resources to produce things we believe will provide us with benefits that outweigh the costs of the resources we used. Point to students' mobiles as indicators of the benefits we expect when we use resources to produce bay grasses.

6. Instruct students to make diagrams showing the resources that go into the production of bay grasses and the benefits we expect to receive from using resources in that way. Label each resource input by name and by the type of resource (land, labor, or capital). You may wish to display a sample diagram or to give students a handout of a blank diagram to fill in:



7. Note: If you are participating in *Bay Grasses in Classes*, have students record the specific costs of raising and planting the grasses – the aquarium, water, student labor, transportation, etc. Help them to keep track of all resources used. Make the above diagram after they have completed the growing and planting project.

Lesson Title: What's In Your Lunch?

VA History and Social Studies Standards of Learning:

- CE.9a – opportunity cost

Economics Concepts and Vocabulary:

- Trade-offs
- Cost / benefit analysis
- Opportunity cost

Note: Of all the lessons in WAVE, this lesson requires the most modification to incorporate sound economic thinking and learning.

Terminology problems

The first problem is one of terminology, fortunately easily solved with some planning on the teacher's part. On p. 219, direction 4 for Part II, the words *limited* and *unlimited* are used to describe different types of renewable resources. Economists define all resources as limited, knowing that because of scarcity, it isn't possible to expand resources – no matter what the physical amount or how much we are currently using – to meet all human wants and needs. When discussing nonrenewable resources, avoid presenting any resource as unlimited. (Even if it seems unlimited now – as petroleum once did – who knows what use we'll invent for it in the future?) Instead, discuss with students how our demand for some resources makes them *more or less scarce* than other resources, but that even those we perceive as being less scarce – sand, for example - are limited.

The student directions in italics at the beginning of Part II (p. 227) also imply that only nonrenewable resources are limited. Again, it's worth reminding students that all resources are limited – whether renewable or not.

Trade-offs

The second problem is the lack of attention to the fact that packaging is a deliberate decision on the part of manufacturers, meaning that an analysis of benefits and costs was made. (We may not agree with that analysis, but it's important for students to consider it.) Expand question #3 in Part I, substituting the "Pros" and "Cons" labels on the graphic with "Benefits" and "Costs." Help students to see some of the benefits of packaging that may not be immediately obvious to them: protection during shipping, shelf life, sanitation, convenience, safety, portability.

Remind them that consumers purchase products packaged this way because they see some benefits. Help students identify the trade-offs. Examples help: Are students more likely to eat a sandwich kept fresh in a plastic bag, one wrapped in wax paper, or one not wrapped at all? (Is it better to throw away food or plastic bags?) Does it take more resources (water and soap) to reuse a plastic bag than to make a new one?

Teachers may want to look at *Facts, Not Fear* by Jane Shaw and Michael Sanera, for a more complete treatment of the solid waste issue and for activities to do with students to give them a more balanced view. The book clearly highlights many of the health benefits of packaging. It also suggests more powerful incentives for reducing packaging than just making people feel guilty about it. See the examples of municipalities that have reduced trash by charging by the bag.

Orange Juice: Fresh or Frozen?

Packaging may not be as wasteful as it seems. A simple activity will make this clear. Purchase a can of frozen orange juice concentrate and some fresh oranges. Have children make the frozen orange juice according to the package instruction and save all of

the packaging from the frozen orange juice. Then make the same amount of juice from fresh oranges. Save all the orange rinds as you make the juice.

Weigh the squeezed orange peels and compare them with the weight of the empty orange juice container (or just look at the space they take up). Ask the young people which form of packaging produces more waste that will go into a landfill.

(Michael's eight-year-old son Devin made twenty-four ounces of fresh orange juice, and had twenty-eight ounces of empty orange rinds when he was through. When he made the same amount of juice from concentrate, the only waste was the empty can, which weighed on e ounce.)

Once the juice has been fresh-squeezed, ask the children what happens to the skin and pulp. Of course, unless you have a compost pile, it will be thrown away. Tell them how commercial juice producers use the pulp and skin for animal feed, orange extracts, and flavoring oils. In the light of that reuse, which method of delivering orange juice is less wasteful?

“Orange Juice: Fresh or Frozen?” from Facts, Not Fear by Michael Sanera and Jane S. Shaw (Regnery, 1999), p. 189-90. Reprinted with permission.

The Case of the Disappearing Trash

Objective: Students work in small groups to analyze clues and solve a mystery. How did one community reduce its trash production while at the same time reducing its costs of trash collection?

Time Estimate: 30 minutes

Materials: Handout 1. Provide each group with a copy of the mystery in Handout 1. Distribute the clues separately. There are nine clues. Make enough copies of the clues in Handout 1 for each student to have at least one clue. With 27 students make three sets of clues and give each student one clue. With 30 students make four sets, divide the students into groups of seven to eight, and give some students two clues, and so forth.

Teaching Procedures

1. Explain that the purpose of this lesson is for students to sharpen their critical thinking skills by using clues to solve a mystery about garbage disposal.
2. Remind the group to think economically. People respond predictably to positive and negative incentives. When solving a mystery, show me the incentives! Read the mystery in Handout 1 to the class. Invite the students to speculate about what the solution to the mystery might be.
3. Divide the class into small groups. Ask each group to select a discussion leader. Give each group a copy of the mystery in Handout 1. Then put the groups to work with these instructions: A. Their task is to propose a solution to the mystery, explaining their solution by using economic reasoning. B. They should first decide which clues provide useful information. They are only to decide which clues are relevant to

solving the mystery. C. Hand each group member at least one clue. Each group member is responsible for evaluating the relevance of his or her own clue and for leading a discussion within the group of its relationship to the mystery.

4. Monitor the group discussion. You will probably find that many students will be eager to have their clues matter. Some will go to extremes of tortured logic to argue that their clues are crucial. Remind the students in these cases that this exercise involves sorting out the useful from the irrelevant. Not all information is of equal value.
5. Ask each group to report its solution to the mystery. Most trash collection systems do not reward people for putting less trash on the curb to be picked up. Thus collection costs tend to increase with population, as evidenced in clue 6. Clue 5 makes clear that the leaders of Perkasio decided to present their citizens with new alternative-setting incentives by reducing the garbage collection fee and establishing the special bag program. While most citizens favored the convenience of city garage pick-up, charging a fee for each bag provided an incentive for people to use the minimum number of bags. Of course, individuals still had choices. People who wished to use more bags could do so. However, clues 3 and 9 make it clear that most Perkasioans decided to economize on their use of bags, thus reducing the amount of trash to be collected as well as the cost.

Handout 1 The Mystery

The Philadelphia suburb of Perkasio was experiencing population growth. With more people, one would expect an increase in trash and increased costs related to trash collection. Instead, however, the citizens of Perkasio have reduced the amount of trash they produced and have reduced their garbage collection costs by 40 percent. How can this be?

The Clues

1. All the people in the world today could live within the boundaries of Texas, with a standard-sized suburban house for a family of four.
2. The first law of garbage is that everyone wants you to pick it up, and nobody wants you to put it down.
3. In 1987, the town of Perkasio collected an average of 2.2 pounds of trash per person per day. In 1988, trash collection in Perkasio fell to 0.9 pounds per person per day.
4. In the late 1980's, the citizens of Philadelphia suburbs were faced with rising garbage collection fees because of declining local waste disposal space.
5. In 1988, Perkasio eliminated their \$120 per year garbage collection fee and declared that only garbage set out in specially marked bags would be picked up by the city. The bags were relatively inexpensive – the 20-pound size sold for \$.80 and the 40-pound bag for \$1.50.
6. Neighboring boroughs increased yearly garbage fees by 900 percent. Average pounds of trash collected per person per day continued to increase.

7. In 1980, 81 percent of solid waste went to landfills. By 1990, only 67 percent went to landfills.
8. According to A. Clark Wiseman, an economist at Gonzaga University, “At the current rate, if all the nation’s solid waste for the next 500 years were piled or buried in a single landfill for a depth of 100 yards...this ‘national landfill’ would require a square site less than 20 miles wide on a side. With compaction, even this volume could be reduced.”
9. The average Perkasian household paid 30 percent less for garbage disposal in 1988 than it paid in 1987.

“The Case of the Disappearing Trash,” by Kathy Ratté, reprinted from *Environmental Examiner* (Spring 1997), published by PERC—The Center for Free Market Environmentalism. Reprinted with permission.

Inaccuracies

Third, despite its obvious good intentions, this lesson contains a number of factual inaccuracies that should not be passed along to students. The first column of the teacher background on page 218 contends that trees are “being consumed faster than they can be replaced.” This is clearly not the case in the United States, and not in the developed nations of the world, generally. As Bast, Hill, and Rue noted in their 1994 publication, *Eco-Sanity*:

In all the developed countries in the world, including the U.S. and Canada, forestry is now conducted on a *sustainable yield* basis, whereby growth exceeds harvests. Not only does this ensure future supplies of wood and wood fiber products, but it also creates habitat for a wide array of wildlife and protection for many plant species. (p. 24.)

According to the U.S. Forest Service, annual timber growth in the U.S. now exceeds harvest by 37 percent. Annual growth has exceeded harvest *every year since 1952*. . . . As a result of growth steadily exceeding harvests, the number of wooded acres in the U.S. has grown by 20 percent in the past 20 years. (p. 23)

And,

During the past fifty years there has been very little net change in the total wooded area of the world’s temperate regions—Europe, North American, and parts of Asia—which together account for approximately half the wooded area of the world. This is true despite a dramatic growth in the amount of wood taken from temperate forests, testimony to the success of plantation forests and sustainable yield forestry techniques. (p. 82)

(This chapter goes on to talk about very real threats to forests in the developing world, which should not be ignored. However, the existence of those threats doesn’t justify implying to students that the threats exist in the United States as well.)

Question #5, Part II student worksheet, p. 228 – The work of Julian Simon and other resource economists has established quite firmly the inaccuracy of the prediction that we will run out of mineral resources. This idea, which is perpetuated in popular doomsday writing, like that of Paul Ehrlich (*The Population Bomb*) neglects to mention that the *supply* of a resource is not the same as the absolute *amount* that exists in nature and that, as has been shown historically time and again, prices act to prevent the depletion of resources. Teachers are referred to the article, “Betting the Planet” for a full discussion of the debate between Ehrlich and Simon which outlines the misconceptions of those who forecast resource depletion.

The last line of student direction #5 displays more emotion than logic, worrying students that we might use “nonrenewable resources faster than they can build up.” Common sense suggests that if they’re nonrenewable, they won’t build up, and a more fruitful approach would be to consider what factors will determine the rate at which we use nonrenewable resources.

Suggested Lesson Modifications:

Rewrite the worksheet questions to:

- Rewrite definitions (renewable, etc.) so that they don’t conflict with economic definitions.
- Rewrite student handout questions to incorporate consideration of the costs of actions that reduce solid waste
- Remove factual inaccuracies from student handout questions.

Lesson Title: What’s Hanging Out in the Yard?

VA History and Social Studies Standards of Learning:

- CE.9a – choice, opportunity cost

Economics Concepts and Vocabulary:

- Trade-off
- Opportunity Cost

Note: Question 3 on page 376 allows you to review **trade-offs (opportunity cost)**. Note with students that land is a **scarce resource** and we have to choose how to use it, giving up or reducing other potential uses.

After separating the limitations on biodiversity into “natural” and “man-made,” consider the man-made list. Limiting biodiversity was a cost of constructing the man-made things, but people don’t bear costs unless they perceive that the benefits will outweigh the costs.

- What benefits do you suppose were anticipated in creating each of the man-made items? *Help students to see that the man-made items were not constructed to deliberately restrict biodiversity. In some cases, the biodiversity cost was*

acknowledged but felt to be less important than the benefits. In other cases, people may accept the cost to biodiversity because of lack of information or because of their own values.

- Do you think our perception of the benefits and costs of limiting biodiversity by building each item have changed since the time it was built? In what way? How do you know? *As we have come to learn more about biodiversity, we have come to value it more. We have evidence of that value in the very fact that we often survey for biodiversity before deciding where to build and develop. Also, studies show us that as people become wealthier, they tend to value environmental amenities more, so it may be that where once we would have willingly traded off habitat for a shopping mall, we're now less likely to bear that cost.*

Other connections to economics and social studies would be forced – i.e. the mention (p. 376) of man-made elements of the school yard could be used to review the definition of capital goods as “man-made goods used to produce goods and services – e.g. buildings, machines, and tools,” but this seems a disruption rather than an enhancement of the lesson.

Suggested Lesson Modifications: none

Sixth Grade

- 6.1 The student will plan and conduct investigations in which
- * a method is devised to test the validity of predictions and inferences;
 - * data are organized and communicated through graphical representation (graphs, charts, and diagrams); and
 - * models are designed to explain a sequence.
- 6.2 The student will demonstrate scientific reasoning and logic. Key concepts include
- * ideas are investigated by asking for and actively seeking information;
 - * multiple tests of ideas are performed before accepting or rejecting them;
 - * alternative scientific explanations are analyzed; and
 - * conclusions are based on scientific evidence obtained from a variety of sources.
- 6.11 The student will investigate and understand public policy decisions relating to the environment. Key concepts include
- * management of renewable resources (water, air, plant life, animal life);
 - * management of nonrenewable resources (coal, oil, natural gas, nuclear power); and
 - cost/benefit tradeoffs in conservation policies.

Lesson Title: When Rain Hits the Land

VA History and Social Studies Standards of Learning:

- CE 9a – opportunity cost

Economics Concepts and Vocabulary:

- Opportunity cost
- Trade-offs

Note: Adding economics to the experiment activity, itself, would be distracting. However, there is an important economics lesson in the student reading. It bears revisiting the reading for a second, shorter lesson after students have completed the experiment.

The use of **resources** in **production** is both important and inherently ethical and teachers can use the reading that accompanies the student activity to remind student that this is the

case. Sentences like: “Most of us blame pollution and its effect on large industries . . . In reality, we’re all responsible.” and “All of us – in our everyday activities – are polluters.” have the potential to mislead students into thinking that pollution is a sin rather than a problem that occurs as a result of people engaging in acceptable and valuable activities. The key to facing pollution as a challenge rather than as the result of bad people doing bad things is the economic concept of **opportunity cost**.

Because of scarcity we always face **trade-offs**. Our **resources** are limited and to use them in one way precludes other uses. We give up our “next-best alternative,” and in doing so, we bear an **opportunity cost**. If we choose to build streets and parking lots, we bear the cost of the lost ability to prevent run-off and the associated pollution. However, it is equally important to point out that if we choose not to build streets and to gain the benefits of less run-off, we bear the opportunity cost of the lost benefits of the streets.

If students understand that pollution is the unavoidable result of production, then they begin to understand that “no pollution” is neither possible nor desirable, and they turn to the more important question of how much pollution we’re willing to bear and what benefits we’re willing to trade-off in order to reduce pollution.

Suggested Lesson Modifications:

After students have read the handout, “Do You Know What Happens When It Rains?” engage the class in a discussion of the questions below.

1. Give me examples of activities that create pollution. *Expect students to begin with people doing bad things – dumping toxic waste, etc. Acknowledge that those are clearly pollution (and also violations of the law), but extend their thinking by asking about the activities that created the toxic waste in the first place. Nuclear generating plants, paint factories, dry cleaners, cars – all create pollutants.*
2. Can we create a generalization about what causes pollution? *Production causes pollution.*
3. Is pollution a crime? Is it wrong to pollute? *The answer is both yes and no. Some kinds of pollution are crimes. You may be able to point to examples in your own community. Others clearly are not. Students should begin to see that pollution is the result of production.*
4. Can pollution be a good thing? *Yes. Production creates goods and services that make people’s lives better. The farmer who fertilizes his fields provides people with food. Unfortunately, some of the fertilizer runs off his land during rain storms and becomes pollution.*
5. Should it be our goal to have no pollution? *No – No pollution means no production.*
 - If our goal was no pollution, what would we have to give up? *Producing goods and services to satisfy our wants and needs.*

6. Economists tell us that we make trade-offs. Because our resources are limited, we have to give up some things in order to have others. How is pollution an example of a trade-off? *We give up some cleanliness in order to get goods and services we want.*

7. An **opportunity** cost is the benefit of the alternative we give up. Look at the last paragraph on page 24 of the handout. It lists all the ways in which we pollute. What is the opportunity cost we would bear if we gave up the items on the list? In other words, what benefits would we give up by not using:

- Detergent *the health and appearance benefits of clean clothing and dishes*
- Fertilizer *the benefits of more abundant and cheaper food*
- Pesticides *the health benefits of fewer mosquitoes, the agricultural benefits of healthier, more abundant crops*
- Paint *the benefits of protecting wooden housing from rot and decay*

8. Now look at the last paragraph in the second column on page 25. It says, “Ninety-five percent of us live within an hour’s drive of a publicly owned lake, and 70 percent are similarly close to coasts. The water we have used (and the waste it carries) finds its way back to these waters, eventually limiting recreational opportunities for all, and usually destroying the area’s economic base – marinas, resorts, restaurants, fishing and hunting suppliers.”

- What’s the **opportunity cost** of allowing these public waterways to become extremely polluted? *The lost recreational opportunities, failed businesses*
- What would we have to do to eliminate pollution of these waterways? *Prohibit all use.*
- What would be the **opportunity cost** of prohibiting all use? *The same as the cost of allowing it to be severely polluted – the lost recreational opportunities and business opportunities.*

9. It looks like the pollution problem we face is really a trade-off problem. What is the trade-off? *Pollution vs. production*

- In the experiment you just conducted, what did you find out about the trade-off that occurs when production results in less permeable land surface? What is being produced that creates more pollution. *The trade-off is that less permeable land surface increases run-off pollution. The production that causes this is production of things that make people’s lives better – housing, shopping areas, streets, etc.*

10. Is it realistic to make NO Pollution our goal? Why or why not? *It’s not realistic. The opportunity cost is too high. We’re not willing to accept the trade-offs.*

11. Does this mean that we shouldn’t look for the causes of pollution or try to reduce it? *No, but it does suggest that we have to consider the trade-offs.*

12. Economists would say that the important question to ask ourselves is not “How do we eliminate pollution?” but “Knowing the opportunity costs we must bear, how much

are we willing to reduce pollution?” Give examples of pollution problems where you think the trade-off for reducing pollution is acceptable and examples where you think the cost is too high. Here’s an example:

- Acceptable: Clean up after my dog every day, and carry a pooper-scooper when I take him to the park.
- Unacceptable: Outlaw dog ownership in the community.
- Acceptable: Get regular maintenance checks on my car to prevent oil leaks. OR Pass laws requiring car manufacturers to increase pollution control on new cars (even though it may make new cars more expensive)
- Unacceptable: Get rid of my car.

Encourage students to use the water polluting examples from the handout – oil, paint, pet waste, etc. – and help them to see that the trade-offs don’t have to be all-or-nothing. Incorporate the 3 suggestions at the end of the article as ways for individuals to make choices about the costs they are willing to bear or the trade-offs they are willing to make in order to get the benefit of improved water quality. Also, take the opportunity to point out that individuals will differ in the costs they’re willing to bear and in how much they value the benefit of improved water quality.

Lesson Title: Sediment Impediment

VA History and Social Studies Standards of Learning:

- CE.9a – opportunity cost

Economics Concepts and Vocabulary:

- Cost/benefit analysis

Note: Any activity that asks students to consider alternative courses of action provides the opportunity to remind students that there are **costs** to their actions, and that it is important to weigh the **benefits** and **costs** before choosing an alternative.

Suggested Lesson Modifications:

7. After students have generated their lists (questions 6 and 7) create a master list on the blackboard or overhead.

a. Choose one item on the list (planting vegetation along the stream in the schoolyard, for example) and in a large group discussion, ask students to identify the costs associated with this course of action. (This cost list need not be in dollar terms. “Buying the plants,” “time spent putting them in,” “fencing or other barriers to keep people off,” are all acceptable cost items.) Note the costs on the board.

- b. Rate the benefit of this action in terms of reducing sediment run-off, using a 5 point scale from “very little” to “very great.” Note the rating next to the cost list. Discuss whether this level of benefit is worth the cost or whether another alternative might be a better course of action. (Help students to see that the least costly alternative or the alternative with the highest benefit may not be the best choice in terms of resource use.)
- c. Ask students, working as partners or in small groups, to make the same analysis of 3 other alternatives and then to recommend which alternative course of action should be taken.
- d. Have groups report their conclusions to the class. Discuss to reach consensus on the best alternative.
- e. Emphasize in closure that scarcity means we want to use our resources in the best way, and that cost/benefit analysis helps us to do this by identifying the alternative with the greatest benefits over costs.

Lesson Title: Bay Buffers

VA History and Social Studies Standards of Learning:

- CE.9a – opportunity cost

Economics Concepts and Vocabulary:

- Marginal

Note: The quote from Tom Horton’s *Turning the Tide* can be used to reinforce the understanding that pollution generally results from beneficial activities and that zero pollution is not a realistic or desirable goal. (The economics addendum to “When Rain Hits the Land” addresses the **opportunity cost** of no pollution.)

Additionally, if your students responded well to the introduction to **marginal analysis** in “How Hard Is Your Yard,” you may want to take their understanding of this tool one step farther.

Suggested Lesson Modifications:

7a. We’ve been considering sediment as a pollutant because of its potential to damage the Chesapeake ecosystem. We’ve learned in earlier lessons that pollution is generally the result of a beneficial human activity - production. What kinds of production generate sediment pollution? (*agriculture, logging for lumber to build homes, raising cattle for milk and beef, paving to create transportation, etc.*)

7b. Increased sediment is one of the costs we bear in producing the goods and services you identified in 7a. We can change production in order to reduce sediment. Some

changes, obviously, are easier and less costly than others, but we can find ways to create less sediment. According to Tom Horton, should our goal be to reach the level of 0 sediment? Why or why not? (*some sediment is beneficial to the bay ecosystem, and zero "pollution" would damage the bay*) Economically, we know that's true, too, because no pollution would mean no production.

7c. In the lesson "How Hard Is Your Yard?" you learned the term *marginal* to mean *additional* and you also learned that *additional benefits* meant bearing *additional costs*. Think about Tom Horton's quote and think about what you know about the trade-offs associated with reducing pollution. Tom Horton is telling us that Bay clean-up is a marginal problem we need to think about how much *additional* sediment reduction is best for the Bay ecosystem."

Now it's your turn to think marginally. Suppose that you're in charge of creating buffer zones in the watershed. How can marginal analysis help you do your job? List some marginal analysis questions you should ask yourself.

Examples include:

How much more buffer does it take to reduce pollution an additional 1%?

How much more / less is sediment reduced by planting 10 acres of buffer along river X than river Y?

Are some species of trees more able than others to reduce sediment? How much more do they cost? How much more benefit do they give?

Lesson Title: Schoolyard Report Card

VA History and Social Studies Standards of Learning:

- CE.9a – choice, opportunity cost
- GOVT.16c – environmental issues

Economics Concepts and Vocabulary:

- Cost / benefit analysis

Note: The school report card is based on the assumption that we are not willing to bear the **opportunity cost** of our current lifestyle in terms of its impact on the water quality in Chesapeake Bay. From an economic perspective, filling out the report card is a way to determine what conditions are causing that cost to mount to unacceptable levels – the worse the report card score for an identified factor, the more that factor is contributing to the degradation of the Bay. Incorporate the economic perspective when you introduce and set up the lesson by noting with students that the activity is based on the assumption that the **choices** people are currently making (driving to school, for example) or choices that were made in the past (paving the parking lot) are imposing a cost that we are no

longer willing to bear (the declining water quality in Chesapeake Bay). Our purpose in filling out the report card is to find ways to reduce that cost.

It is equally important that students understand that improving the schoolyard’s report card score cannot be made without imposing new costs and that the determination of what they can “actually accomplish” will rest partially on both their and others’ willingness to bear the new costs. Modify Part II of the activity to include acknowledgement of what those costs will be and who will bear them.

Suggested Lesson Modifications:

2.a. (page 386) Add three columns to the chart, or number the solutions on the original chart and then make a second one, as shown below. Have students work with partners or individually to fill in the second chart. (*The example of getting people to adopt one water-saving device is listed for you.*)

Solution #	(Benefit) Anticipated change in report card score	Cost of this change (monetary and non-monetary)	Who will bear these costs?
<i>#example – getting half the people at school to adopt 1 water- saving device</i>	<i>from 0-5</i>	<i>\$20 for posters and a pre and post survey Time and attention that could be spent on other things</i>	<i>- classmates will contribute 25¢ and ask PTA for \$10 - everyone</i>
#1			
#2			
#3			
#4			
#5			
#6			

2b. Put a check mark next to the solutions numbers for which you believe the benefits are worth the cost.

2c. Do you think other people are likely to agree with you that the benefits of the checked solutions are worth the cost? (Hint: pay attention to who is bearing the cost.) If you think they will agree – and that therefore your solution will work – circle the item.

2d. Total the benefits (improvement in report card score) and the costs of the solutions you've circled. Consider these elements as part of your school improvement plan.

3. No changes to question.

4. Add to the question: How did your analysis of the benefits and costs of the solutions affect your decision about what you can actually accomplish?

5. Add to the question: In your letter to the principal, don't forget to use your analysis of the benefits and costs to persuade him to help you make your improvements happen.

Seventh Grade

LS.1 The student will plan and conduct investigations in which

- * interpretations from the same set of data are evaluated and defended.

LS.12 The student will investigate and understand the relationships between ecosystem dynamics and human activity. Key concepts include

- * environmental issues (water supply, air quality, energy production, and waste management).

Lesson Title: How Hard Is Your Yard?

VA History and Social Studies Standards of Learning:

- CE 9a - cost

Economics Concepts and Vocabulary:

- Marginal analysis
- Marginal

Note: The concept of the “**margin**” a little more or a little less is extremely important in economic reasoning. One of its most important applications in environmental issues comes when we’re trying to answer the “how clean is clean enough?” problem.

Decisions about pollution clean up are made easier by comparing the *marginal* costs and *marginal* benefits of the next stage in the project in stead of just comparing total costs and total benefits. If, for example, we find that spending an additional \$1 million will provide an estimated \$5 million in benefits, it’s clear that the additional clean up effort will be worthwhile. When we find that an additional \$1 million expenditure would only provide \$250,000 in estimated benefits, then we have to stop and ask ourselves if the \$1 million expenditure could produce greater benefits used in another way – even though the totals tell us that spending \$2 million will generate benefits of \$5¼ million.

“How Hard Is Your Yard?” is an opportunity to introduce marginal analysis. Asking students to identify the marginal differences in the percolation rates of the various surfaces will prepare them for marginal applications in economics in later lessons.

Suggested Lesson Modifications:

Add Part III to the student worksheet:

Part III

1. In the chart below, list the 4 surfaces you tested, in order of their percolation rates, from slowest to fastest.

Surface	Percolation Rate	Increase
A.		
B.		_____
C.		_____
D.		_____

2. Calculate the difference in the percolation rates from each surface to the next. Enter the increases on the appropriate lines in the “Increase” column.

3. The word “marginal” means “additional.” For which of the changes above was the marginal percolation greatest? (circle one)

- From A to B From B to C From C to D

4. Look around the school yard and make a mental estimate of the amount of surface area in each of the 4 categories you tested. Suppose that you wanted to decrease run-off on the school ground and you could only change one surface area AND you could only upgrade it to the next level on your chart. What change would you make and why?

It’s not necessary for students to make calculations. Look for understanding of the impact of the margin in student’s answers. For example, a student might say that although there is relatively little cement on the school yard, the marginal increase in percolation from cement to gravel is huge, so it would be worthwhile to take out the sidewalks. Or, a student might say that the margins are so close to being the same from A to B, B to C, and C to D, that the best choice would be to upgrade B to C because there is more of C.

5. (optional) This is also a good place to review opportunity cost. Ask students, “Other than the cost of the materials, what are the opportunity costs of replacing A with B?” *For example, replacing sidewalk with grass to reduce run-off might mean giving up the benefits of being able to keep your shoes dry on rainy days.*

Lesson Title: Wetlands Work

VA History and Social Studies Standards of Learning:

- CE.9a – resources, production
- GOVT.15c – factors of production

Economics Concepts and Vocabulary:

- Resources
- Production
- Goods
- Services

Note: The scientific study of a **resource** is compatible with the economic study, as it is the characteristics of the resource which help to determine how it is used in **production**. As students consider the characteristics of wetlands, they can also consider how our demand for the goods and services we “produce” using wetlands has changed as we have come to appreciate the environmental value of this resource.

Suggested Lesson Modifications:

1. After students read the handout, “Chesapeake Wetlands,” ask the class whether wetlands are an economic resource. Accept a variety of answers, requiring students to give reasons to support their opinions.
2. Remind students that resources are used to produce goods and services that people want and need. Does this definition change your answer to the first question?
3. What are some of the goods and services that wetlands resources help us produce? *Many are listed in the reading. Point out that most on the list are services – bird-watching, etc. Also point out that some wetlands are productive by remaining wetlands, but others are productive by becoming something other than a wetland. Wetlands have been used to produce houses and highways; the land was drained and built-up so that it satisfied different wants and needs than it did as a swamp or bog.*
4. Are all wetlands the same in terms of ability to produce goods and services? *No – the reading and the wetlands classifications cards should help students to realize that different types of wetlands are productive in different ways – some for canoeing, some for hunting, some for birding – possibly even some for draining and building something on.*
5. How do we decide what goods and services should be produced by using wetlands resources? *Answers will vary, but students should begin to connect the destruction of wetlands to the trade-offs that occur in deciding what we want to produce with our resources. Help them to understand that, thanks to growing scientific knowledge, we now place greater value on wetlands as habitat, open space and buffers, whereas in the past we placed little value on those uses of the resource, preferring to alter its character to produce such things as places to put houses.*

Lesson Title: Wetland Clues (Down and Dirty)

VA History and Social Studies Standards of Learning:

- CE.9a – choice, cost

Economics Concepts and Vocabulary:

- Opportunity cost
- Trade-off
- Cost / benefit analysis

Note: The student letter-writing task is already set up as a **cost / benefit** activity. You can improve the economic perspective of the lesson simply by making sure that students identify cost as explicitly as they identify benefits.

Suggested Lesson Modifications:

Add to direction #8, Part 1 of the student direction sheet:

- Identify the costs you believe will be associated with your recommendation for the donated property. Include not only a list of modifications or improvements (you need not estimate prices, just list the item) but also the opportunity cost (the next-best, alternative use that must be given up).
- Explain why you think that the benefits you've identified are worth the costs.

Optional addition to Part 1:

12. Divide the class into 4 groups, each group representing the school board. Distribute to each group ¼ of the letters, not including any of the letters of the group members.

Instruct the school board to review the proposals.

- Make a chart that allows you to compare the costs and benefits of the proposals submitted to you.
- Rank the proposals in terms of greatest benefits over costs.
- Identify the best alternative and the next-best alternative.

Be prepared to announce your choice (the best alternative) and to explain why you think it's worth bearing the cost (not being able to do the next-best alternative).

Lesson Title: Animal Poop: What's the Scoop?

VA History and Social Studies Standards of Learning:

- CE.9a – scarcity, incentives, demand, supply, price
- GOVT.14c – gov't and economic choice
- GOVT.16c – environmental issues

Economics Concepts and Vocabulary:

- Scarcity
- Choice

- Incentives
- Demand and Supply
- Price

Note: This activity does a good job of pointing out that we always face **scarcity** and therefore must make choices, but it misses the chance to use that terminology.

Suggested Lesson Modifications:

In discussing the problem with students before they take on their role assignments and before they complete the chart on p. 285, ask the following questions:

1. What's scarce in this situation? What choice are people forced to make because of this scarcity? *(The scarcity of land creates the original problem – were there more space, the chickens would be spread out, the chicken poop wouldn't pile up where it could be washed into the rivers, etc. If we choose to use the land for other things – space for housing, for example, there is less for chicken farming.)*
2. What are the alternatives? What is the opportunity cost of each alternative? *One of the important omissions in this activity is that students consider only the problems created by poultry production. Chicken farming doesn't just produce poop; it also produces chicken, which we value a great deal.*

It's always important to consider the opportunity cost of our decisions, and to recognize that choices we make have consequences – benefits for some people, burdens for others. The chart on page 285 can be extended so that students consider the consequences of the alternative choices, and the incentives individuals have for accepting or rejecting each alternative.

Review or introduce simple definitions of:

- Incentives – rewards or punishments that influence behavior,
- Supply - the amount made available for sale at various prices, and
- Demand – the amount consumers want to buy at various prices

3. Point out to students that each of the solutions on the chart will affect the supply of poultry and that none affects demand. Add a 5th column, labeled “What happens to the production cost and the supply of chicken?” *(For most alternatives, the production cost increases. Students may want to evaluate the amount of the likely increase – a little, a great deal, etc.)*
4. Add a 6th column asking: “Who bears the burden if this solution goes into effect?” *(You may have to help students figure out which costs will be borne by the producers in the form of less profit and which will be passed along to consumers in the form of higher prices and/or less chicken available at the grocery store.)*
5. Add a 7th column asking students whether either Farmer Joe or Poultry, Inc. have an incentive to accept this proposal. *(It's important to talk about an individual farmer and a*

specific company. “Farmers” don’t decide; each farmer does. The poultry “industry” doesn’t decide; the directors of each company do.

Eighth Grade

PS.1 The student will plan and conduct investigations in which

- * valid conclusions are made after analyzing data;
- * research methods are used to investigate practical problems and questions; and
- * experimental results are presented in appropriate written form.

Lesson Title: Oysters and a Clear Bay

VA History and Social Studies Standards of Learning:

- CE.9a – supply and demand, price
- CE.10d – Virginia economy, technological innovation
- GOVT.15d – supply and demand
- GOVT.15f – impact of technological innovation

GOVT.16c – environmental issues

Economics Concepts and Vocabulary:

- Demand shifters (determinants of demand)
- Supply shifters (determinants of supply)
- Market price

Note:

Part II. All the ingredients for reviewing **supply** and **demand** are included in the handouts for this lesson. If your class is relatively new to economic analysis, use the timeline to help them distinguish between supply and demand changes in the oyster market. If students have experience with supply and demand graphs, page 83 is an excellent source of practice problems.

Part III. This is an important reinforcement of **cost / benefit analysis** and a good example of the application of content in economics to problems in science. From an economics perspective, the cost / benefit analysis in the activity is incomplete, but this omission can be easily remedied in debriefing.

Suggested Lesson Modifications:

Review with students the supply and demand shifters (also known as the determinants of supply and the determinants of demand):

Demand Shifters	Supply Shifters
<ul style="list-style-type: none"> • Changes in income • Changes in tastes and preferences 	<ul style="list-style-type: none"> • Changes in the price and/or availability of resources

<ul style="list-style-type: none"> • Changes in the prices of substitutes and complements • Changes in population (the number of consumers) 	<ul style="list-style-type: none"> ○ Including natural events • Changes in the price of substitute goods producers could provide • Changes in the number of producers
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With the class, generate examples for each of the categories, using any Bay economic product other than oysters.

Amend question 8, page 80 as follows:

8. a. Choose 2 events from the timeline on page 83, one which you believe changed the supply of oysters and one which changed the demand for oysters.

8. b. Which of the demand shifters was responsible for the change in demand you identified in 8a?

8. c. Based on the harvest data and descriptions on pp. 82-3, predict what happened to the price of oysters as a result of this change in demand. (optional) Draw a graph to illustrate and support your prediction.

Note: The descriptions in the timeline sometimes include changes in both supply and demand. Proficient students should be able to isolate one of the changes and predict the price change caused by either a supply shift or a demand shift. Don't be surprised, however, if advanced students can take changes in both into account. For example, a student might argue that the reduced supply of oysters during WWII didn't cause a big price change because demand fell at the same time, so even though there weren't as many oysters for sale, it didn't matter because not many people had money to buy them.

8.d. Which of the demand shifters was responsible for the change in supply you identified in 8a?

8.e. Based on the harvest data and descriptions on pp. 82-3, predict what happened to the price of oysters as a result of this change in supply? (optional) Draw a graph to illustrate and support your prediction.

Note for question #9. The question uses the word “scarcity” as it’s used in everyday conversation rather than in its economic sense. You may want to point out to students that the scarcity of oysters is not new; oysters have been scarce since man first wanted to eat them. A better term, economically, for this question is “the increasing scarcity.”

An optional addition to the question might be to have students consider whether the increasing scarcity of oysters will *necessarily* cause a rise in the price of oysters. *The correct answer is No, because price results from the interaction of supply and demand. If, for some reason, the demand for oysters falls – people decide that oysters give you bad breath for example, then the price may not rise even as the supply diminishes.*

Part III

Question 4. Questions 1-3 lead students to approach the cost / benefit analysis in question 4 (using the chart on page 87) in terms of the efficiency of the mechanical and oyster filters in their experiment.

Use the “Expenses” row in the chart to help students think about the bigger picture of the costs involved. Don’t overwhelm them with the enormity of the task or undermine their creative efforts with the filters, but do ask them to consider the how big the job is and that the short term and long term outlooks may differ.

Ideas to bring up in discussion of the expense:

- The “cost” of filtering the bay with oysters is not, of course, simply the current seafood shop price of oysters, but the cost of restoring habitat.
- The costs of filtering the bay mechanically aren’t just those of building the filters. What happens to the price when the size is greatly increased? Is there a cost in terms of the view, for example, to having the Bay mechanically filtered? What about the resources used to build the filters – could they be used elsewhere?
- Once a filtering mechanism is chosen, another question – restoring habitat to what level? – must be asked and answered. To the level of 1800 or does the Bay have to be that clean?

Lesson Title: Nutrient Nuisance

VA History and Social Studies Standards of Learning:

- CE.9a – opportunity cost

Economics Concepts and Vocabulary:

- cost

Note: Students sometimes have the impression that the changes necessary to reduce pollution are just “common sense,” leading them to the (spoken or unspoken) assumption that the reason changes aren’t made is that people aren’t good or just don’t care enough. WAVE lessons do a good job of pointing out that pollution results from activities and production we value. To reinforce students’ awareness of this **trade-off** and to add another dimension to their understanding, take opportunities provided by the readings and handouts to highlight the **costs** that may stop people from implementing “common sense” changes.

Suggested Lesson Modifications:

After students read the *Nutrient Pollution* fact sheet and before they start Part II of the worksheet (or in conjunction with large group debriefing of question #4), initiate a discussion of opportunity cost.

1. Review with the students the definition of opportunity cost and ask class members to generate examples.
2. Explain to students that there are 3 important characteristics of cost:
 - Costs are the results of actions. *(Costs don't just exist. They occur when people make choices about the use of limited resources. Making a choice means giving up the next best alternative.)*
 - Costs are TO someone, and only people bear costs. *(Things have no cost, in and of themselves. It's important to identify who bears the burden of costs; it may not always be readily apparent.)*
 - Costs lie in the future. *(We make choices on what we think the costs will be – but there's always some uncertainty, and we don't bear the costs until after the choice is made.)*
3. Let's look at the alternatives for reducing nutrient pollution that are mentioned in the handout and analyze the costs. Skim back through the "Correcting the problem" and "Signs of progress!" sections of the "Nutrient Pollution" handout and find the examples of actions that reduce nutrients. *(List on the board as students identify: farm nutrient management plans, forest buffers, manure pits, fertilizer application improvements, storm water management ponds in new construction projects, upgrade to Washington D.C. sewage treatment plant)*
4. Remember that costs are TO someone. For each of the projects listed, identify who bears the cost.
 - Agricultural runoff reduction – *all the plans are costly to the farmer. Because farmers compete with other farmers, you can understand why they may not want to pay the price for the improvements if other farmers aren't doing the same thing. If farmers are required (by law) to pay for them, the price of the food they produce will increase, meaning that people who eat the food (you and me) will eventually bear the burden of these improvements. Explain to students that while it seems fair that the people consuming the product that causes the pollution pay to reduce the pollution, higher prices for food will be harder for some people to pay than others.*
 - Construction runoff - *same general reasoning as above. One producer won't do it if competitors not required to. Ultimately, home owners pay higher prices.*
 - Sewage treatment plant – *probably paid for by municipal taxes and/or higher rates. If higher rates, users will see that they are paying. If taxes, users may not realize that they are paying and that other things (potholes?) aren't being done because of the treatment plant improvements.*

Lesson Title: The Solution to Pollution May Not Be Dilution

VA History and Social Studies Standards of Learning:

- CE.9a – incentives
- CE.11c – impact of government programs (in optional extension to lesson)
- GOVT.15f – impact of technological innovations
- GOVT.16c – environmental issues

Economics Concepts and Vocabulary:

- Incentives

Note: This activity provides a great opportunity to talk about **incentives** and to consider why development of water-saving strategies generally has not produced significant changes in people’s behavior. While public-relations campaigns provide incentives that shouldn’t be under ignored, they generally have a hard time overcoming the **costs** – both monetary and non-monetary - that people must bear if they change their water use habits. Whether we like it or not, the reality is that **price** is a very powerful incentive and one often overlooked in our water conservation campaigns.

Suggested Lesson Modifications:

1. After students fill out the charts on page 295, ask them to list the **non-monetary costs** of adopting water-saving habits.

2. Define **incentives**: rewards or punishments for behavior

3. Ask students to list the **incentives** they have to:

- Adopt water-saving devices
- Continue old habits and not adopt water-saving devices

4. Transition into Activities #1, “When Is A Basketball a Substitute for Water?” in PERC’s *Are We All Wet?* curriculum. (This lesson has students compare the effectiveness of different incentives including a variety of price changes for changing water use.)

OR

Ask students to recalculate the chart at the top of page 295, first doubling and then tripling the price of water.

5. Comment that all the water saving methods listed on page 294 have an accompanying opportunity cost.

- How does an increase in the price of water affect your willingness to adopt the items on the list?
- Put a check mark next to any items you think you would do now that you know they save water.
- Put an X next to any items you think you’d do if the price of water doubled.
- Put a star next to any items you think you’d do if the price of water tripled.

6. (optional) This activity doesn't deal with the larger issue of whether or not household savings would make a significant impact on water usage. You can extend the activity by offering students information about agricultural use and the incentives provided by water subsidies to agriculture to help students gain a more accurate "big picture." Nationally, about 85% of water use is in agriculture, and while careful personal use of water is certainly an admirable habit, it's important not to mislead students into thinking that reduced household use will solve water shortages. Assign students to research a list (similar to that on page 294) of water-saving alternatives in agriculture and then discuss what kinds of incentives might convince farmers to adopt them.

Lesson Title: Testing the Waters

VA History and Social Studies Standards of Learning:

- CE.9a – choice, opportunity cost

Economics Concepts and Vocabulary:

- Cost / benefit analysis

Note: Don't force connections to economics. The focus of the activity is on the collection and analysis of data. Other 8th grade lessons from the WAVE unit are better suited to active development of economic concepts. Do use discussions to incorporate economic concepts – like **cost/benefit analysis** – that students have already studied and find familiar.

Suggested Lesson Modifications:

In the class discussion of Part II, questions 4 and 5 (p. 358) encourage students to identify what their data indicates about the variety of alternative uses for water as a factor of production (or "land" resource), and to consider how the quality of that resource affects its potential usefulness.

Additionally, whenever students are discussing action plans, it is pertinent, and important, to ask them to consider the costs and benefits of the different alternatives before they choose a course of action. If your class will be choosing an action project, formalize this process, creating a blackboard chart listing the costs and potential benefits of the various student proposals.

Lesson Title: Development Dilemmas

VA History and Social Studies Standards of Learning:

- CE.9a – scarcity, choice, opportunity cost
- GOVT.14c – individuals' freedoms and gov't policies

Economics Concepts and Vocabulary:

- Trade-off

- Opportunity cost
- Scarcity

Note: The teacher background to the lesson makes the important point that development is an important and legitimate use of land. However, the options suggested in the teacher background are somewhat limited. An excellent source for quickly adding to your knowledge of additional research and creative ideas about growth and development is a series of readings collected by the Heritage Institute and the Political Economy Research Center (PERC), called *A Guide to Smart Growth – Shattering Myths, Providing Solutions*. The short chapters in the collection provide information on a variety of topics connected to issues of development. For example:

- Recent research has raised questions about the ability of the development strategies collectively known as “Smart Growth” to deliver on their promises of environmental protection. The Cascade Policy Institute analyzed Portland, Oregon’s decades long push for smart growth and found the policies produced little success:

Smart growth advocates frequently cite Portland as a model of what all communities should be doing to control urban sprawl. They claim its style of growth management offers many potential benefits: It will protect rural farm and forest land from development; reduce the costs of development by encouraging more efficient use of urban infrastructure, and reduce traffic congestion through mass transit serving higher population densities. Moreover, this approach will provide affordable housing while preserving open space and scenic vistas.

Notwithstanding their praise, Portland’s 20-year commitment to smart growth has failed to achieve most of these predictions. Its approach has been ineffective in limiting suburban development, and it actually has intensified several of the city’s most troubling problems, such as traffic congestion and a lack of affordable housing. (John Charles, Cascade Policy Institute, quoted in “A Guide to Smart Growth,” p. 119)

- Studies by the Texas Traffic Institute confirm that smart growth policies may actually exacerbate pollution and congestion; the reality being that just because people live closer together doesn’t mean they use their cars significantly less. Additionally, because all those cars are crowded together in a smaller area, pollution may dissipate more slowly.
- A significant problem with growth restrictions is the issue of affordable housing. As cities set aside land for open space, or constrict the boundaries of growth, remaining land and housing become increasingly valuable – and housing becomes

increasingly expensive. The consequence is that one of the trade-offs of adopting some forms of environmentally-friendly development policies is the loss of housing for communities' lower-income members.

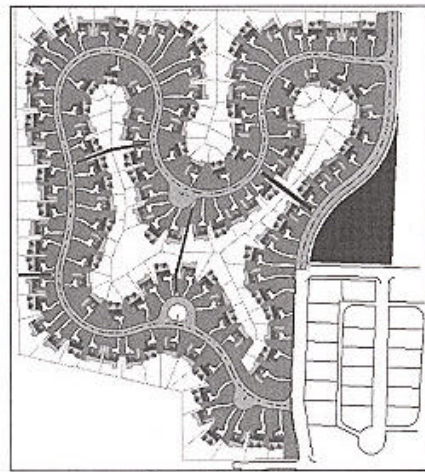
- Creativity is helping to reconcile people's desire for suburban amenities in housing with reduction of paved, impervious surfaces in a way that so-called TNDs – traditional neighborhood developments have not. Site designer experimented successfully with “coving” and “bay home” patterns and there are now about 100 communities in existence or in process that use these developmental models.

Chart 8.1

Example of a Coved Housing Development: Allen, Texas



Before: 124 Lots



After: 119 Lots

Coving results in 4% fewer lots, but 70% less land for infrastructure, 48% less public paving and the added value of living in an open neighborhood instead of a "subdivision"

Source: Rick Harrison, 1999.

Chart 8.2

Example of a Bay Home Housing Development

In a "bay home"-style development, the land and all items outside the home are not owned by the individual homeowners, but held in common by a homeowners association.

Since homes are linked by meandering walkways instead of streets, infrastructure savings can reach 50% when compared to the "traditional neighborhood development" rigid grid pattern of streets.



Source: Rick Harrison, 1999.

Diagrams of coved and bay home developments from "The Market Responds to Smart Growth," by Donald R. Leal, in *A Guide to Smart Growth: Shattering Myths and Providing Solutions*, edited by Jane S. Shaw and Ronald D. Utt (Heritage Foundation and PERC, 2000). Reprinted with permission.

Suggested Lesson Modifications:

Before students begin Part 1

1. "Developmental Dilemmas" brings students face-to-face with the scarcity of land and the choices that scarcity forces upon us. Before beginning the activity, remind students that land has alternative uses and ask them to generate a list. If necessary, remind them to include environmental "uses" such as buffer zones and open space.
2. Reinforce the concept of trade-offs; using the land in one way precludes its use in another. Using the overhead transparency of the region map (p. 263), discuss the different land uses depicted and identify the alternatives:
 - What is the opportunity cost of leaving the forest (in the upper left quadrant of the map) intact? (*the next-best alternative use – which may be grazing land, or housing, or an industrial part*)

3. Instruct students to keep trade-offs in mind as they work on Part 1 of the handout. Add the following questions to the handout:

- 2a. Identify 3 cost / benefit trade-offs people make by choosing to live in the type of community in your profile. An example might be that living in a Traditional City means trading off large private yards for more interaction with neighbors.
- 5a. As you discuss where to place the templates, identify the trade-offs that would be involved in various placements. For example, if you place housing far from the city center, you might be trading off convenience for spaciousness.
- 6a. Include in your presentation the trade-offs you considered and accepted in placing the templates and allowing for development in your community. Be sure to identify clearly those trade-offs that have an impact on the health of the Bay – both negative and positive impacts.