In Section 3, you will
- describe what a production possibilities curve is and how it is constructed
- explain what economists learn from using production possibilities curves
- analyze how production possibilities curves show economic growth

Beyond these objectives, you will also learn:

- how to describe what a production possibilities curve is and how it is constructed
- how to explain what economists learn from using production possibilities curves
- how to analyze how production possibilities curves show economic growth

**Key Terms**
- economic model, p. 18
- production possibilities curve (PPC), p. 18
- efficiency, p. 18
- underutilization, p. 20
- law of increasing opportunity costs, p. 21

**Taking Notes**
As you read Section 4, complete a summary chart to identify the most important points on production possibilities. Use the Graphic Organizer at Interactive Review @ ClassZone.com

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**Graphing the Possibilities**

In Section 2, you learned that all economic choices involve trade-offs. Economists have created **economic models**—simplified representations of complex economic activities, systems, or problems—to clarify trade-offs. One such model is a **production possibilities curve (PPC)**, a graph used to illustrate the impact of scarcity on an economy by showing the maximum number of goods or services that can be produced using limited resources.

Like all other economic models, the PPC is based on assumptions that simplify the economic interactions. For the PPC these assumptions are:

1. **Resources are fixed.** There is no way to increase the availability of land, labor, capital, and entrepreneurship.
2. **All resources are fully employed.** There is no waste of any of the factors of production. In other words, the economy is running at full production.
3. **Only two things can be produced.** This assumption simplifies the situation and suits the graphic format, with one variable on each axis.
4. **Technology is fixed.** There are no technological breakthroughs to improve methods of production.

Since the curve on a PPC represents the border—or frontier—between what it is possible to produce and what it is not possible to produce, this model is sometimes called a production possibilities frontier. It is a useful tool for businesses and even governments, but it works just as well with individual, small-scale economic decisions. For example, suppose you are preparing food for a soup kitchen and have the ingredients to make 12 loaves of whole wheat bread or 100 bran muffins or some combination of the two. A PPC can help you decide what to make.
Production Possibilities Curve

The production possibilities table in Figure 1.3 below shows five production possibilities for loaves of bread and bran muffins. These production possibilities run from the two extremes of all bread or all muffins through several combinations of the two products. The data in the table also can be plotted on a graph, as in Figure 1.4. The line joining the plotted points is the production possibilities curve. Each point on the curve represents the maximum number of loaves of bread that can be produced relative to the number of bran muffins that are produced.

Further, the PPC shows the opportunity cost of each choice in a visual way. Trace the curve from left to right with your finger. Notice that as you move along the curve you make fewer loaves of bread and more muffins. The opportunity cost of making more muffins is the bread that cannot be made.

**ANALYZE GRAPHS**

1. If you decided to make ten loaves of bread, how many bran muffins could you make?
2. What is the opportunity cost of making the ten loaves of bread?

**APPLICATION Interpreting Graphs**

A. Look at the production possibilities curve in Figure 1.4. What is the opportunity cost of increasing bread production from four loaves to seven loaves?
What We Learn from PPCs

No economy actually operates according to the simplified assumptions underlying the PPC. However, economists use the simplified model because it spotlights concepts that work in the real world of scarce resources.

One important concept revealed in a PPC is **efficiency**, the condition in which economic resources are being used to produce the maximum amount of goods and services. Another is **underutilization**, the condition in which economic resources are not being used to their full potential. As a result, fewer goods and services are being produced than the economy is capable of making. Both of these conditions are easy to see in the PPC.

**EXAMPLE  Efficiency and Underutilization**

Figure 1.5 shows the classic production possibilities model of guns vs. butter. In this model, “guns” is shorthand for military spending and “butter” represents consumer products. Every point along this PPC shows a different combination of military and consumer production. Regardless of the combination, each point represents efficiency, the most that can be produced with the available resources.

Any point inside the curve represents underutilization, or the inefficient use of available resources. Look again at Figure 1.5 and notice that point 3 indicates that all resources are not fully employed. The PPC shows that the economy is capable of producing either 47 million more guns (point 1 on the curve) or 30 million more pounds of butter (point 4).

**QUICK REFERENCE**

- **Efficiency** involves producing the maximum amount of goods and services possible.
- **Underutilization** means producing fewer goods and services than possible.

**ANALYZE GRAPHS**

1. What is the opportunity cost of moving butter production from 1 to 2?
2. At 3, factors of production are not being used efficiently. Identify a situation where this might occur.

Use an interactive production possibilities curve at ClassZone.com
2 on the curve). Any point outside the curve is impossible to meet because resources are fixed. To produce the number of guns indicated at point 4, fewer pounds of butter would have to be made (point 1 on the curve). Similarly, to produce the amount of butter indicated at point 4, fewer guns would have to be made (point 2 on the curve).

The shape of the PPC shows a third important economic concept. This is the **law of increasing opportunity costs**, which states that as production switches from one product to another, increasingly more resources are needed to increase the production of the second product, which causes opportunity costs to rise.

**EXAMPLE Increasing Opportunity Costs**

Return again to Figure 1.5. A nation makes 250 million pounds of butter (point 1 on the curve), but wants to make 280 million pounds (point 2 on the curve). The opportunity cost of making the extra 30 million pounds of butter is 37 million guns. That works out to a cost of about 1.2 guns for every pound of butter. If the nation increases its output of butter to 312 million pounds (point 5 on the curve), the opportunity cost of the change would be 63 million guns, nearly 2 guns for every pound of butter. This increase in the opportunity cost—each additional unit costs more to make than the last—explains why the curve is bow-shaped.

The reason for the increasing costs is fairly straightforward. Making butter involves different resources than making guns. Converting from gun production to butter production is not a simple procedure. New machinery must be produced, new factories must be built, and workers must be retrained. The cost of all these actions will be fewer and fewer guns.

**APPLICATION Writing about Economics**

B. Write a brief paragraph explaining the concepts a PPC shows graphically.

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**QUICK REFERENCE**

The **law of increasing opportunity costs** states that as production switches from one product to another, increasing amounts of resources are needed to increase the production of the second product.

**Opportunity Cost** In the guns vs. butter equation, if more resources are used to make military products, such as stealth bombers, there are fewer resources available for other things, such as butter and other consumer goods. The opportunity cost of making more military products is the other products that cannot be made.
Changing Production Possibilities

The PPC illustrates a country’s present production possibilities as if all resources are fixed. However, a country’s supply of resources is likely to change over time. When additional resources become available, new production possibilities beyond the original frontier become attainable, and the PPC moves outward.

**EXAMPLE A Shift in the PPC**

In the late 1700s, the United States occupied a relatively narrow strip of land along the Atlantic Coast. Yet in less than a hundred years, it had expanded to the Pacific Ocean. This additional land provided the United States with an abundance of natural resources. Similarly, successive waves of immigration have added huge numbers of workers to the labor pool. Also, new technology has made the use of land, labor, and capital more efficient.

The addition of new resources or the more efficient use of resources already available meant that the United States could produce more goods and services. This is shown on the PPC as a shift of the curve outward, or to the right, as Figure 1.6 illustrates. Economists refer to this increase in the economy’s total output as economic growth. You’ll learn more about this concept in Chapter 12.

**APPLICATION Applying Economic Concepts**

C. Identify three developments that would cause the PPC to move outward.

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**ANALYZE GRAPHS**

1. If the curve PPC2 represents current production possibilities, what does point 1 represent?
2. What might cause the PPC to shift inward?
1. Explain how each of these terms is illustrated by the production possibilities curve.
   a. underutilization 
   b. efficiency

2. On what assumptions is the PPC based? Explain how these conditions do not correspond to the real world.

3. What economic data does a PPC bring together?

4. Why do opportunity costs increase as you make more and more butter and fewer guns?

5. Based on what we learn from PPCs, what does an economy need to be able to produce more of both products on the graph?

6. Using Your Notes Write a one-paragraph summary of this section. Refer to your completed summary chart for the ideas to use in your summary.

Use the Graphic Organizer at Interactive Review @ ClassZone.com

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**Creating a PPC**

The following information reflects the production possibilities of an economy that makes only corn and television sets. Use the data to create a production possibilities curve.

<table>
<thead>
<tr>
<th>Bushels of Corn</th>
<th>Television Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

Label Points on a PPC Use the letters to locate the following points on your PPC:

A The point at which the economy makes all TVs and no corn
B A point representing efficiency
C A point representing underutilization
D A point representing an impossible level of production

**Challenge** Use information from your PPC to explain the law of increasing opportunity costs.

Use SMART Grapher @ClassZone.com to complete this activity.