

**Destination L1: A Thematic Unit**

**Minimum Energy Transfer Orbits**

**TEACHER GUIDE SUPPLEMENT**

**GROUP SUPPLEMENT**

A group summary chart can help you review and remember information from a text. Students should work in groups to fill in the chart using the background information in the student activity. The box in the upper left is used to provide a general description of the information. This might be a one-sentence summary of the text. The upper right box is used to list the detailed supporting information—in this case, a description of the variables and formulas used. The lower left box states how the information is used. The box in the lower right lists any historical connections. Use the group summary chart below as you read the background information and procedures on your student activity sheet.

<b>Group Summary for Minimum Energy Transfer Orbits</b>	
<p><b>Description</b></p> <p>The background information has information about how a spacecraft can move from one planet to another in our solar system.</p>	<p><b>Components</b></p> <ul style="list-style-type: none"> <li>• There are two planets (1 and 2) orbiting the sun.</li> <li>• The planets are in circular orbits.</li> <li>• Planet 1 has a faster speed than Planet 2, which is further away from the sun.</li> <li>• The spacecraft will travel from Planet 1 to Planet 2 in an elliptical orbit.</li> <li>• Planet 1 is a distance of “R1” from the sun and planet 2 is at a distance of “R2” from the sun.</li> <li>• <math>a = (R_1 + R_2)/2</math></li> <li>• <math>P^2 = k \times a^3</math></li> <li>• P is the orbital period of a planet in years</li> </ul>
<p><b>Uses</b></p> <p>The formula <math>P^2 = k \times a^3</math> can be used to find the Hohmann minimum energy transfer orbit Earth to another planet in our solar system.</p> <p>The Excel spreadsheet can be used to find:</p> <ol style="list-style-type: none"> <li>1. The velocity of the starting and ending planets.</li> <li>2. The velocity of the spacecraft in transit.</li> <li>3. The time of flight for the spacecraft to get from one planet to another.</li> </ol>	<p><b>Historical Connection</b></p> <p>Walter Hohmann developed the technique for minimum transfer orbits in 1925.</p>