11.4 Three-Dimensional Figures
For use with Exploration 11.4

Essential Question  What is the relationship between the numbers of vertices $V$, edges $E$, and faces $F$ of a polyhedron?

1 EXPLORATION: Analyzing a Property of Polyhedra

Work with a partner. The five Platonic solids are shown below. Each of these solids has congruent regular polygons as faces. Complete the table by listing the numbers of vertices, edges, and faces of each Platonic solid.

<table>
<thead>
<tr>
<th>Solid</th>
<th>Vertices, $V$</th>
<th>Edges, $E$</th>
<th>Faces, $F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>tetrahedron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cube</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>octahedron</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>dodecahedron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>icosahedron</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Communicate Your Answer

2. What is the relationship between the numbers of vertices \( V \), edges \( E \), and faces \( F \) of a polyhedron? (Note: Swiss mathematician Leonhard Euler (1707–1783) discovered a formula that relates these quantities.)

3. Draw three polyhedra that are different from the Platonic solids given in Exploration 1. Count the number of vertices, edges, and faces of each polyhedron. Then verify that the relationship you found in Question 2 is valid for each polyhedron.
11.4 Notetaking with Vocabulary
For use after Lesson 11.4

In your own words, write the meaning of each vocabulary term.

polyhedron

face

edge

vertex

cross section

solid of revolution

axis of revolution

Notes:
11.4 Notetaking with Vocabulary (continued)

Core Concepts

Types of Solids

Polyhedra
- prism
- pyramid

Not Polyhedra
- cylinder
- cone
- sphere

Notes:

Extra Practice

In Exercises 1 and 2, tell whether the solid is a polyhedron. If it is, name the polyhedron.

1. 

2. 

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11.4 Notetaking with Vocabulary (continued)

In Exercises 3–6, describe the cross section formed by the intersection of the plane and the solid.

3. 

4. 

5. 

6. 

In Exercises 7 and 8, sketch the solid produced by rotating the figure around the given axis. Then identify and describe the solid.

7. 

8.