Satellites Module
(Grades 9-12)

What are the essential questions for this module?

- What is a projectile?
- How do gravity, velocity, and angle of launch affect the motion of a projectile?
- What are the types of satellite orbits? Why do we use satellites?
- What projectile velocities result in a successful orbit?
- What is the history of projectiles and satellites?

What are the central ideas of this module?

Students will be able to define and predict the movement of a projectile (including satellites). They will be able to compare and contrast the types of satellite orbits. They will be able to describe how types of satellite orbits determine satellite usage. They will be able to list 3 factors affecting the launch of satellites.

What Arizona Science State Standards are addressed?

- **Strand 5: Physical Science**
  - **Concept 2: Motions and Forces**
    - PO 4: Newton’s second Law
    - PO 6: Analyze the two-dimensional motion of objects by using vectors and their components.
    - PO 7: Give an example that shows the independence of the horizontal and vertical components of projectile motion.
    - PO 8: Analyze the general relationships among force, acceleration, and motion for an object undergoing uniform circular motion.
    - PO 11: Using the Law of Universal Gravitation, predict how the gravitational force will change when the distance between two masses changes or the mass of one of them changes.

What do students need to know to work with this module?

- Use of a protractor to measure angles
- Familiarity with the use of computers and the internet
- Basic reading skills
- Metric system (length)
- Motion in terms of speed, direction and velocity
- Mass and its relation to weight
- Gravitational pull of matter
- Inertia (Newton’s First Law of motion)
<table>
<thead>
<tr>
<th>What will students understand as a result of their work with this module?</th>
<th>How will students come to this understanding? They will…</th>
<th>How will students demonstrate this understanding? They will…</th>
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<tbody>
<tr>
<td>Define “projectile” as any object that moves through the air or through space, acted on only by gravity (and air resistance, if any), continuing in motion by its own inertia.</td>
<td>• Read and analyze information</td>
<td>• Identify which images are projectiles and answer questions that follow.</td>
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<tr>
<td>Predict the movement of a projectile when the velocity, gravity, and angle launched changes.</td>
<td>• Read and analyze information • Using a simulation, explore how changing velocity, gravity (on different planets), and angle launched affect the motion of a projectile (aimed at a target).</td>
<td>• Students will adjust settings to hit a target with a projectile and answer questions regarding how these 3 factors affect a projectile’s launch.</td>
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<tr>
<td>The similarities and differences between the motion of a projectile versus a satellite.</td>
<td>• Read and analyze information</td>
<td>• Answer question comparing projectile definition to satellite definition.</td>
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<tr>
<td>The type of orbit a satellite can have and how its orbit determines its usage.</td>
<td>• Read and analyze information • Using a simulation, explore and view the orbital types, their coverage of the Earth, and their properties (potential uses).</td>
<td>• Properly manipulate satellite orbits and explain how satellite orbit influences satellite use.</td>
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<td>The common uses of satellites including military, data collection and communications (GPS, TV, emergency beacons, etc).</td>
<td>• Read and analyze information • Using a simulation, explore the effective orbit type on use.</td>
<td>• Answer questions about altitude of satellites and how this affects their uses.</td>
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<td>The history of projectiles and satellites.</td>
<td>• Manipulate the timeline to view and read important projectile milestones.</td>
<td>• Answer questions that relate to timeline.</td>
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