



PROFESSIONAL DEVELOPMENT

AP[®] Microeconomics

**Market Failure
and Deadweight Loss**

CURRICULUM MODULE



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and Deadweight Loss**

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**The College Board
New York, NY**

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Preface

AP[®] curriculum modules are exemplary instructional units composed of one or more lessons, all of which are focused on a particular curricular topic; each lesson is composed of one or more instructional activities. Topics for curriculum modules are identified because they address one or both of the following needs:

- a weaker area of student performance as evidenced by AP Exam subscores
- curricular topics that present specific instructional or learning challenges

The components in a curriculum module should embody and describe or illustrate the plan/teach/assess/reflect/adjust paradigm:

1. *Plan* the lesson based on educational standards or objectives and considering typical student misconceptions about the topic or deficits in prior knowledge.
2. *Teach* the lesson, which requires active teacher and student engagement in the instructional activities.
3. *Assess* the lesson, using a method of formative assessment.
4. *Reflect* on the effect of the lesson on the desired student knowledge, skills, or abilities.
5. *Adjust* the lesson as necessary to better address the desired student knowledge, skills, or abilities.

Curriculum modules will provide AP teachers with the following tools to effectively engage students in the selected topic:

- enrichment of content knowledge regarding the topic
- pedagogical content knowledge that corresponds to the topic
- identification of prerequisite knowledge or skills for the topic
- explicit connections to AP learning objectives (found in the AP curriculum framework or the course description)
- cohesive example lessons, including instructional activities, student worksheets or handouts, and/or formative assessments
- guidance to address student misconceptions about the topic
- examples of student work and reflections on their performance

The lessons in each module are intended to serve as instructional models, providing a framework that AP teachers can then apply to their own instructional planning.

— The College Board

Introduction

Mary Kohelis
Brooke High School
Wellsburg, W.Va.

A fundamental concept in microeconomics is the maximization of consumer and producer surplus through efficient free markets. The purpose of this AP curriculum module is to examine market failure and deadweight loss, key areas in which efficiency *eludes* the free market. Although students taking the AP Microeconomics Exam are expected to answer questions on these subjects, as described in the *AP Economics: Microeconomics Macroeconomics Course Description*, many students have trouble understanding the material. In his 2011 AP Microeconomics Exam Report, Chief Reader David Anderson listed 11 topics, on the operational and overseas exams, that proved challenging to students. The concepts of market failure and deadweight loss make up four of those topics.

Some of the course textbooks do not explain these subjects adequately. Therefore, students must depend on their teachers' initiative and expertise in supplementing the textbook with appropriate resources. Although deadweight loss is a part of several economic models, teachers, as well as students, may not take into account the connections that exist. For example, deadweight loss that exists in firms with market power, in markets with positive and negative externalities, and with public goods all share one trait: a loss of efficiency. This curriculum module offers teachers a ready resource for the information and skills necessary in helping students understand market failure and deadweight loss.

The first lesson, "Market Structures and Deadweight Loss," written by James Redelsheimer, begins with an explanation of efficiency in the perfectly competitive market and serves as the benchmark for the activities that follow, by showing the efficiency achieved in a perfectly competitive industry. The second half of Lesson 1 describes the monopoly model: it illustrates the market failure that exists when a monopoly charges a higher price and produces a lower quantity than the perfectly competitive industry.

Lesson 2, "Externalities and Public Goods," by Pamela Schmitt, presents detailed descriptions and graphical analyses of two additional areas in which inefficiency exists in free markets. In the first activity, Schmitt distinguishes between marginal private benefits/costs and marginal social benefits/costs as they pertain to both positive and negative externalities. The second activity provides teachers with an instructional tool for explaining public goods and the deadweight loss that exists if only private markets are considered.

It is important to note that in both Lessons 1 and 2, the discussion focuses on the issues of market failure and deadweight loss with the polar extremes of market structures, those being perfect competition and pure monopoly. Although not a part of this curriculum module, the other market structures — monopolistic competition, oligopoly, and duopoly — also exhibit market failure and deadweight loss.



Connections to the AP Microeconomics Curriculum

This curriculum module supports the AP Microeconomics curriculum in several areas. Lesson 1 addresses the following topics: consumer surplus, producer surplus, market efficiency, efficiency and perfect competition, and inefficiency of monopoly under firm behavior and market structure. Lesson 2 addresses marginal social benefit and marginal social cost, positive externalities and negative externalities, public goods versus private goods, and provision of public goods.

Connections to the AP Microeconomics Exam

The 2008 and 2009 AP Microeconomics Exams included questions concerning monopolies and efficiency. On the 2010 exam, students identified consumer and producer surplus as they related to a perfectly competitive market. Explanations of these topics are included in Lesson 1 of this module. Question 3 of the 2010 and 2011 exams asked students to identify and shade the area of deadweight loss, given certain conditions. By following the strategy as described in Lesson 2 of this module, teachers emphasize the line of reasoning that will help students correctly determine deadweight loss, regardless of the circumstances.

Instructional Plan

To present the instructional materials in this module effectively, teachers should be proficient in explaining the market structures and in interpreting the accompanying graphical analyses. Lesson 1 requires teachers to link the various market models to the concept of efficiency and deadweight loss. Using the graphs of a perfectly competitive industry and of a monopoly, the teacher compares and contrasts the two models. In Lesson 2, teachers must differentiate between the marginal private costs/benefits and the marginal social costs/benefits. In both lessons, teachers need to be alert to signals of student misunderstanding, especially with the identification and explanation of deadweight loss.

Both lessons include methods of instruction that support several learning preferences. In Lesson 1, students are provided introductory information in lecture format, followed by opportunities to work in small groups; they are also encouraged to illustrate their answers. Additional questions accompany the lesson for reinforcement of the subject material. Finally, by assigning groups the responsibility of creating a pricing policy for a monopoly, teachers offer students the chance to role-play and to reach a consensus decision. In Lesson 2, similar strategies address various learning styles.

Assessments

As with any of the topics listed in the *AP Economics: Microeconomics Macroeconomics Course Description*, teachers pose questions throughout the lesson to determine student comprehension. Inviting students to work on problems on a whiteboard, overhead projection, or chalkboard is another way to

assess comprehension quickly while providing students with the means of sharing information with the class.

Prerequisite Knowledge

Each lesson in this curriculum module begins with a review of the basic information students should already possess. Prerequisite knowledge includes familiarity with the economic way of thinking and with such concepts as supply, demand, market equilibrium, market structures, costs, and revenues. Furthermore, students are expected to have at least been introduced to the topic of externalities in the market. They should also be proficient in their use and interpretation of graphs. Besides supply and demand, students must have graphed the cost and revenue curves associated with market structures. The fundamentals of efficiency are explained and graphed, so students should benefit from this review. As additional information is introduced, teachers pose questions that help them identify students having trouble comprehending the material.

Instructional Time and Strategies

Teachers can use Lesson 1 as a culminating activity for the unit “Firm Behavior and Market Structure” (II, D) in the course description; it should take two or three 50-minute periods. Activity 1 is best introduced after students have become proficient in describing and graphing perfectly competitive markets. Activity 2 is best introduced following the lesson on monopoly pricing.

Lesson 2, which is most appropriately included in the last unit to be covered, “Market Failure and the Role of Government” (IV, A.B), should require two or three 50-minute periods. Activity 1 complements the lessons on externalities. The activity enhances the information contained in many of the textbooks. Activity 2 suggests that the connection between externalities and public goods in this lesson needs to be stressed; therefore, the lessons should be taught sequentially. The two activities supplement many textbooks’ presentations of both concepts.

Lesson 1: Market Structure and Deadweight Loss

James Redelsheimer
Armstrong High School
Plymouth, Minn.

Essential Questions

- How does a perfectly competitive market lead to socially desirable outcomes?
- What is deadweight loss and how is it shown on a graph?
- Why does a monopoly lead to a market failure, and how can a monopoly be regulated?

Lesson Summary

This lesson helps students understand market failure as it relates to any form of imperfect competition and specifically to monopolies. For students to analyze market failure in this context, they must first review, and then be able to explain, why perfectly competitive markets lead to socially desirable outcomes that generate productive and allocative efficiency. Students then learn to identify consumer and producer surplus as a foundation for examining market failure and the way in which it minimizes these surpluses. Emphasis is placed on the mutually beneficial transactions that are hindered by market failure. Students also work in groups as members of a regulatory board to suggest an effective way to regulate a monopoly and to analyze the market failure present in monopolies in which market prices are often much higher than marginal cost, resulting in inefficiency. Finally, this lesson offers students the opportunity to apply economic concepts to numerous scenarios, a skill essential for success in AP Microeconomics.

► *Connections to the AP[®] Microeconomics Course*

This lesson correlates to the following topics in the AP Microeconomics course outline:

- consumer surplus, producer surplus, and market efficiency (II.A.5)
- efficiency and perfect competition (II.D.2.d)



- monopoly: sources of market power, profit maximization, inefficiency of a monopoly, and natural monopoly (II.D.3. a, b, c, e)

► ***Student Learning Outcomes***

As a result of this lesson, students should be able to:

- explain how a perfectly competitive market uses scarce resources efficiently and maximizes consumer welfare;
- define consumer and producer surplus;
- demonstrate how a monopoly fails to maximize total economic well being, resulting in a deadweight loss; and
- discuss options for regulating a monopoly.

► ***Prerequisite Knowledge***

Before undertaking this lesson, students should review and be able to define the following concepts:

- the economic way of thinking
- demand, supply, and market equilibrium
- the profit maximizing position of $MR = MC$
- the costs of production, including marginal, average, fixed, and variable costs
- perfect competition and the market conditions requisite in a perfectly competitive industry
- the basics of a monopoly graph, including the difference between the demand and the marginal revenue curves

► ***Common Student Misconceptions***

Although students sometimes erroneously believe that a market that produces the quantity in which marginal revenue equals marginal cost is socially efficient, this is not the case with imperfect competition and, specific to this lesson, with monopoly.

► ***Teacher Learning Outcomes***

- Teachers become familiar with instructional strategies that are effective in a classroom of students with a variety of learning styles and cognitive abilities. They recognize the benefits of active student participation in graphing and explaining market structures. Teachers examine formative and summative assessments and their usefulness in identifying and correcting misunderstandings.
- As this topic has been identified as a challenge area for students, teachers increase their understanding of the concept of deadweight loss and its relevance to market structures.

► **Materials or Resources Needed**

No special materials are needed beyond graphs displayed in this module; teachers should use their textbook as a reference. Two to three 50-minute class periods are required for this lesson.

Activity 1: Perfect Competition and Market Efficiency

Step 1. How Efficient Markets Lead to Socially Desirable Outcomes (Lecture)

The teacher introduces the lesson on market efficiency and socially desirable outcomes by asking students to list types of markets that do not work well, such as subprime mortgages, monopolies, and businesses with barriers to entry. The teacher should indicate examples of inefficient markets that economists categorize as “market failure.” This term is defined as a situation in which (1) markets do not achieve the optimal outcome and (2) mutually beneficial transactions do not occur. Markets can work efficiently at an equilibrium price and quantity combination, in which all mutually beneficial transactions take place and the price of a good equals the cost of production.

The lesson ends with a teacher-led discussion with students on the ways that perfectly competitive markets achieve *productive and allocative efficiency*.

- **Productive efficiency** occurs when a firm produces at its lowest unit cost, where marginal cost equals average total cost; the business is producing maximum output from a given set of inputs.
- **Allocative efficiency** occurs when the optimal allocation of goods and services is produced, and the output level is where price equals marginal cost.

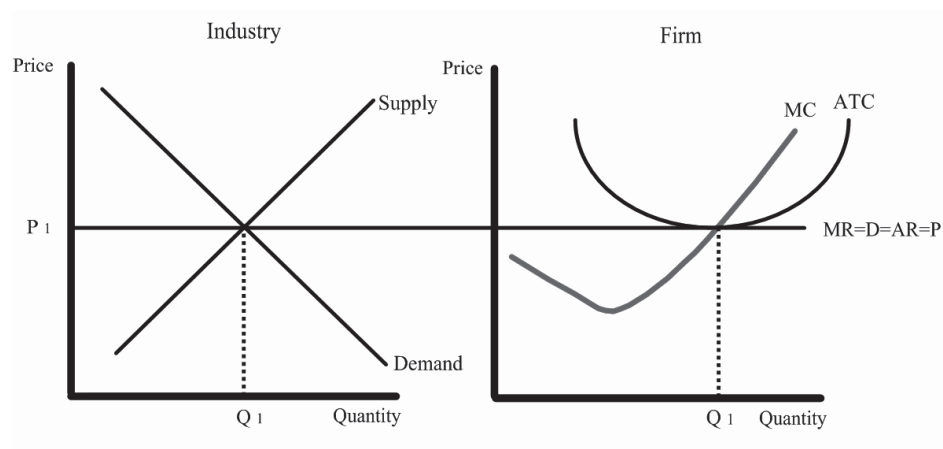
Step 2. Efficiencies in Long-term Equilibrium (Student Activity)

This activity gives students the opportunity to indicate both their grasp of the topic and their skill in graphing. In their notebooks students draw a side-by-side industry-and-firm graph of a perfectly competitive market, and then indicate, on the graph, the price and quantity that shows productive and allocative efficiency. Individual students can be asked, or can volunteer, to demonstrate their work to the class. The teacher shows students Figure 1 and then, with the class, discusses and answers questions 1–3 below.

LESSON 1: Market Structure and Deadweight Loss



Figure 1. Perfectly Competitive Market and Firm Showing Productive and Allocative Efficiency



1. Why is the firm price the same as the industry price in long-run equilibrium?
A firm in a perfectly competitive market with easy entry and exit has no control over the market price and is a “price taker.”
2. Q_1 on the firm’s quantity axis shows allocative efficiency. Why is production at this point allocatively efficient?
 $P = MC$. The cost of production of a product is what the consumer pays. Consumers who are willing to pay an amount equal to or more than the production cost get the product.
3. Q_1 on the firm’s quantity axis also shows productive efficiency. Why is production at this point productively efficient?
In long-run equilibrium, the firm is producing at its minimum level of average total cost and ensures that scarce resources are being used efficiently in production.

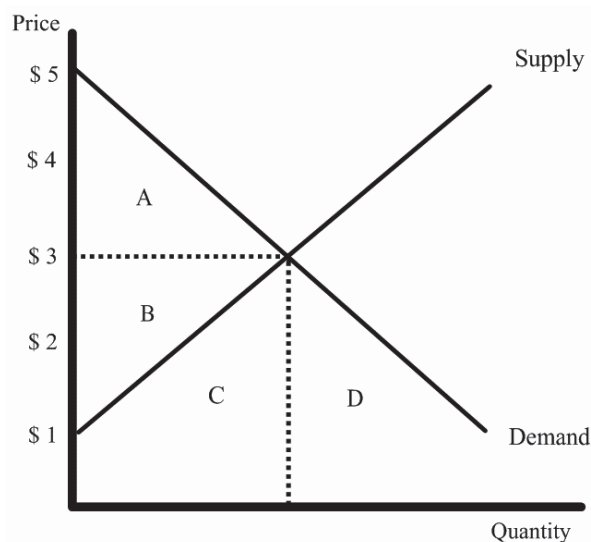
Step 3. Consumer and Producer Surplus (Group Activity)

The concepts of producer and consumer surplus are helpful in studying markets. The teacher should assign students to groups of three or four and ask them to analyze the following example, which involves the market for a pound of apples where the equilibrium price is \$3:

1. Assume Jack would have paid a maximum of \$5 and Jill would have paid a maximum of \$4, but the price they both paid was \$3. What is the total consumer surplus for Jack and Jill?
Jack: $5 - 3 = 2$. Jill: $4 - 3 = 1$. Total consumer surplus: $2 + 1 = 3$.
2. Also, while the price of apples is \$3, Joe’s Orchard would have offered apples for sale at \$1. Ask students to calculate the Joe’s Orchard producer surplus.
Joe’s Orchard: $3 - 1 = 2$. Total producer surplus = \$2.

3. After responding to questions 1 and 2, the groups can discuss and write what the members think are the definitions of *consumer surplus* and *producer surplus*, without assistance from their textbook. Then the teacher, after asking a few students to read their groups' answers to the class, shows the actual definitions below:
 - **consumer surplus:** the difference between the highest price a buyer is willing to pay for a product and the equilibrium price of that product
 - **producer surplus:** the difference between the lowest price at which a seller is willing to sell a product and the equilibrium price of that product
4. Next, teachers should show students Figure 2 and ask them to discuss how the areas representing consumer and producer surplus measure welfare. Each group can discuss what will happen when a monopoly, a price ceiling, or a price floor reduces the quantity bought and sold in a market. Teachers should verify that each group has concluded that consumer and producer welfare are reduced.

Figure 2. Consumer and Producer Surplus in a Perfectly Competitive Market



► Formative Assessment

Teachers should emphasize that perfectly competitive markets maximize both consumer and producer surplus. After asking students working individually to analyze Figure 2 and answer questions 1–5 below, teachers can circulate around the room, checking students' responses. Finally, students return to their original groups to discuss their answers.

1. Which letter corresponds to the consumer surplus? *A*
2. Which letter corresponds to the producer surplus? *B*



3. If the equilibrium price of a good increases to \$4 because of a decrease in supply, what happens to the total consumer surplus? (*increases/decreases*) Explain why this outcome occurs.
Consumers who would have purchased the good at a maximum price of \$3 will not buy the product.
4. If the equilibrium price of a good increases to \$4 because of an increase in demand, what happens to the total producer surplus? (*increases/decreases*) Explain why this outcome occurs.
Additional producers will now sell the product at \$4, thus increasing the producer surplus.
5. Explain how a policy that reduces the quantity bought and sold, such as a price floor, affects welfare.
Society is now worse off because the area of consumer and producer surplus is decreased. The optimal quantity that society wants to buy and sell no longer exists, a deadweight loss is created, and the market has moved away from productive and allocative efficiency.

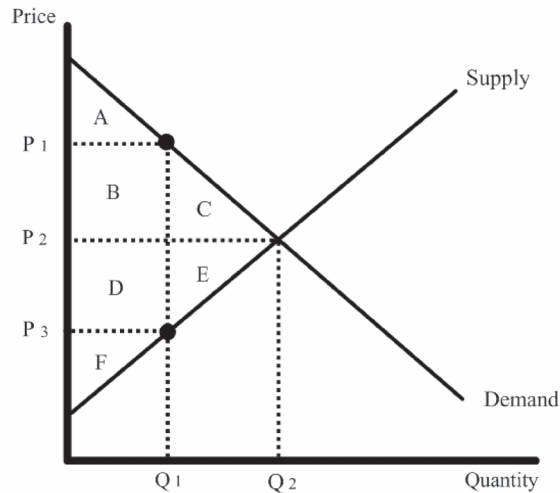
► **Student Work Sample (Hypothetical) in Response to Questions 1–5**

The letter corresponding to consumer surplus is A, and the letter for producer surplus is B. If the price increases because of a decrease in supply, then there will be a decrease in consumer surplus. If the price increases because of an increase in demand, then there will be a decrease in producer surplus. Whenever price increases, consumer and producer surplus will decrease. A policy that reduces the quantity bought and sold, such as a price floor, will not affect welfare, because society is no worse off: sellers now receive higher prices for their products, and thus have more demand for other products.

► **Next Steps**

In the sample above, the student has accurately identified the areas of consumer and producer surplus, and has correctly recognized that consumer surplus is reduced when a price increase is caused by a decrease in supply. However, the student incorrectly assumes that any price increase reduces surplus. If a price rise is caused by an increase in demand, then producer surplus will increase. In question 5, the student incorrectly assumes that welfare will not be affected. The student fails to grasp the idea that when the optimal quantity that society wants to buy and sell has been reduced, a deadweight loss occurs, and there will be neither productive nor allocative efficiency.

During the classroom activity, the teacher may observe that the students have answered the questions correctly and have a sound understanding of the concept. If so, the teacher can proceed to Activity 2. If comprehension is uncertain, teachers should review the material and show the effect of a price floor with the following questions and graphs.

Figure 3.1. Identifying Deadweight Loss in a Perfectly Competitive Market

Refer to Figure 3.1 for the following questions:

6. Assume that the economy is in equilibrium at P_2 and Q_2 . Which combination of letters in the graph makes up the consumer surplus? *ABC*
7. Assume that the economy is in equilibrium at P_2 and Q_2 . Which combination of letters in the graph makes up the producer surplus? *DEF*
8. Now assume that a price floor is placed on the sale of this product. As a result of the price floor, what is the new price and the new quantity purchased?
 P_1, Q_1
9. After the price floor is imposed on the market, what letters show the deadweight loss in societal welfare because of the price floor? *CE*

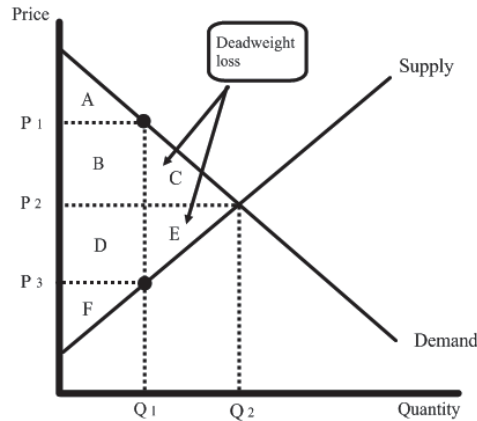
► Student Work Sample (Hypothetical)

Consumer surplus is indicated by ABC, producer surplus by DEF. The new price will be P_1 , and the quantity purchased will be Q_1 . The deadweight loss will be BCDE.

► Next Steps

The student has answered all but the last question correctly: the area of deadweight loss should be CE. Areas identified as BD are now a part of producer surplus, which now includes the total area of BDF. Based on student responses to questions 6–9, the teacher may choose to provide further examples of market conditions that lead to a reduction in societal welfare. Since it is important that students understand the concept well enough to identify and/or diagram it graphically, additional graphing exercises or handouts can be helpful in reinforcing this concept. The teacher can show Figure 3.2, calling on students to come to the interactive whiteboard or overhead to explain why a policy or a market that reduces the quantity from the equilibrium of P_2, Q_2 reduces societal welfare.

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**Figure 3.2.** Deadweight Loss in a Perfectly Competitive Market

Activity 2: Monopoly and Market Failure

Step 1. Monopolies and Market Failure

By now, students should understand how the market structure of perfect competition can lead to mutually beneficial outcomes for consumers, producers, and society. Monopolies and other forms of imperfect competition, however, can result in market failure, which is the focus of this activity. To begin, the teacher announces that he or she would like to buy a pencil at the lowest price offered in class and that students, when called on, should make their best offer. The competition in class will, most likely, lower the price of a pencil. In addition, as the teacher can point out, the consumer surplus will increase as the price falls.

Then, after appointing one student in class to be the sole seller of pencils, the teacher asks students what will likely happen to the price and quantity of pencils if there is only one seller in a market. Students should observe that since there is only one seller of pencils, there is little or no competitive pressure to reduce costs; as a result, prices will rise. Furthermore, as the price increases, consumer surplus decreases, in this case because of market structure. This situation is a *deadweight loss*: the decline in consumer and producer surplus when a government policy, a tax, or a market structure distorts market results.

Next, students can provide a definition, in their own words, of a *monopoly*, and the teacher follows up with the actual definition: monopoly occurs when one producer controls a market and is thus the single seller of a good or service, with no substitutes. The teacher should ask for real-world examples of monopolies and the effect a monopoly has on consumers and producers. Student answers — which may include De Beers, Microsoft, utility companies, and pro sports teams — can lead to a class discussion of the impact of monopolies on consumer and producer surplus. The teacher might then read to the class the following quotation from Adam Smith:

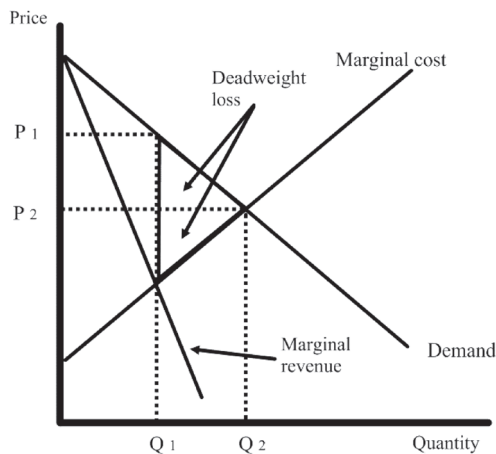
A monopoly granted either to an individual or to a trading company has the same effect as a secret in trade or manufactures. The monopolists, by keeping the market constantly understocked, by never fully supplying the effectual demand, sell their commodities much above the natural price, and raise their emoluments, whether they consist in wages or profit, greatly above their natural rate.

Students can then discuss how each of their examples includes characteristics that Adam Smith described more than 230 years ago and how global monopolies differ from those imagined by this author widely cited as the “father of capitalism.”

Step 2. Determining the Deadweight Loss of a Monopoly

Working in small groups, students draw a graph of the classroom market for pencils with a single seller, clearly highlighting the deadweight loss. Before showing students the correct graph, the teacher asks one member of each group to visit other groups, as a way for class members to compare their responses with those of other students and to correct their graphs as necessary. After a few minutes of this rotation, the traveling students return to their home group for discussion and verification of the graphing and identification of the deadweight loss resulting from a monopoly. Then one student comes to the board and draws his or her graph. A correct graph of this model is shown in Figure 4.

Figure 4. Deadweight Loss in a Monopoly Market



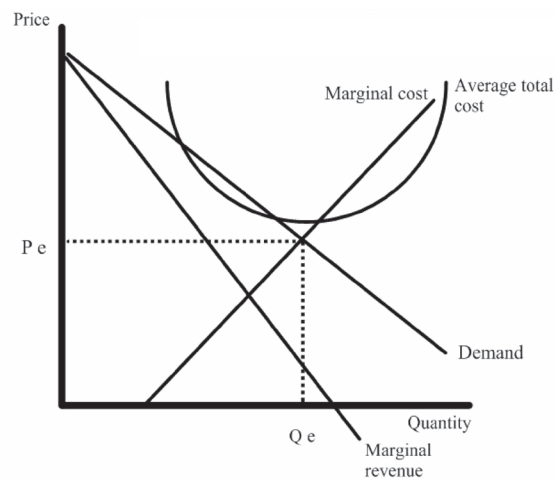


► **Formative Assessment**

To determine how well the class comprehends market failure, the teacher asks students to draw and label graphs in class, an activity that enables the teacher to analyze their progress. The following question and sample student response can serve as a means to diagnose problems in conceptual understanding:

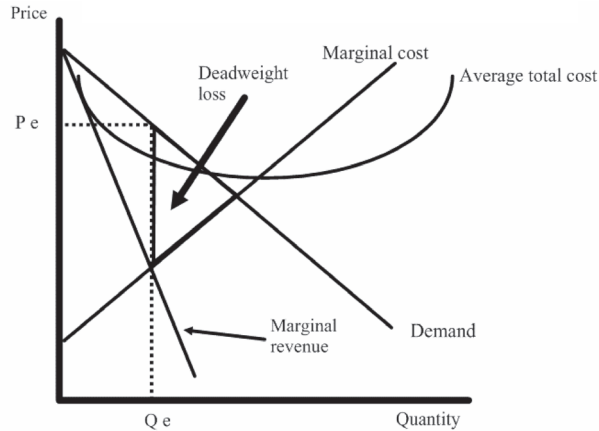
Draw a graph of a monopoly firm earning positive economic profits. Label the equilibrium price and the equilibrium quantity P_e and Q_e , respectively. Make sure all curves are labeled correctly. Does this market have a deadweight loss? If so, label it on the graph (see Figure 5). Then explain your graph in one to two sentences.

Figure 5. Hypothetical Student Sample Incorrectly Showing Deadweight Loss



► **Student Work Sample (Hypothetical)**

This market is currently efficient, with no deadweight loss. The equilibrium is where demand meets marginal cost at P_e and Q_e and is, therefore, allocatively and productively efficient.

Figure 6. Correct Illustration of Deadweight Loss

In the sample (Figure 5), the student has not labeled the equilibrium price and the quantity correctly. The equilibrium quantity should be where marginal revenue equals marginal cost, and the price should be where the equilibrium quantity meets the demand curve. Also, the student does not recognize that there is a deadweight loss, as the equilibrium is not where price equals marginal cost (see the correct graph, in Figure 6).

► Next Steps

If students still need help understanding the monopoly graph, the teacher can provide a brief lecture encompassing the questions listed below, referencing Figure 4. Students might be reminded that a profit-maximizing monopolist will produce the quantity at which marginal revenue equals marginal cost. After pointing out the relationship between a monopoly and a price ceiling or a price floor — both result in a deadweight loss — teachers can remind students that monopoly is the extreme form of imperfect competition and that monopolistic competition and oligopoly also result in deadweight loss. In contrast, the perfectly competitive industry in long-run equilibrium achieves allocative efficiency by producing goods or services in such a way that $P = MC$; it achieves productive efficiency by producing them such that $P = \text{minimum ATC}$. A monopoly, the class should observe, does not meet these requirements, as shown in Figure 4.

1. What level of output and price will the profit-maximizing monopolist produce?
 Q_1, P_1
2. What would be the quantity produced and the price if this market were purely competitive? Q_2, P_2
3. Explain the significance of the deadweight loss.
It shows the decline in societal welfare as a result of the monopoly.

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4. In Figure 4, at production point P_1, Q_1 , is the situation allocatively efficient? Why or why not?

No. The monopoly is not producing such that $P = MC$.

5. At the price and the quantity referenced in question 4, is this monopolist productively efficient? Why or why not?

No. The monopoly is producing above its average total cost. Also, the monopoly is earning economic profits, which are not present in perfectly competitive industries in long-run equilibrium.

Activity 3: Monopoly and Public Policy Group Activity

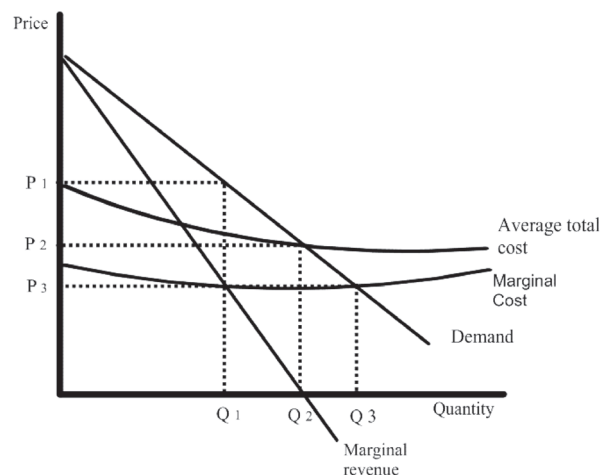
Step 1. Regulating a Monopoly

The teacher should ask students for examples of industries in which it may be beneficial to have a monopoly. Responses may include natural gas, electric, and cable companies. A class discussion can be based on the explanations that students provide for their choices. The teacher should point out examples of *natural monopolies*, in which the average total cost decreases as output increases throughout the range of demand. It may be beneficial to confine production to only one seller instead of many, since unit costs are lower with high levels of output. To encourage efficiency, public oversight can reduce deadweight losses.

Step 2. Group Analysis of a Natural Monopoly

The teacher organizes the class into small groups and tells them that they have been appointed to the board that regulates natural monopolies in their county. After examining Figure 7, the class discusses proposals for regulating the monopoly, including the price, if any, that should be imposed. Then each group presents the rationale behind its pricing decision, explaining the choice both verbally and graphically in front of the class.

Figure 7. Natural Monopoly Pricing Possibilities



Following the presentations, the teacher, leading a class discussion on the pros and cons of each regulatory proposal, emphasizes that there is no perfect solution to monopoly regulation. Using Figure 7, the class can focus on the following possibilities:

- Marginal cost pricing (P_3, Q_3). A price ceiling here is allocatively efficient but will likely result in a loss for the firm, which must be subsidized or go out of business. The government would have to raise money for the subsidy through taxation, which creates its own deadweight loss.
- Price = average total cost (P_2, Q_2). A price ceiling here increases consumer surplus from the marginal revenue equals marginal cost output of a profit-maximizing monopolist, but the output level is still less than the allocatively efficient level at which the price equals the marginal cost.
- Marginal cost = marginal revenue pricing (no regulation) (P_1, Q_1). This approach results in a large deadweight loss similar to that of any profit-maximizing monopoly.
- Impose a tax on the monopoly. This situation will result in an even higher price and smaller output level than that of an unregulated monopoly. An unregulated natural monopoly already has a deadweight loss; a tax will only make the deadweight loss larger.

► **Formative Assessment**

The students should write answers to the following questions:

1. Why are natural monopolies allowed to exist if other types of monopoly are illegal?
2. Of the pricing strategies listed above, which one will provide the most consumer surplus? Explain.

► **Student Work Sample (Hypothetical)**

A natural monopoly is allowed to exist because it provides a good or service that society needs. It is impossible to determine which pricing strategy provides the greatest amount of consumer surplus.

The student has incorrectly explained why natural monopolies are allowed to exist. The distinguishing feature of a natural monopoly is that it may be beneficial to confine production to only one seller because unit costs are lower with high levels of output. Examples include the provision of electricity or cable service, whose average total cost decreases as output increases throughout the range of demand. If more firms provided the good or service, the average total costs would be greater, since each firm's market share would be less. The pricing strategy that would provide the most consumer surplus is the marginal cost pricing. When price equals marginal cost, there is no deadweight loss and there is allocative efficiency. By definition, the area of consumer surplus is maximized in a perfectly competitive industry when price equals marginal cost.



▶ ***Next Steps***

It is helpful to have students practice additional graphs that emphasize monopoly pricing and equilibrium. Successful follow-up strategies include having students practice graphing deadweight loss on a large area, such as a chalkboard, interactive whiteboard, or even on a sidewalk with chalk. This strategy allows the teacher to give immediate feedback to the student. The more that students practice graphing, the better will be their understanding.

Lesson 2: Externalities and Public Goods: Market Failures and Deadweight Loss

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Essential Questions

- Why are markets inefficient in the presence of positive and negative externalities?
- How does private provision of a public good lead to a market failure?
- How do we find the area of efficiency loss (deadweight loss)?

Lesson Summary

As was discussed in Lesson 1, a market failure exists if a free market (private provision) inefficiently provides a good. It is important to understand why private provision is inefficient. Returning to supply and demand as the basis for market efficiency, we can see that the *deadweight loss* (DWL) merely represents a loss in total surplus (consumer surplus + producer surplus), because the marginal costs to society are not equal to the marginal benefits to society at the current level of provision. Since many textbooks seem to miss the connection to total surplus, students try to memorize what a graph should look like rather than to understand the cause of the inefficiency. As a result, the area of deadweight loss is often mistakenly identified.

If students are still unclear as to what “inefficient provision” entails, the teacher should continue to emphasize this concept, using a variety of examples of market failure and approaches, some of which are provided in Lesson 1 and some in this lesson.

Activity 1, which supplies a great deal of content for teachers, is more heavily teacher directed. Although most textbooks present these concepts using conventional methods, this activity provides a unique approach that is proving



to be more effective in helping students analyze externalities. Activity 2 involves more student-centered strategies and questions.

► **Connections to the AP Microeconomics Course**

- positive externalities (IV.A.1, 2)
- negative externalities (IV.A.1, 3)
- public goods (IV.B)
- connections to market efficiency (II.A.5)

► **Student Learning Outcomes**

As a result of this lesson, students should be able to:

- provide examples of positive and negative externalities in production or consumption;
- recognize that in the absence of externalities, $MSB = MPB$ and $MSC = MPC$ (because there is no need to distinguish between private and social costs and benefits, students can refer only generally to “marginal benefits” [MB] and “marginal costs” [MC]);
- identify and shade the area of deadweight loss in the presence of externalities and in the private provision of public goods; and
- accurately graph the following:
 1. marginal private benefit curve (MPB)
 2. marginal social benefit curve (MSB)
 3. marginal private cost curve (MPC)
 4. marginal social cost curve (MSC)
 5. socially efficient quantity (where $MSC = MSB$)
 6. demand (vertically sum individuals’ demand curves) for a public good

► **Prerequisite Knowledge**

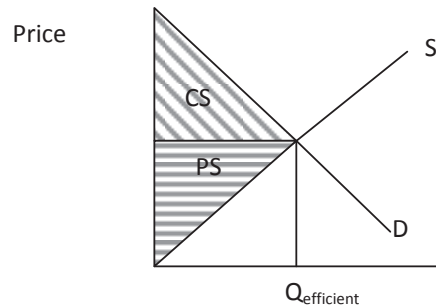
Students should be able to do the following:

- graph supply and demand and make the connection to marginal benefit and marginal cost
- show the efficient quantity (where $S = D$) under perfect competition
- identify consumer and producer surplus on a perfectly competitive market graph
- demonstrate familiarity with the basic definitions of positive and negative externalities
- list the characteristics of public goods (nonexcludable and nonrival)

Since textbooks provide the prerequisite knowledge listed, the teacher should have covered the material before this lesson. If students cannot connect supply and demand, the efficient quantity, and consumer and producer surplus, teachers can display Figure 8 as a way to enhance the connection of these topics. The figure

can help students understand that with a perfectly competitive market, $CS + PS = TS$ is maximized at Q_{mkt} .

Figure 8. Efficient Production



► **Common Student Misconceptions**

Students often try to memorize the area of DWL and forget to reconnect it to the inefficiency with over- or under-production. It is important to turn back to Lesson 1, to understand that DWL occurs with over- or under-production. With externalities, students tend to use the existing “triangle” in their graph and call it deadweight loss. Teaching students to erase the nonrelevant line will help avoid this confusion; doing so is the intention of Activity 1.

► **Teacher Learning Outcomes**

- This topic has consistently been a challenge for students. Therefore, teachers might review the concepts so that they will be better equipped to explain externality graphs, deadweight loss (graphically and intuitively), and the connection of public goods to externalities.
- Teachers will be able to explain clearly that, in the absence of externalities, MB (from supply and demand) is MSB and that MC is MSC.
- Teachers will be able to identify and explain where the inefficiency arises in the presence of externalities and/or public good provision; that is, total surplus is not maximized.

► **Materials or Resources Needed**

No special materials are needed beyond the graphs displayed in this module. Teachers should provide examples and use the textbook as a reference.

Activity 1: Positive and Negative Externalities

► **Background Knowledge**

This activity begins with a short review of *efficiency*. The teacher can provide information about externalities, but students will be asked questions throughout the activity. The questions can be answered independently or in groups.



The teacher starts out by asking students why perfectly competitive markets are efficient. The teacher should be sure that both Pareto efficiency and maximization of total surplus are discussed. If students have trouble with the Pareto efficient criterion (no one can be made better off without making someone worse off), the teacher may need to define it.

Next, on the board, the teacher reviews a simple supply and demand graph, calling students' attention to the quantities to the right or to the left of the market equilibrium and then explaining why too little or too much is inefficient (students should focus on the *loss* of consumer and/or producer surplus). Without externalities, *supply* represents marginal (implicitly [social]) cost (label $MSC = S$ on the graph) and *demand* represents marginal (implicitly [social]) benefit (label $MSB = D$ on the graph); we do not distinguish between private and social costs and benefits. Efficient outcomes are *always* identified according to marginal *social* costs and benefits. (Pointing this out will help in identifying deadweight loss when externalities are discussed.)

► **Defining/Identifying Positive and Negative Externalities**

The teacher introduces the discussion by defining *externalities*, which take place when a third party is affected by a market transaction. Externalities can occur either during production or during consumption (and sometimes both). The activity continues as the teacher, focusing first on positive externalities and then on negative externalities, encourages students to suggest appropriate examples of each.

1. The teacher defines the types of *positive externalities*:
 - A *positive consumption* externality exists if someone (other than the producer or the consumer of the product) benefits from the consumption of a good.
 - A *positive production* externality exists if someone (other than the producer or the consumer of the product) benefits from the production of a good.
2. The students brainstorm examples of positive consumption and positive production externalities (the more examples the better). The teacher should be prepared to point out externalities that are negative. Note: the graphing exercise will be based on positive consumption externalities.
 - A typical example of a *positive consumption* is vaccination. A nonvaccinated student at school is better off when a classmate has been vaccinated.
 - A personal example of a *positive consumption* is that our neighbors receive benefits from our purchase of a mosquito control device that attracts and eliminates the insects. Our "one acre" of protection also reduces the presence of mosquitoes in our neighbors' yard, even though the next-door family has not purchased protection against the insects.

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- A typical example of a *positive production* is enhanced infrastructure when an existing road is paved to accommodate the building of a new plant. A third party, such as someone living on the previously unpaved or gravel road, is better off if the road is paved because travel becomes easier, quicker, and safer.

The teacher can locate recent news articles on such topics as park services, flu shots, or other positive consumption externalities.

3. The teacher asks students to generate definitions of the types of *negative externalities* before explaining the following:
 - A *negative consumption* externality exists if someone (other than the producer or the consumer of the product) incurs a cost from the consumption of a good.
 - A *negative production* externality exists if someone (other than the producer or the consumer of the product) incurs a cost from the production of a good.
4. Students brainstorm examples of negative consumption and production externalities (again, the more examples the better), with the teacher correcting examples in which the externality is positive. Note that the graphical analysis will be based on negative production externalities.
 - A typical example of a *negative consumption* externality is cigarette smoking. A third party, usually a person near the smoker, is hurt by second-hand smoke, which may be an annoyance and has been found to cause or exacerbate asthma, lung cancer, and other serious conditions. But note that some cynics feel that cigarette smoking also creates a *positive consumption* externality because a greater number of smoker deaths among younger citizens leads to fewer payouts from entitlement programs such as Social Security and Medicare.
 - A typical example of a *negative production* externality is pollution or toxic spillage from a plant into a nearby river. A third party (e.g., a person fishing in the river who does not buy or sell what the plant is producing) is hurt by the pollution or spillage because the fish in the river may be sickened or unable to reproduce as a result of the pollution.

Teachers can locate recent news articles on a topic such as an oil spill, overconsumption of alcohol, or other examples of negative consumption externality.

5. The teacher poses questions, such as the following, that students answer (e.g., by writing on whiteboards, discussing responses in small groups). The key is not to move to the next topic until students can demonstrate an understanding of the basics.
 - What are the differences between positive and negative externalities?
 - What are the differences between consumption and production externalities?

For their part, students provide examples of each type of externality; their answers should include the following:



- Positive externalities provide a benefit to a third party. Negative externalities harm a third party. A third party is any person or group that is not directly involved in the buying or the selling of a good.
 - Externalities can occur through production or consumption. Although many textbooks do not emphasize the difference, the distinction — while intuitive in many cases — is nevertheless important.
6. Students place each of the following goods into the appropriate category: positive consumption externality, positive production externality, no externality, negative consumption externality, or negative production externality.
- antibiotics (*positive or negative consumption externality*)
 - gasoline (*negative production or negative consumption externality*)
 - hand sanitizer (*positive or negative consumption externality*)

These examples can provoke interesting discussions. Students may observe that antibiotics and hand sanitizers can positively impact a third party by preventing the spread of germs. However, the items, if overused, can negatively affect a third party by introducing the threat of “super germs” (antibiotic-resistant bacteria). Likewise, as the 2010 BP oil spill in the Gulf of Mexico shows, the production of gasoline can negatively impact third parties along the polluted coast. In addition, the consumption of gasoline leads to global air pollution, detrimental even to those who do not purchase the fuel.

► **Graphing Positive Externalities and Determining the Inefficiency (Area of Deadweight Loss)**

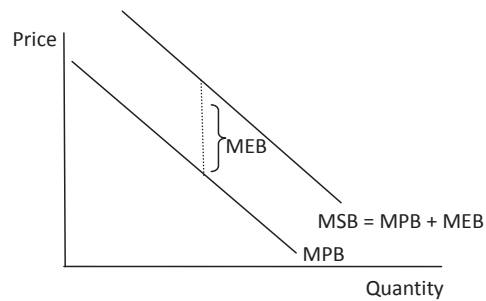
The teacher leads a discussion of examples from recent news stories depicting goods that may be underprovided by private markets. For example, during the measles outbreak of 2011, third parties were affected because not all children had been vaccinated. Had more parents decided to have their children vaccinated, there would have been significantly fewer cases of measles. This reasoning can be applied to other subsidized vaccinations (flu shots are provided at public schools in some areas; the vaccine against HPV, or human papillomavirus, provoked controversy in some communities). Teachers can clarify the concept and make the material more relevant by exploring examples like these.

Positive externalities can be internalized through government-funded subsidies. For instance, vaccines are often provided to consumers at a price lower than the producer receives; the difference in prices is the *given subsidy*. This practice would shift demand to the right because it increases consumers’ willingness and ability to pay. This topic has been excluded from the discussion here, since the main focus is the identification of the area of inefficiency associated with the market failure.

The teacher then graphs *demand* on the board (see Figure 9), labeling the *demand* curve (representing those purchasing the good) and the *marginal private benefit* curve (MPB). The addition of the word *private* indicates that this curve represents the marginal benefit of those in the market — those who buy the good. Students

should observe that without externalities, the marginal benefit curve is the marginal (social) benefit curve.

Figure 9. Marginal Private Benefit, Marginal External Benefit, and Marginal Social Benefit



Next, the teacher adds a line that represents the *marginal social benefit* (MSB) and explains the following:

- If third parties are better off because *someone else* consumes the good, this increases the benefit to *society*.
- Because of the benefit to a third party, society is willing and able to pay a higher price at every given quantity.

At this point the teacher should call students' attention to a vertical difference between MSB and MPB, define this distance as MEB (marginal external benefit), and explain that the MEB is added to the MPB (marginal private benefit) to get the marginal social benefit (MSB).

After the graph is complete, the teacher summarizes MSB. The summary should point out that the marginal social benefit curve, MSB, includes all benefits furnished to society, both by the purchaser and by those who are positively impacted without purchasing the good themselves.

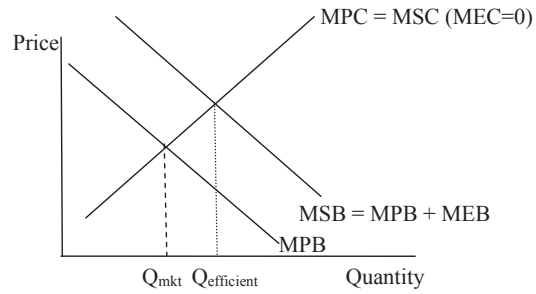
Before adding the marginal private cost curve, the teacher asks students to speculate whether the quantity produced by the market would be more or less than what is efficient. Encouraging students to consider the question prevents them from just memorizing the outcome. The teacher should ensure that students understand the following: If a third party benefits from the production or consumption of a good, even without directly buying it, the market *underproduces* a good with *positive externalities*.

The teacher adds a *marginal private cost* curve to the existing graph with only positive externalities and no negative externalities; see Figure 10.

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Figure 10. Market with a Positive Externality



The teacher should emphasize that, as a result of the underproduction, deadweight loss occurs when total surplus (CS + PS) is not maximized. This situation represents a loss in efficiency, because the benefits to society exceed the costs to society; therefore, more should be produced.

To identify the correct area of deadweight loss and to reinforce visually the loss of surplus, the teacher can go back to the graph and erase the MPB curve on the board or projector; see Figures 11 and 12. Without the MPB curve, it is easy to find the area of inefficiency, because the market underproduces, as indicated by $Q_{mkt} < Q_{efficient}$. The teacher should caution students not to misidentify the deadweight loss. Without erasing the MPB curve, students are drawn to the existing triangle.

Figure 11. DWL with General Underproduction

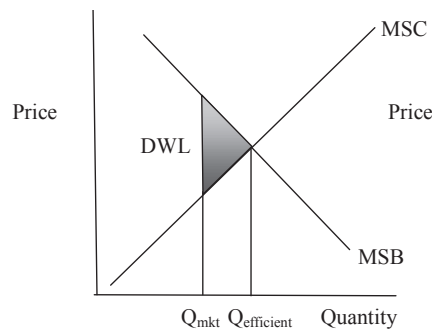
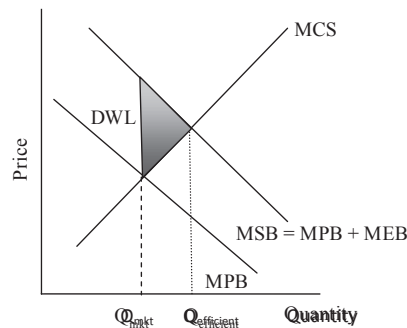


Figure 12. DWL with Positive Externalities



The teacher should remind students that we always identify deadweight loss (DWL) as the area between the MSB (marginal social benefit) and the MSC (marginal social costs) curves.

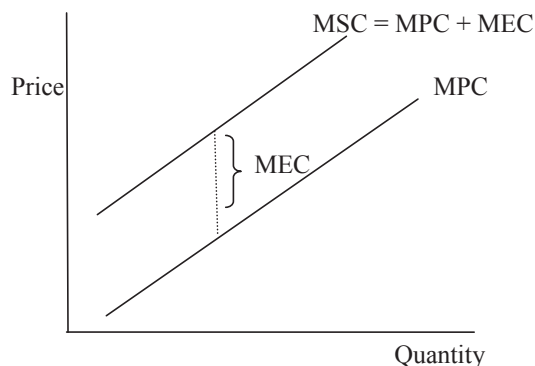
► Graphing Negative Externalities and Determining the Inefficiency (Area of Deadweight Loss)

Recognizing that externalities are a difficult concept, teachers can go step by step through the positive externality portion. However, because negative externalities are the opposite of positive externalities, this part of the lesson gives students a chance to apply the tools acquired from the discussion of positive externalities to negative externalities.

Negative externalities can be internalized through government taxation or quotas. For instance, we expect taxes on items such as gasoline and cigarettes. Taxation would cause a shift in the supply curve to the left, because a tax is an additional cost to the producer.

1. After asking students to summarize again the definition of *negative externalities*, the teacher addresses incorrect responses and redirects the focus if necessary.
2. At least one student can be called to the board to draw a standard supply curve (or individual whiteboards can be used, to make sure that everyone gets a chance to answer). The teacher asks the class how an increase in cost impacts the supply curve being drawn and to explain why the shift occurs. (The increase shifts the supply curve to the left.)
3. The teacher indicates that this additional cost may apply to the third parties that were identified in the definition of a negative externality (which is why the redirected focus may be necessary). Another student can go to the board to show this graphically (the shift to the left).
4. The teacher should explain that this supply curve, or marginal cost curve, represents the cost to the firm and to the third parties; this curve represents the *marginal social cost* (MSC). Since *someone else* consumes the good, the cost to *society* increases. Society incurs higher cost at every given quantity, so MEC (marginal external cost) is added to the MPC to get the MSC (marginal social cost).
5. At their seats, students draw a line indicating the vertical difference between MSC and MPC and define this distance as MEC (as shown in Figure 13). Students can ask classmates how MSC is determined, while the teacher circulates around the room checking that all students understand that the MEC is added to the MPC to get the MSC. If students do not understand that the MEC is added to the MPC, the teacher should explain the reason: the cost to society has increased.

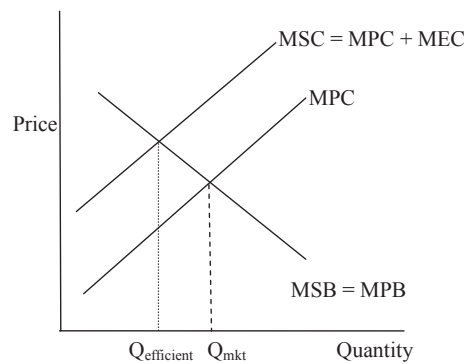
Figure 13. Marginal Private Cost, Marginal External Cost, and Marginal Social Cost





- The teacher chooses any student's graph to summarize that the marginal social cost curve (MSC) includes all costs to society, both those acquired by the producer and those applying to third parties who are negatively impacted without purchasing or producing the good themselves.
- Before adding the marginal private benefit curve, the teacher asks students for their best intuitive response to this question: If third parties incur a cost as a result of the production of a good, how is this cost graphically represented? Would this cost lead to *over-* or *underproduction*? If students incorrectly answer the question, the teacher should explain that with costs to society, private markets overproduce a good with negative externalities.
- The teacher calls on a student to add a *marginal private benefit* curve to the existing graph (Figure 13). What happens when the MPB curve is added with only negative externalities and no positive externalities (see Figure 14)?

Figure 14. Market with a Negative Externality



- At the teacher's request, a student erases the MPC curve from the graph on the board (see Figures 15 and 16). Once the MPC curve has been erased, the student identifies and shades the area of deadweight loss. Without the MPC curve, it is easy to find the area of inefficiency with overproduction, since total surplus is not maximized.
- If the student incorrectly identifies and shades the area of deadweight loss, the teacher reminds students to erase the "irrelevant line" — students should go back to their graph, erase the MPC, and now show the DWL. Deadweight loss (or the inefficiency associated with private provision of the good) occurs because at Q_{mkt} the MSC is greater than the MSB. The teacher should remind the class that the DWL is always the area between the MSB and the MSC curves.

Figure 15. DWL with General Overproduction

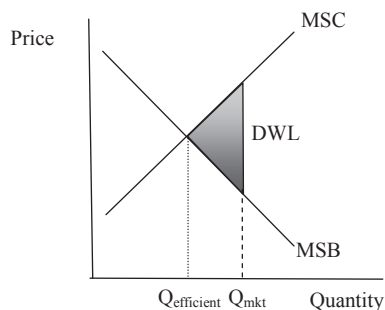
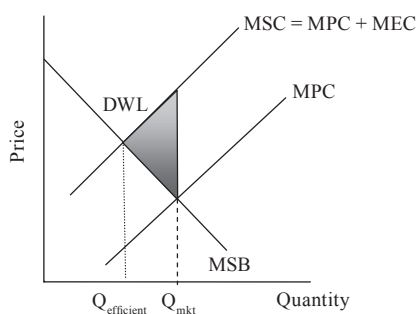


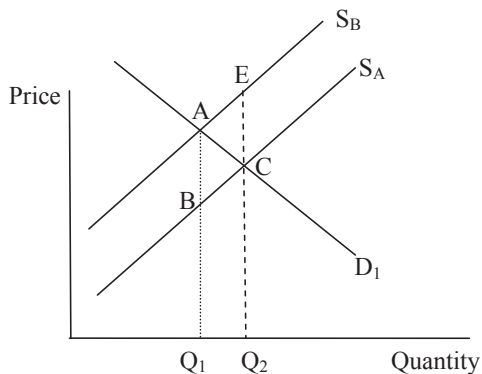
Figure 16. DWL with Negative Externalities



► **Formative Assessment**

The best type of formative assessment to use with deadweight loss involves the creation of graphs and the identification of major variables and depicted areas. If students have difficulty with labeling, finding the efficient quantity, and/or shading the deadweight loss, the teacher should provide additional examples, with explanations as needed, until class members grasp the concept. The key to deadweight loss shading is to erase the MPC line, so that students can see that the existing triangle is not the area of deadweight loss.

Figure 17. Externalities and Deadweight Loss



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Using Figure 17, answer the following:

1. What are correct labels for S_A , S_B , and D_1 when externalities exist?
2. Are the externalities positive or negative? Explain.
3. What is the efficient quantity?
4. Using the labeling on the graph, indicate the area of deadweight loss.

► **Student Work Samples (Hypothetical)**

First Student Answer

1. S_A should be labeled the marginal social cost (MSC), S_B should be labeled the marginal private cost (MPC), and D_1 should be labeled marginal social/private benefit (MPB = MSB).
2. There are negative externalities because the supply curve has shifted to the left.
3. The efficient quantity is Q_2 .
4. The area of deadweight loss is represented by the triangle AEC.

Second Student Answer

1. S_A is the marginal private cost curve, and S_B is the marginal social cost curve. D_1 is the marginal private benefit curve.
2. There are negative externalities because the marginal social cost is greater than the marginal private cost ($MSC > MPC$).
3. The efficient quantity is Q_1 .
4. The area of deadweight loss is ABC.

► **Next Steps**

In the first set of answers, the student assigned the incorrect labels. The teacher can take additional class time to stress the importance of using the correct terminology — marginal *social* cost (MSC) and marginal *private* cost (MPC) — and to emphasize what each of the costs represents. The teacher can also remind students that marginal social costs will be greater than marginal private costs at each level of output if a negative externality exists. In response 2, identifying the curves as supply curves is not an acceptable answer, because it does not differentiate between marginal private and social costs. If students use incorrect labeling, they will be unable to determine the efficient quantity. For example, in response 3 the efficient quantity is *not* Q_2 . However, in answer 4 the student correctly identified the deadweight loss. As a reinforcement activity, teachers may ask students to draw graphs on the board showing the correct labeling for both positive and negative externalities. Additionally, the students may be reminded to use the “erase” strategy described earlier to identify correctly the triangle of deadweight loss.

In the second set of answers above, the student correctly labeled the curves in response to question 1, recognized and explained the negative externality in 2, and provided the correct quantity in 3. However, in response 4, the student failed to show the correct area of deadweight loss. This is the most common error in

identifying deadweight loss. The student chose the existing triangle instead of shading the area that represents the loss of efficiency, marked as AEC. To respond to this gap in understanding, the teacher can ask students to pair up with each other; one student will draw a graph with a negative externality, and the other will draw a graph with a positive externality. Together the students identify and shade the areas of deadweight loss. The students then work with another pair to check their answers. This strategy should help reinforce the concept.

The key to students' understanding of the area of deadweight loss in the presence of externalities is to realize the connection to basic supply and demand. The teacher should stress that students are not learning anything new; efficiency always occurs where MSB equals MSC . If the market produces too much or too little, this area represents the deadweight loss. Students who have difficulty identifying the area of deadweight loss can benefit from practice with different scenarios. The teacher should find as many examples of positive and negative externalities as possible and have students graph, shade, and explain where and why the area of deadweight loss exists.

Activity 2: Public Goods

► Background Knowledge

This activity begins with a short review of the characteristics of public goods. The teacher may need to explain how public goods are connected to positive externalities, because this connection is lacking in many textbooks. To reinforce this connection after completing the activity on externalities, the teacher may assign students to create a graph depicting the public good example in this activity.

Step 1. Characteristics of Public Goods

The teacher can start by asking students to list the characteristics of public goods. Students should define public goods as *nonrival* and *nonexcludable*.

Again, while the topic is not the focus of this discussion, teachers might note that private goods are rival and excludable, common-pool (or common-property) resources are private and nonexcludable, and toll (impure public) goods are nonrival and excludable.

If students do not define public goods as nonrival and nonexcludable, the teacher may remind them that nonrivalry implies that the use by one person does not diminish the benefits of use by another; the good can be jointly consumed. The teacher can also point out that nonexcludability implies that once the good is produced for one person, it is difficult or impossible to prevent others from receiving the benefits of the good.

Students can then brainstorm examples of public goods; common examples include firework shows and national defense. Many people can view fireworks



simultaneously (nonrival), and people cannot easily be charged for, or prevented from, observing and enjoying a fireworks display (nonexcludable).

Working in small groups, students explain why national defense is nonrival and nonexcludable. If the students are unable to do so, the teacher can ask them whether a person can be excluded once national defense has been provided, and whether providing that benefit to one person decreases the benefit for a neighbor. Both answers are *no*. When a country invests in national defense, its protection applies to all citizens; and regardless of how much they pay in taxes, it is costly or impossible to exclude citizens from receiving protection once it has been provided.

Step 2. Deriving the Demand Curve for a Public Good

The teacher asks students how third parties valuing a good once it is produced would affect MB and MC. Students can depict the effect graphically and explain the similarity between public goods and goods with positive externalities, as discussed in Activity 1 of Lesson 2. That is, once a public good is provided, third parties (those that did not purchase the good) are positively impacted.

To promote critical thinking skills, the teacher asks students whether free markets will *underprovide* or *overprovide* public goods. Because these goods provide external benefits to other people, free markets will underprovide public goods. If students fail to recognize the underproduction of goods with positive externalities, the teacher should refer to the previous activity.

On the board, the teacher depicts, graphically, a numerical example of a public good (refer to Figures 18, 19, and 20) and stresses several points:

- Graphing a public good is similar to graphing a good that has positive externalities.
- By adding MEB to the MPB, we sum *all individuals' marginal benefit* (demand) curves to find the market demand (vertical summation).
- If the good was provided to any one individual, the benefits to *all other users* in the community would be external benefits.

Suppose that Figures 18, 19, and 20 illustrate, respectively, Lily's, Natalie's, and Danny's individual demand for fireworks displays. The demand for the public good is found by adding up each individual's willingness to pay for a given quantity.

Figure 18. Lily's Demand for Fireworks Displays

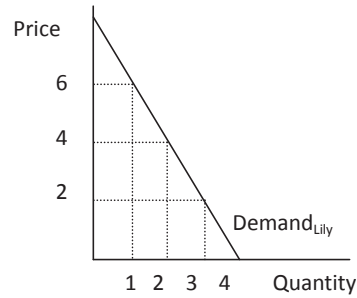


Figure 19. Natalie's Demand for Fireworks Displays

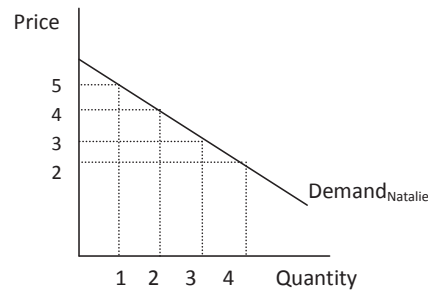
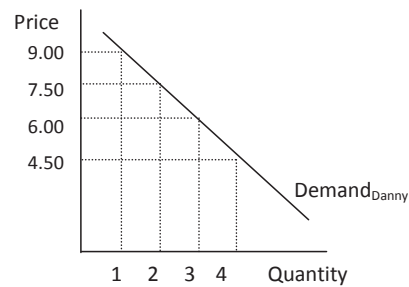


Figure 20. Danny's Demand for Fireworks Displays

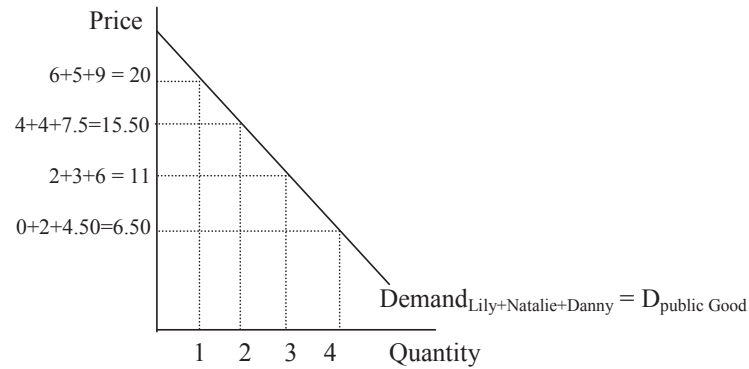


1. The teacher picks two quantities and vertically shows the summation. Let the students calculate the other two quantities. For $Q = 3$, Lily's MB is \$2, Natalie's MB is \$3, and Danny's MB is \$6; therefore, the demand for the third unit of the public good is \$11. If three fireworks displays are provided, all three students can fully enjoy them (nonrival), and all three can view each fireworks show (nonexcludable); see Figure 21.

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Figure 21. Demand for a Public Good: Vertically Summed Individual Demand Curves



2. The teacher leads a discussion on how to provide these goods.

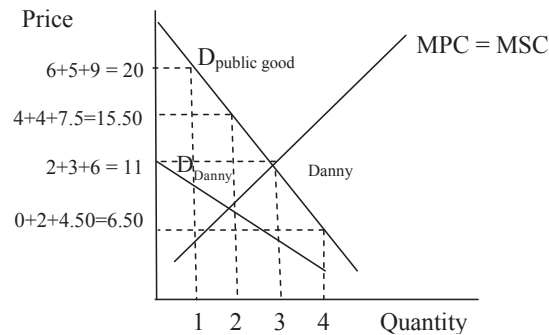
- To avoid underproduction (since voluntary provision of these goods leads to free-riding or underprovision), the government provides many nonexcludable, nonrival goods. For example, cities provide fireworks displays, art shows, public parks, lighthouses, streetlights, and veterans' memorials, because individuals would not be willing or able to pay for these entities, and many nonproviders would receive benefits from their provision.
- It is important to note the difference among publically provided nonpublic goods, publically provided public goods, and nonpublically provided public goods. As counterintuitive as it seems, not all publically provided goods are public goods. One common example is public education. Although provided publically by the government, education can be an excluded good (based on classroom size, entrance exams, or tuition) and a rival good (e.g., if the classes become too large, the educational benefit for some students is diminished).
- Some public goods are privately provided (typically funded by voluntary contributions). For example, a number of nonprofit environmental organizations fund wildlife research and conservation efforts. Finally, if exclusion costs for some nonrival goods are not too great, then user charges can be imposed to provide those goods. For example, many beaches in New Jersey require beach tags for admission, and many highways and bridges, particularly in the Northeast and on the West Coast of the United States, are financed by tolls.

► Formative Assessment

Their responses to the following formative assessment prompts will indicate whether students understand the concepts related to public goods, deadweight loss, and efficiency.

1. Suppose Danny is the neighbor who puts on a fireworks show every July 4, and he uses only his demand curve to determine how many fireworks packages to display. Using Figure 22:
 - a. Identify the quantity of fireworks packages Danny would choose to purchase.
 - b. What is the efficient quantity?
 - c. Shade the area of deadweight loss, based on Danny's decision.
 - d. Why are fireworks displays considered public goods?

Figure 22. Public Good: Danny's Demand and Total Demand



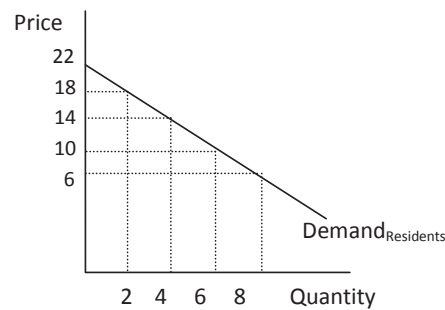
2. Suppose Aubrey is a wealthy benefactor and is considering purchasing land for a public park. Other residents of the area will benefit if a public park is built. Consider Figure 23 to be Aubrey's demand curve and Figure 24 to be the demand curve for all other residents. Assume that the values on the vertical axis refer to thousands of dollars, to create a more realistic scenario. Use the information from Aubrey and all other residents' demand curves (for acres of the park) to respond to the following:
 - a. Draw a correctly labeled graph that shows the public demand for the local park.
 - b. Determine the efficient quantity (acres of park) if the marginal cost is constant and equal to \$20 per acre.
 - c. Using the same graph, draw Aubrey's demand curve.
 - d. Shade the area of deadweight loss if only Aubrey provides the park.



Figure 23. Aubrey's Demand



Figure 24. Demand of All Other Residents



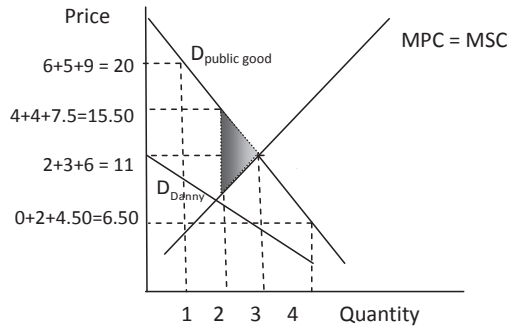
► **Samples of Student Work (Hypothetical)**

First Student Answer for Question 1

If Danny is the neighbor who is displaying the fireworks, then according to the graph,

- a. *he is providing two fireworks packages, since that is where Danny's demand curve and the marginal social cost curve intersect;*
- b. *the efficient quantity would be three, because that is where $D_{public\ good} = MSC (MPC)$;*
- c. *the deadweight loss would be the triangle shown in Figure 25 that follows; and*
- d. *fireworks displays are considered public goods because they are paid for by the government.*

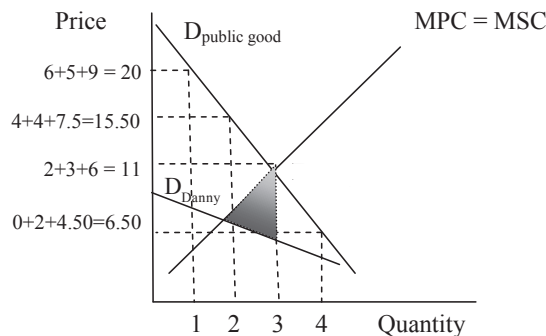
Figure 25. Public Good: Danny's Demand and Total Demand (First Student's Correct Graph)



Second Student Answer for Question 1

- a. Danny will provide two fireworks packages, since he is basing his decision only on his demand curve. The quantity is determined by the intersection of Danny's demand curve and the marginal cost curve $D_{\text{Danny}} = \text{MSC}$.
- b. The quantity will increase to three for the public good, since that is the quantity where $D_{\text{public good}} = \text{MSC (MPC)}$.
- c. See Figure 26 for deadweight loss.
- d. Fireworks displays are considered public goods because they are nonexcludable and nonrival. Therefore, individuals who have not paid for the fireworks can still enjoy them, and one person's consumption (enjoyment) does not decrease another person's enjoyment of the fireworks.

Figure 26. Public Good: Danny's Demand and Total Demand (Second Student's Incorrect Graph)

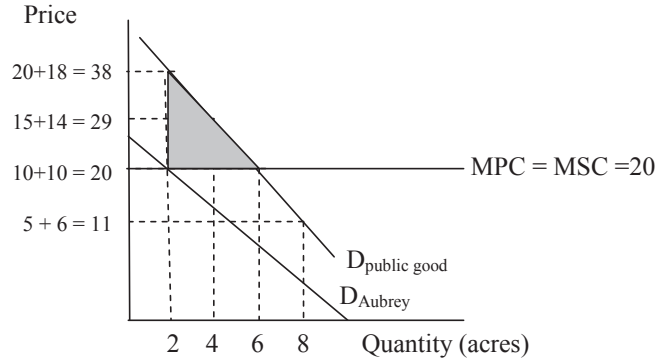


First Student Answer for Question 2

- a. Aubrey and the other residents' demand curves have been summed vertically to determine the market demand curve. See Figure 27.
- b. The efficient quantity (acres of park) will be 6, because that is the equilibrium quantity where $D_{\text{public good}} = \text{MSC (MPC)}$.
- c. See Figure 27 for Aubrey's demand curve.
- d. See deadweight loss shading, Figure 27, if only Aubrey provides the park.



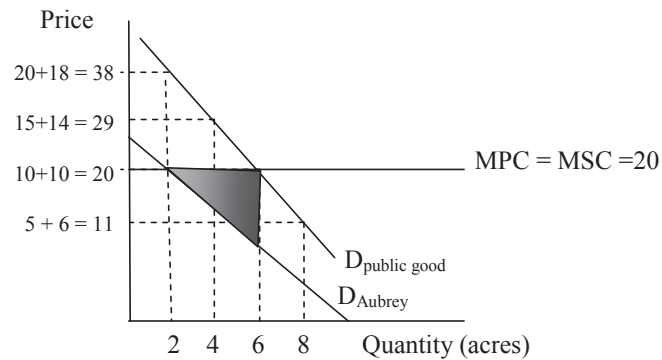
Figure 27. Demand for a Public Good and Aubrey’s Demand (First Student’s Correct Graph)



Second Student Answer for Question 2

- a. Aubrey and all other residents’ demand curves show what each is willing to pay for quantities (acres) of the park. Using that information determines the market demand curve shown below.
- b. The efficient quantity will be 6, where $D_{public\ good} = MSC (MPC)$.
- c. See Figure 28 for Aubrey’s demand curve.
- d. The area of deadweight loss is shown in the graph Figure 28.

Figure 28. Demand for a Public Good and Aubrey’s Demand (Second Student’s Incorrect Graph)



► **Next Steps**

In question 1, students were provided with a graph, Figure 22, to determine the efficient quantity of a public good (i.e., fireworks displays) and the deadweight loss if privately provided (by Danny). In the first student answer for question 1, the student correctly identified the area of deadweight loss (as shown in Figure 25) but provided an incomplete explanation of a public good: the answer stated only who provides public goods and not why certain goods are included in that category. The teacher should remind students that nonrivalry implies that use by one person does not diminish the benefits of use by another; the good can be jointly consumed. Also, once the good is produced for one person, it is difficult or impossible to prevent others from receiving the benefits of the good.

LESSON 2:
Externalities and
Public Goods

In the second student answer for question 1, the student incorrectly shaded the area of deadweight loss shown in Figure 26. The student chose a triangle associated with a quantity of three, but the deadweight loss does not use the marginal social benefit (demand for a public good) and the marginal social cost (also marginal cost, since there are no externalities present) as the determinants of deadweight loss. As mentioned previously, students will benefit from practicing the determination of deadweight loss using the method described in Activity 1.

In question 2, students were asked to create the graph for a public good, given two demand curves (Aubrey and All Other Residents) and the marginal cost curve information. In the first student answer for question 2, the student answered all parts of the question correctly. The graph (shown in Figure 27) is correctly labeled, the demand curve for the public good is accurate, and the marginal cost curve is correctly shown as a horizontal line at a price of \$20. The student has chosen the correct equilibrium quantity and has shown the correct area of deadweight loss if only Aubrey provides the park.

In the second student answer for question 2, the student graphed the public demand curve correctly and identified the efficient quantity but incorrectly shaded the area of deadweight loss in Figure 28. The area should have been determined by using the public demand curve and the marginal social cost (MSC) curve to identify the triangle showing deadweight loss.

Additionally, although the problem is not shown on this sample set, some students may have difficulty determining the public demand curve. Teachers should stress that for a public good, the demand curve reflects a vertical summation, which is the sum of what all the consumers are willing to pay for each quantity. For example, in question 2, Aubrey is willing to pay \$20 for two acres, and all other residents are willing to pay \$18, so the public (Aubrey and all other residents) is willing to pay \$38 for two acres. The process then continues, for all the remaining quantities, to determine the public demand curve. That is why at a quantity of six acres, Aubrey is willing to pay \$10, and all other residents are willing to pay \$10. At this quantity of six acres, the sum of what Aubrey and all other residents are willing to pay (\$20 per acre) equals the marginal social cost (\$20 per acre).

Also, students may not recall that a constant marginal cost curve is shown as a horizontal line. In many of the microeconomics problems, the marginal cost curve (MC or S) is upward sloping. The teacher can remind students to read the question carefully.

Teachers might also remind students that, to receive full credit for their answers, they should be sure to label all the axes and curves correctly. Finally, students should know the characteristics of a public good and the connection between public goods and externalities. It is helpful, as well, for teachers to bring up public “bads” — to explain how the characteristics of goods can lead to negative externalities (that is, not all public goods are *actually* “good”).



Summative Assessment

Assessments that address students' comprehension of market failure and deadweight loss should include questions on efficiency and the loss of efficiency under certain conditions — the existence of market power, externalities, and public goods. Students should be able to explain the following:

- how a monopoly's pricing strategy leads to inefficiency
- why externalities, both negative and positive, prevent the private market from producing the efficient quantity of goods and services
- why public goods are not provided by private markets

The skills being evaluated should primarily focus on problem solving, using graphical analysis. Students should be able to draw the market models correctly and identify the deadweight loss associated with monopolies. They should also be able to determine, graphically, the socially optimal quantity of a good or a service, whether associated with an externality or with a public good. The deadweight loss should be identified in all the graphs that show inefficiency.

Free-response questions may be used in evaluating student comprehension of Lessons 1 and 2. When teachers create assessment rubrics, the following components should be included: credit for graphs with correctly drawn and labeled axes, curves, and correctly shaded areas, as designated in the question; credit for determining price/output combinations specific to the question; and credit for correct explanations using appropriate economic terminology.

All the concepts and skills described in Lessons 1 and 2 are included in the *AP Economics: Microeconomics Macroeconomics Course Description* under "The Nature and Functions of Product Markets" and "Market Failure and the Role of Government."

Curriculum Module Summary

Learning Outcomes

This curriculum module presents several concepts listed in the *AP Economics: Microeconomics Macroeconomics Course Description*. The rationale for including the particular topics is that they focus on problem areas with which students have struggled on previous AP Microeconomics Exams. Some textbooks do not adequately address the content or provide sufficient graphical analysis, so this module furnishes teachers with content and strategies that should lead to improved instruction, comprehension, and performance on the exam.

Next Curricular Steps

The material in this module should prove helpful throughout the teaching of AP Microeconomics. The first topic in Activity 1 concerns efficiency; therefore, the identification of consumer/producer surplus and total surplus will be applicable to each of the main units. Although many course syllabi list *externalities* and *public goods* toward the end of the course, teachers, by using the module, can integrate these concepts into discussions of current events, which often include the topic of externalities and/or the role of government in a market economy. For those who also teach government/civics courses, this module provides the rationale for government's spending on public goods, such as roads, national defense, and transportation. Additional interdisciplinary connections exist, especially with math and science courses. In both courses, the students are expected to draw and interpret graphical data, skills that are an intrinsic part of this module.

Reference

Smith, Adam. (1776) 1977. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Vol. 69. Chicago: University of Chicago Press.



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Note: Contributors' biographical information was current at the time of publication.

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