



POWELL CENTER FOR
ECONOMIC LITERACY

Lesson Plan

WRITTEN BY Powell Staff,
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The Polluted Lake

Using Marginal Analysis to Solve Problems

Time Required

45 minutes

Grade Level and Subject

Middle and High School; Civics, Social Studies

Keystone Principles

Principle #7 - Economic thinking is marginal thinking

Voluntary National Content Standards in Economics

Standard #2 - [Marginal Cost/Benefit](#).

Standard #17: [Using Cost/Benefit Analysis to Evaluate Government Programs](#).

Economic Concepts

Benefit – *The positive gain received from an action or decision.*

Cost - *The value of everything a consumer must give up to obtain a good or service. The resources used (time, money, talents, etc.) when we choose to do something.*

Marginal – *In economics, the word refers to one more unit of something.*

Marginal Benefit - *The additional gain from consuming or producing one more unit of a good or service. The gain can be measured in dollars or satisfaction.*

Marginal Cost - *The increase in the total cost when consuming or producing one additional unit.*

Trade-off - *Giving up one thing for another.*

Overview

Students enjoy this hands-on simulation of one town's efforts to clean its polluted lake. They will weigh the benefits of having a clean lake against the costs of losing other programs that can no longer be afforded. In determining how clean is clean enough, students will use marginal analysis to understand the trade-offs required.

Objectives

- Students will demonstrate an understanding of the meaning of diminishing marginal returns.
- Students will demonstrate an ability to realize when the costs of government policies exceed benefits.
- Students will demonstrate an ability to use simple marginal analysis.
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Materials and Handouts

- Large plastic garbage bag or plastic drop cloth
- A small cloth towel you do not mind staining
- 11 small paper cups
- Trash with small and large pieces of garbage (e.g., newspapers, yard debris, empty soda cans, shredded paper, used coffee grounds, dryer lint, sand)
- One cup of a dark liquid (coffee, cola, juice)
- 53 beans (can use any substitute such as pennies, or marbles)
- Plastic gloves
- Three empty plastic bags
- A stopwatch or watch capable of measuring seconds
- Handout #1, Municipal Budget form
- Handout #2, Labels for the paper cups
- Handout #3, Keystone Decision Grid.
- Visual #1, Marginal Analysis

Teaching Activity

Preparation: Assemble all the materials required. The activity will go quickly, so you will want everything at hand. Tape one label from Handout #2 on each paper cup. Prepare a transparency of Visual #1, Marginal Analysis.

Activity:

1. You will need five volunteers for this activity: a Town Treasurer, three Pollution Abatement Workers, and one Timekeeper.
2. Ask the rest of the class to imagine that, collectively, they comprise a small town's Town Council.
3. Distribute Handout #1 (the Municipal Budget) to each student. Discuss with the students the source of the money to be allocated in the town budget (such as personal and corporate income tax, sales tax, and property tax). Allow the town treasurer **one minute** to allocate the 53 beans among the 11 budgetary items. Instruct the timekeeper to mark

the 45 second and one minute mark. (If you prefer, you could pass out the Municipal Budget as a homework assignment the preceding day, assigning each student to write a paragraph on the relative allocations accorded each budgetary item. If you have enough class time, you may want to have the class determine the budget line items to be used in this exercise. Be sure they include a category for recreation or environmental clean-up.)

4. Now the fun begins. Quickly spread out the plastic drop cloth where all the students can view it. Pick up the cloth towel and tell the students it represents a lovely lake in one of the town parks. Explain that once this lake was a pleasant recreation spot for the whole town. Embellish your comments with your vision of an attractive, enticing asset with swimming, boating, and pleasant memories for all. As you lay the cloth down on the drop cloth, change your expression to one of great sadness and explain how over time and through neglect, the lake is no longer an asset to the community. It has become dirty and polluted. As you describe the deterioration of the lake, begin throwing all the trash you have on the lake. The *coup de gras* will be the pouring of the cup of dark liquid over the lake. (This is why you want a plastic drop cloth under everything!) Spread plenty of trash on the lake, using both large and small items.
5. Display Visual #1, Marginal Analysis. Explain to the students that the economic term “margin” means having or doing one more or one less unit of a thing. We make that decision according to which is greater – our costs or our benefits.
6. Ask students what the town should do with the lake. Encourage students to discuss several options varying from doing nothing to requiring a 100% clean-up of the lake. Tell them you will conduct an experiment to see what happens as the town tries to restore the lake to its previous splendor.
7. Instruct the Town Treasurer to negotiate a price with the Pollution Abatement Workers to begin cleaning the lake. Establish the rules of engagement: the towel represents a real lake, and therefore cannot be picked up or shaken to get rid of the pollution; trash must be picked up using only their hands; pieces of trash may not be used to collect other pieces of trash. The Treasurer must pay the workers from the allotted beans in the budget. Assuming the students did not know this problem would be forthcoming, there will not likely be very many beans in the section for Arts, Culture and Recreation. Talk with the students about the reality that if the budgetary allocation is spent on the lake, that money will not be available for other projects in that category. Have students think specifically about programs that might be foregone.
8. Give the first Pollution Abatement Worker a plastic bag and some plastic gloves. The worker will be given **15 seconds** to clean as much of the “pollution” from the lake as possible.
9. The student will quickly fill the bag by focusing on the large items first. At the end of the 15 seconds, have the treasurer pay the negotiated price to the worker and hold up the filled bag for the class to see. Thank the worker for the good effort.
10. Look aghast at the lake and pretend to realize that to your surprise, it is not completely cleaned up. (At the very least you should still see coffee grounds, sand, and the wetness from the soda or juice). Is there still money in your budget? If so, proceed with the next round of clean-up. If not, the Treasurer will need to re-allocate the budget on an emergency basis. Ask students whether they agree with the Treasurer’s selection. Why or why not? What trade-offs will now be necessary to continue cleaning the lake?
11. Hand the second abatement worker another plastic bag and some gloves, again allowing

15 seconds for the lake clean-up. Notice that the second worker will not fill the bag with nearly as much trash as the first worker. Ask students why they think this happens. Is the second worker less competent or perhaps not as conscientious? No. The first worker picked up the pieces of trash that would make the greatest difference relative to the time available for clean-up. The second worker worked just as hard, but the same amount of effort produces a diminished amount of visible return. As the lake becomes cleaner, using the same amount of resources will produce progressively fewer results.

12. Repeat the process with a third worker. The third worker will produce an even smaller rate of return on the effort than did the second worker, and students should be able to see the pattern. This is an illustration of the economic law of diminishing marginal returns.
13. Ask the class to consider all the municipal programs that had to be cancelled, and still the lake is not totally clean. Is the cost to the town worth the result? (*It depends on how much the town values the clean lake.*) What options are available to the town if it wants to continue to clean the lake completely? (*They could institute a surtax to fund the clean-up, find new sources of revenue, or stretch out the project over a longer period to fund it out of annual revenue.*) Ask the “town council” for their assessment of how clean is clean enough? (*To be “good enough” requires a realistic evaluation of what is possible and the costs and benefits of getting there.*)
14. Introduce the decision grid (Handout #3), explaining the need for analyzing both long- and short-term costs and benefits. As either an in-class assignment or a homework assignment, instruct students to follow the structure of the decision grid and list the long- and short-term costs and benefits of cleaning the lake. (*Be sure they think about the short- and long-term consequences of any programs which are de-funded.*) You may arbitrarily assign the two alternatives (such as “75% clean or 100% clean”), or you may ask students to select their own alternatives. Students’ answers will be widely varied as they use their own value system to pinpoint the appropriate trade-off in cleaning up the lake.
15. Again refer students to Visual #1. Did the process of analyzing costs and benefits change anyone’s mind about the resources the town should spend to clean the lake?

The Polluted Lake Municipal Budget

The town's total municipal budget is 53 beans. It must be divided among the following items. Prepare your suggested budgetary allocations.

| BUDGET ITEM | AMOUNT ALLOCATED |
|----------------------------|------------------|
| Administrative Expenses | |
| Arts, Culture & Recreation | |
| Debt Service Funds | |
| Economic Development | |
| Education | |
| Health & Human Services | |
| Infrastructure | |
| Police and Fire Protection | |
| Sanitation | |
| Transportation | |
| Utilities | |
| Total | 53 Beans |

| |
|----------------------------|
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| Arts, Culture & Recreation |
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| Health & Human Services |
| Infrastructure |
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| Sanitation |
| Transportation |
| Utilities |
| |

Keystone Decision Grid

Question:

| | Costs | | Benefits | | Consequences | |
|-----------------------|------------|-----------|------------|-----------|--------------|----------|
| | Short-term | Long-term | Short-term | Long-term | Positive | Negative |
| Alternative #1 | | | | | | |
| Alternative #2 | | | | | | |

Decision:

Marginal Analysis

“Marginal” describes the additional cost of one more unit of a given behavior.

The question economic thinkers ask is, “Do my marginal benefits exceed my marginal costs?” Putting additional time or resources into something only makes sense if the marginal benefit exceeds the marginal cost.