Where are the small worlds?

Middle School 21st Century Skills Standards Alignment

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

Learners 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.
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/ 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 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

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 21st Century Skills.
- You will know that you have achieved these instructional objectives if students demonstrate the related learning outcomes (LO), also aligned with 21st Century Skills.
- 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 21st Century Skills. 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*

## Instructional Objective

Students will be able to:

## Learning Outcomes

Students will demonstrate the measurable abilities:

**IO1:** Use a model 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.

## Standards

Students will address:

- Communication
  - Grade 8 Benchmark

This material is based upon work supported by NASA under cooperative agreement No. NNX16AD79A. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration. This lesson was prepared by Arizona State University’s Education Through eXploration (ETX) Center. Lesson formatting was adopted and adapted from Arizona State University’s Mars Education Program. The lesson and its’ associated materials may be photocopied and distributed freely for non-commercial purposes. Copyright 2016-2021.

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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 Common Core State Standards 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.
- **LO1c:** Identify and evaluate limitations of the solar system model.
- **LO1b:** Explain the relationship of relative speed (pattern in the rate of change) vs distance of the object in the solar system.
- **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 21st Century Skills.

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? 21st Century Skills 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>Instructional Objective</th>
<th>21st Century Skill</th>
<th>Grade 8 Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>IO1: Use a model to make observations, analyze, and interpret empirical evidence to identify patterns in the phenomena of Solar System arrangement.</td>
<td>Communication</td>
<td>Students are familiar with the use of computational models as tools to describe and predict real-world phenomena.</td>
</tr>
<tr>
<td>Learning Outcomes</td>
<td>21st Century Skill</td>
<td>Grade 8 Benchmark</td>
</tr>
<tr>
<td>-------------------</td>
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</tr>
<tr>
<td>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.</td>
<td>Communication</td>
<td>Students are familiar with the use of computational models as tools to describe and predict real-world phenomena.</td>
</tr>
<tr>
<td>LO1b: Explain the relationship of relative speed (pattern in the rate of change) vs distance of the object in the solar system.</td>
<td>Communication</td>
<td>Students are familiar with the use of computational models as tools to describe and predict real-world phenomena.</td>
</tr>
<tr>
<td>LO1c: Identify and evaluate limitations of the solar system model.</td>
<td>Communication</td>
<td>Students are familiar with the use of computational models as tools to describe and predict real-world phenomena.</td>
</tr>
</tbody>
</table>
**WHERE ARE THE SMALL WORLDS?**

(N) Teacher Resource. Where are the small worlds? 21st Century Skills Alignment Rubric

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

**Partnership for 21st Century Skills**

<table>
<thead>
<tr>
<th>Communication</th>
<th>Expert</th>
<th>Proficient</th>
<th>Intermediate</th>
<th>Beginner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Names at least one relevant limitation to the solar system model provided and clearly and correctly articulates how the limitation affected exploration.</td>
<td>Names at least one relevant limitation to the solar system model provided and attempts to articulate how the limitation affected exploration.</td>
<td>Names at least one relevant limitation to the solar system model provided.</td>
<td>Attempts to name a limitation.</td>
</tr>
</tbody>
</table>