WHERE ARE THE SMALL WORLDS?

Middle School Common Core State Standards Alignment

WHAT STUDENTS DO: Use a model to collect data in the solar system.

Students will explore our solar system from the perspective of the Sun. They will observe the motion of different worlds to determine their location in the solar system. Then they will launch probes to search these small worlds for the caches hidden on them in order to collect the astrocoins inside.

NRC FRAMEWORK/NGSS CORE & COMPONENT QUESTIONS

WHAT IS THE UNIVERSE, AND WHAT IS EARTH’S PLACE IN IT?

NGSS Core Question: ESS1: Earth’s Place in the Universe

What is the universe, and what goes on in stars?

NGSS ESS1.A: The Universe and its Stars

What are the predictable patterns caused by Earth’s movement in the solar system?

NGSS ESS1.B: Earth and the Solar System

INSTRUCTIONAL OBJECTIVES (IO)

Students will be able to

IO1: Use a model to make observations, analyze, and interpret empirical evidence to identify patterns in the phenomena of solar system arrangement.

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1.0 About This Activity

How Students Learn: Science in the Classroom (Donovan & Bransford, 2005) advocates the use of a research-based instructional model for improving students’ grasp of central science concepts. Based on conceptual-change theory in science education, the 5E Instructional Model (BSCS, 2006) includes five steps for teaching and learning: Engage, Explore, Explain, Elaborate, and Evaluate. The Engage stage is used like a traditional warm-up to pique student curiosity, interest, and other motivation-related behaviors and to assess students’ prior knowledge. The Explore step allows students to deepen their understanding and challenges existing preconceptions and misconceptions, offering alternative explanations that help them form new schemata. In Explain, students communicate what they have learned, illustrating initial conceptual change. The Elaborate phase gives students the opportunity to apply their newfound knowledge to novel situations and supports the reinforcement of new schemata or its transfer. Finally, the Evaluate stage serves as a time for students’ own formative assessment, as well as for educators’ diagnosis of areas of confusion and differentiation of further instruction. The 5E stages can be cyclical and iterative.
2.0 Instructional Objectives, Learning Outcomes, Standards, & Rubrics

Visit [https://infiniscope.org/lesson/where-are-the-small-worlds/](https://infiniscope.org/lesson/where-are-the-small-worlds/) for access to the digital learning experience, lesson plans, standards alignment documents, and additional resources.

Instructional objectives and learning outcomes are aligned with:

- **Achieve Inc.’s, Next Generation Science Standards (NGSS)**
- **National Research Council’s, A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas**
- **National Governors Association Center for Best Practices (NGA Center) and Council of Chief State School Officers (CCSSO)’s, Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects**
- **Partnership for 21st Century Skills, A Framework for 21st Century Learning**

The following chart provides details on alignment among the core and component NGSS questions, instructional objectives, learning outcomes, and educational standards.

- Your **instructional objectives (IO)** for this lesson align with the Common Core State Standards.
- You will know that you have achieved these instructional objectives if students demonstrate the related **learning outcomes (LO)**, also aligned with the Common Core State Standards.
- You will know the level to which your students have achieved the learning outcomes by using the suggested **rubrics**.

**Quick View of Standards Alignment:**

This alignment document provides full details of the way in which instructional objectives, learning outcomes, 5E activity procedures, and rubric assessments were derived through, and align with the Common Core State Standards. For convenience, a quick view follows:
WHAT IS THE UNIVERSE, AND WHAT IS EARTH’S PLACE IN IT?

NGSS Core Question: ESS1: Earth’s Place in the Universe

What is the universe, and what goes on in stars?
NGSS ESS1.A: The Universe and its Stars

What are the predictable patterns caused by Earth’s movement in the solar system?
NGSS ESS1.B: Earth and the Solar System

<table>
<thead>
<tr>
<th>Instructional Objective</th>
<th>Learning Outcomes</th>
<th>Standards</th>
</tr>
</thead>
</table>
| Students will be able to make observations, analyze, and interpret empirical evidence to identify patterns in the phenomena of solar system arrangement. | **LO1a:** Use a model (Sun-based view and Bird’s eye view) to observe the motion and relative speed of an object to predict its location in the solar system. **LO1b:** Explain the relationship of relative speed (pattern in the rate of change) vs distance of the object in the solar system. **LO1c:** Identify and evaluate limitations of the solar system model. **LO1d:** Develop a hypothesis to explain the origin of small world zones. | **WRITING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS:**
- Text Types and Purposes
  - CCSS.ELA-LITERACY.WHST.6-8.1
  - CCSS.ELA-LITERACY.WHST.6-8.2

**MATH STANDARDS:**
- Ratios and Proportional Relationships
  - CCSS.MATH.RP.6.3.1
  - CCSS.MATH.RP.6.3.2
  - CCSS.MATH.RP.7.1
  - CCSS.MATH.RP.7.3
3.0 Learning Outcomes, NRC Framework, NGSS, Common Core, & 21st Century Skills Connections

The connections diagram is used to organize the learning outcomes addressed in the lesson to establish where each will meet the Next Generation Science Standards, Common Core Standards, and the 21st Century Skills and visually determine where there are overlaps in these documents. See NGSS Alignment Document and 21st Century Skills Alignment Document for details on their specific alignments.

**LO1a:** Use a model (Sun-based view and Bird's eye view) to observe the motion and relative speed of an object to predict its location in the solar system.

**LO1b:** Explain the relationship of relative speed (pattern in the rate of change) vs distance of the object in the solar system.

**LO1c:** Identify and evaluate limitations of the solar system model.

**LO1d:** Develop a hypothesis to explain the origin of small world zones.

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4.0 Evaluation/Assessment

Use the *(N)* Where are the small worlds? Alignment Rubric as a formative and summative assessment, allowing students to improve their work and learn from mistakes during class. The rubric evaluates the activities using the Common Core State Standards.

5.0 References

Achieve, Inc. (2013). Next generation science standards. Achieve, Inc. on behalf of the twenty-six states and partners that collaborated on the NGSS.


WHERE ARE THE SMALL WORLDS?

(M) Teacher Resource. Where are the small worlds? Common Core State Standards Alignment (1 of 2)

You will know the level to which your students have achieved the **Learning Outcomes**, and thus the **Instructional Objective(s)**, by using the suggested **Rubrics** below.

<table>
<thead>
<tr>
<th>Common Core State Standards</th>
<th>Writing Standards for Literacy in Science and Technical Subjects (6-8)</th>
<th>MATH STANDARDS (6-8)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instructional Objective</strong></td>
<td><strong>Text Types and Purposes:</strong> CCSS.ELA-LITERACY.WHST.6-8.1**</td>
<td><strong>Ratios and Proportional Relationships</strong> CCSS.MATH.RP.6.3.1</td>
</tr>
<tr>
<td>IO1:</td>
<td>Write arguments focused on discipline-specific content.</td>
<td>Understand ratio concepts and use ratio reasoning to solve problems.</td>
</tr>
<tr>
<td></td>
<td>a. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.</td>
<td>Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.</td>
</tr>
<tr>
<td></td>
<td>b. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.</td>
<td>a. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.</td>
</tr>
<tr>
<td></td>
<td>c. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.</td>
<td><strong>CCSS.MATH.RP.6.3.2</strong> Understand ratio concepts and use ratio reasoning to solve problems.</td>
</tr>
<tr>
<td></td>
<td>d. Establish and maintain a formal style.</td>
<td>Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.</td>
</tr>
</tbody>
</table>
|                            | e. Provide a concluding statement or section that follows from and supports the argument presented. | b. Solve unit rate problems including those involving unit pricing and constant speed. For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in...
35 hours? At what rate were lawns being mowed?

**CCSS.MATH.RP.7.1**
Analyze proportional relationships and use them to solve real-world and mathematical problems.
1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks ½ mile in each ¼ hour, compute the unit rate as the complex fraction \( \frac{\frac{1}{2}}{\frac{1}{4}} \text{ miles per hour} \), equivalently 2 miles per hour.

**CCSS.MATH.RP.7.3**
Analyze proportional relationships and use them to solve real-world and mathematical problems.
3. Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.
### Common Core State Standards

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Writing Standards for Literacy in Science and Technical Subjects (6-8)</th>
<th>MATH STANDARDS (6-8)</th>
</tr>
</thead>
</table>
| **LO1b:** Explain the relationship of relative speed (pattern in the rate of change) vs distance of the object in the solar system. | Text Types and Purposes: CCSS.ELA-LITERACY.WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.  
  a. Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.  
  b. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.  
  c. Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.  
  d. Use precise language and domain-specific vocabulary to inform about or explain the topic.  
  e. Establish and maintain a formal style and objective tone.  
  f. Provide a concluding statement or section that follows from and supports the information or explanation presented. | Ratios and Proportional Relationships CCSS.MATH.RP.6.3.1 Understand ratio concepts and use ratio reasoning to solve problems.  
  Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.  
  b. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.  
  CCSS.MATH.RP.6.3.2 Understand ratio concepts and use ratio reasoning to solve problems.  
  Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.  
  c. Solve unit rate problems including those involving unit pricing and constant speed. For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed? |
<table>
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<tr>
<th>LO1d: Develop a hypothesis to explain the origin of small world zones.</th>
<th></th>
</tr>
</thead>
</table>
| Text Types and Purposes: **CCSS.ELA-LITERACY.WHST.6-8.1** | CCSS.MATH.RP.7.1  
Analyze proportional relationships and use them to solve real-world and mathematical problems.  
1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks \( \frac{1}{2} \) mile in each \( \frac{1}{4} \) hour, compute the unit rate as the complex fraction \( \frac{\frac{1}{2}}{\frac{1}{4}} \) miles per hour, equivalently 2 miles per hour.  

**CCSS.MATH.RP.7.3**  
Analyze proportional relationships and use them to solve real-world and mathematical problems.  
3. Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error. |
WHERE ARE THE SMALL WORLDS?

(N) Teacher Resource. Where are the small worlds? Common Core State Standards Alignment Rubric

Related Rubrics for the Assessment of Learning Outcomes Associated with the Above Standard(s):

### Common Core State Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Expert</th>
<th>Proficient</th>
<th>Intermediate</th>
<th>Beginner</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCSS.ELA.LITERACY.WHST.6-8.1</td>
<td>Introduces topic clearly, provides a general observation and focus, and groups related information logically; Develops the topic with facts, definitions, concrete details, or other examples related to the topic; Links ideas using words, phrases, and clauses; Uses domain-specific vocabulary to explain the topic; Provides a concluding statement related to the explanation.</td>
<td>Introduces topic clearly, provides a general observation, or groups related information logically; Develops the topic with concrete details, or other examples related to the topic; Links ideas using words or phrases; Uses domain-specific vocabulary to explain the topic; Provides a concluding statement related to the explanation.</td>
<td>Introduces topic, provides a general observation; Develops the topic with details, or other examples related to the topic; Links ideas using words or phrases; Uses domain-specific vocabulary to explain the topic.</td>
<td>Introduces topic; attempts to provide details or unrelated examples; Uses day to day vocabulary to explain the topic.</td>
</tr>
<tr>
<td>CCSS.ELA.LITERACY.WHST.6-8.2</td>
<td>Introduces claim clearly, provides alternate or opposing claim and organizes evidence logically using domain-specific vocabulary; Supports the claim with logical data and evidence; Links claims and counter-claims coherently using words, phrases, and clauses; Provides a concluding statement that supports the claim.</td>
<td>Introduces claim clearly and organizes evidence logically using domain-specific vocabulary; Supports the claim with logical data and evidence; Links claims coherently using words, phrases and clauses; Provides a concluding statement that supports the claim.</td>
<td>Introduces claim, provides a piece of evidence; Links the evidence and claim coherently using words, phrases and clauses; Provides a concluding statement that supports the claim.</td>
<td>Introduces claim; attempts to provide evidence or unrelated evidence; Uses day to day vocabulary to explain the claim and evidence.</td>
</tr>
<tr>
<td>CCSS.MATH.RP.6.3.1</td>
<td>Sets the ratio up correctly and accurately solves for the relative speed of objects in the solar system compared to Earth. Accurately explains the relationship between the speed of the objects and their location in the solar system based on this calculation.</td>
<td>Sets the ratio up correctly and solves for the relative speed of objects in the solar system compared to Earth. Attempts to explain the relationship between the speed of the objects and their location in the solar system based on this calculation.</td>
<td>Sets the ratio up and solves for the relative speed of objects in the solar system compared to Earth.</td>
<td>Uses values provided in a non-ratio type of equation.</td>
</tr>
</tbody>
</table>

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