**Lesson 14**

# Sharing Designs of Sustainable Communities on Mars

**Grades:  6-8        Prep Time:  10 Minutes        Lesson Time:  2-3 Hours**

## WHAT STUDENTS DO:  Present Designs

In designing a sustainable community for the extreme environment on Mars, where did students' curiosity lead?  What did it enable them to create?  How can curiosity and creativity inspire others?  Communicating and collaborating is a key component of 21st-Century Skills.  In this activity, students listen to experts give advice on presentations.  They review Tips for Presentations and complete an outline of information to prepare for a talk about their community on Mars.  Finally, students present their design for a community on Mars and other aspirations.  In this collection, this lesson provides a synthesis and summative experience for students, allowing them to share their newly developed problem-solving skills and their design-based solutions with others.  It originates from the Imagine Mars Project, co-sponsored by NASA and the National Endowment for the Arts: http://imaginemars.jpl.nasa.gov

| NRC CORE & COMPONENT QUESTIONS | INSTRUCTIONAL OBJECTIVES |
| --- | --- |
| **HOW DO ENGINEERS SOLVE PROBLEMS?**<br>*NRC Core Question: ETS1:  Engineering Design* | *Students will be able* |
| **What Is a Design for? What are the criteria and constraints of a successful solution?**<br>*NRC ETS1.A:  Defining & Delimiting an Engineering Problem* | **IO1:  to produce** a presentation of a model that aligns with design and communications criteria |

*See Section 4.0 and Teacher Guide at the end of this lesson for details on Instructional Objective(s), Learning Outcomes, Standards, & and Rubrics.*

## 1.0  About This Activity

This activity is part of the Imagine Mars Project, co-sponsored by NASA and the National Endowment for the Arts (NEA). The Imagine Mars Project is a hands-on, STEM-based project that asks students to work with NASA scientists and engineers to imagine and to design a community on Mars using science and technology, then express their ideas through the arts and humanities, integrating 21st Century skills. The Imagine Mars Project enables students to explore their own community and decide which arts-related, scientific, technological, and cultural elements will be important on Mars. Then, they develop their concepts relating to a future Mars community from an interdisciplinary perspective of the arts, sciences, and technology. http://imaginemars.jpl.nasa.gov

The Imagine Mars lessons leverage *A Taxonomy for Learning, Teaching, and Assessing* by Anderson and Krathwohl (2001) (See *Section 4* and *Teacher Guide* at the end of this document). This taxonomy provides a framework to help organize and align learning objectives, activities, and assessments.  The taxonomy has two dimensions.  The first dimension, cognitive process, provides categories for classifying lesson objectives along a continuum, at increasingly higher levels of thinking; these verbs allow educators to align their instructional objectives and assessments of learning outcomes to an appropriate level in the framework in order to build and support student cognitive processes.  The second dimension, knowledge, allows educators to place objectives along a scale from concrete to abstract.  By employing Anderson and Krathwohl's (2001) taxonomy, educators can better understand the construction of instructional objectives and learning outcomes in terms of the types of student knowledge and cognitive processes they intend to support.  All activities provide a mapping to this taxonomy in the Teacher Guide (at the end of this lesson), which carries additional educator resources. Combined with the aforementioned taxonomy, the lesson design also draws upon Miller, Linn, and Gronlund's (2009) methods for (a) constructing a general, overarching, instructional objective with specific, supporting, and measurable learning outcomes that help assure the instructional objective is met, and (b) appropriately assessing student performance in the intended learning-outcome areas through rubrics and other measures.  Construction of rubrics also draws upon Lanz's (2004) guidance, designed to measure science achievement.

*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. This five-part sequence is the organizing tool for the Imagine Mars instructional series.  The 5E stages can be cyclical and iterative.

## 2.0  Materials

### Required Materials

#### Please supply:

- LCD projector and computer
- Note cards (several per student)

#### Please Show:

- 30-second MBA video: How Do I Prepare for an Important Presentation?
  http://www.30secondmba.com/question/how-do-i-prepare-important-presentation

#### Please Print:

#### From Student Guide

| | | |
|---|---|---|
| (A) | Tips for Presentations | – 1 per student |
| (B) | Topics to Include in Presentation | – 1 per team |
| (C) | Presentation Checklist | – 1 per student |

### Optional Materials

#### From Teacher Guide

| | | |
|---|---|---|
| (D) | "Share" Assessment Rubrics | |
| (E) | Alignment of Instructional Objectives, Standards, & Learning Outcomes | |

## 3.0  Vocabulary

**Community planning** — the process of thinking systematically through neighborhood-based problems and situations (The Enterprise Foundation, 1999)

**Constraints** — restricting or limiting circumstances

**Critique** — a helpful analysis meant to point out areas for improvements

**Design Criteria** — the standards that are used to judge a proposal

**Explanations** — logical descriptions applying scientific and technological information

**Evaluate** — check the scientific validity or soundness

**Inflection** — altering the pitch or tone of your voice for dynamic speaking

**Investigation** — an exploration of a topic or question to gain information

**Models**                 a simulation that helps explain natural and man-made systems and shows possible flaws

**Reasoning**              reaching conclusions based on facts

## 4.0  Instructional Objectives, Learning Outcomes, Standards, & Rubrics

Instructional objectives, standards, and learning outcomes are aligned with the National Research Council's *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, which serves as a basis for upcoming "Next-generation Science Standards."  Current National Science Education Standards (NSES) and other relevant standards are listed for now, but will be updated when the new standards are available.

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

- Your **instructional objectives (IO)** for this lesson align with the NRC Framework and education standards.

- You will know that you have achieved these instructional objectives if students demonstrate the related **learning outcomes (LO)**.

- You will know the level to which your students have achieved the learning outcomes by using the suggested **rubrics** (see Teacher Guide at the end of this lesson).

**Quick View of Standards Alignment:**

The Teacher Guide at the end of this lesson provides full details of standards alignment, rubrics, and the way in which instructional objectives, learning outcomes, 5E activity procedures, and assessments were derived through, and align with, Anderson and Krathwohl's (2001) taxonomy of knowledge and cognitive process types.  For convenience, a quick view follows:

| HOW DO ENGINEERS SOLVE PROBLEMS? | | | |
| --- | --- | --- | --- |
| *NRC Core Question: ETS1:  Engineering Design*<br>**What Is a Design for? What are the criteria and constraints of a successful solution?**<br>*NRC Component Question ETS1.A:  Defining & Delimiting an Engineering Problem* | | | |
| **Instructional Objective**<br>*Students will be able* | **Learning Outcomes**<br>*Students will demonstrate the measurable abilities* | **Standards**<br>*Students will address* | |
| **IO1:**<br><br>**to produce** a presentation of a model that aligns with design and communications criteria | **LO1a.** **to explain** the way in which the design addresses human needs in the context of environmental constraints and culture<br>**LO1b.** **to summarize** priorities in a design that address societal challenges per criteria<br><br>**LO1c.** **to explain** how technologies can overcome societal challenges<br>**L01d.** **to critique** presentation skills against criteria<br><br>**L01e.** **to execute** criteria-based presentation | **NSES (E):  SCIENCE & TECHNOLOGY:**<br>    **Abilities of Technological Design**<br><br>        **Grades 5-8:  E2e:**  Technological designs have constraints.<br><br>**NSES (E):  SCIENCE IN PERSONAL & SOCIAL PERSPECTIVES:**<br>    **Science & Technology in Society**<br><br>        **Grades 5-8:** F5b<br><br>**21st Century Skills: Communication & Collaboration**<br><br>        **Communicate Clearly** | *Rubrics in Teacher Guide* |

## 5.0  Procedure

# PREPARATION (~15 minutes)

**Set up:**

- LCD Projector and computer, linked to:

  30 Second MBA video – How Do I Prepare for an Important Presentation?
  http://www.30secondmba.com/question/how-do-i-prepare-important-presentation

## STEP 1:  ENGAGE (~10 minutes)
### Understand the basics of successful presentations.

    **A.** Explain to students that they will be presenting information about their communities.

    **B.** Show students video of expert giving tips on presentations.

    **C.** Have students jot down the big ideas that the expert shares.

    **D.** At the end of the video, ask students to share their ideas.

## STEP 2:  EXPLORE (~10 minutes)
### Self-assess presentation skills.

    **A.** Give students *(A) Tips for Presentations*.

    **B.** Direct students to put a ☺ by tips at which they excel and a ☹ by tips which need improvement.

    **C.** Allow students to share their reflections with a partner.

## STEP 3:  EXPLAIN (~30 minutes)
### Prepare talking points.

    **A.** Give students *(B) Topics to Include in Presentation*.

    **B.** Explain that their presentations will need to include an explanation about how each technology in their communities addresses the criteria.

    **C.** Allow students time to work in groups to complete information on each topic.

## STEP 4:  ELABORATE (~10 minutes)
### Practice presentations.

    **A.** Remind students of presentation time limitations (recommended: 10 minutes) and that everyone must participate equally.

    **B.** Give each student notecards and review the Tip about using notecards.

    **C.** In groups, students should write key points on notecards for their presentation.

    **D.** Once they have finished, give each student *(C) Presentation Checklist for Students* and review directions (be sure to point out the difference between self-reflection & group feedback).

E. Direct students to practice in their groups.

F. If there is time, allow students to practice presenting to a different group, with that group giving feedback based on the Checklist.

## STEP 5:  EVALUATE (~60 minutes)
### Present Information.

A. Allow students to present their information.

 **Teacher Tip:**  You can mark student proficiency using the *(D) "Share" Rubric*.

### 6.0  Extensions

Allow students to use an online program, such as Voki.com to create an avatar to give the presentation.

Use a digital storytelling site.

Invite parents, guardians, siblings, local industry representatives, teachers, administrators, or other interested persons to hear student presentations.

### 7.0  Evaluation/Assessment

In the Teacher Guide, use the *"Share" Rubric (D)* as a formative and summative assessment to evaluate the activities using 21st Century Skills, NRC Framework Endpoints, and National Science Education Standards.

## 8.0  References

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