(G) Teacher Resource. Mars Mission Facts

Fly-bys:

Mariner 4, 6, and 7
http://mars.jpl.nasa.gov/missions/past/mariner3-4.html
http://mars.jpl.nasa.gov/missions/past/mariner6-7.html

Orbiters:

Mariner 9
http://mars.jpl.nasa.gov/missions/past/mariner8-9.html

Viking 1 and 2
http://mars.jpl.nasa.gov/missions/past/viking.html

Mars Global Surveyor
http://mars.jpl.nasa.gov/missions/past/globalsurveyor.html

Mars Odyssey Orbiter
http://mars.jpl.nasa.gov/missions/present/odyssey.html

Mars Reconnaissance Orbiter
http://mars.jpl.nasa.gov/programmissions/missions/present/2005/

Landers / Rovers:

Viking 1 and 2
http://mars.jpl.nasa.gov/missions/past/viking.html

Mars Pathfinder and the Sojourner Rover
http://mars.jpl.nasa.gov/missions/past/pathfinder.html

Mars Exploration Rovers (Spirit and Opportunity)
http://mars.jpl.nasa.gov/missions/present/2003.html

Phoenix Lander
http://mars.jpl.nasa.gov/missions/past/phoenix.html

Mars Science Laboratory and the Curiosity Rover
http://mars.jpl.nasa.gov/missions/present/msl.html

(H) Teacher Resource. Strange New Planet Rubric (1 of 3)

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.

Instructional Objective 1: To produce a concept for an investigation that requires science questions, engineering and technological solutions, and teamwork."

Related Standard(s) (will be replaced when new NRC Framework-based science standards are released):

National Science Education Standards (NSES)
(A) Science as Inquiry: Abilities Necessary to Do Scientific Inquiry
Ask a question about objects, organisms, and events in the environment (Grades K-4: A1a).

Identify questions that can be answered through scientific investigations (Grades 5-8: A1a).

National Science Education Standards (NSES)
(A) Science as Inquiry: Understandings about Scientific Inquiry
Scientific investigations involve asking and answering a question and comparing the answer to what scientists already know about the world (Grades K-4: A2a).

Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models (Grades 5-8: A2a).

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

Learning Outcome	Expert	Proficient	Intermediate	Beginner
LO1a: to generate science questions and answers	Questions and answers are complete and thoughtful.	Questions and answers are complete.	Questions and answers are mostly complete.	Questions and answers are not complete.

(H) Teacher Resource. Strange New Planet Rubric (2 of 3)

Related Standards (will be replaced when new NRC Framework-based science standards are released):

National Science Education Standards (NSES)
(E) Science and Technology: Understandings About Science & Technology
People have always had questions about their world. Science is one way of answering questions and explaining the natural world. (Grades K-4: E1a)

People have always had problems and invented tools and techniques (ways of doing something) to solve problems….(partial) (Grades K-4: E1b)

Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things they could not otherwise see, measure, and do. (Grades K-4: E1e)

Scientific inquiry and technological design have similarities and differences. Scientists propose explanations for questions about the natural world, and engineers propose solutions relating to human problems, needs, and aspirations….(partial) (Grades 5-8: E1a)

Scientific and technology are reciprocal. Science helps drive technology, as it addresses questions that demand more sophisticated instruments and provides principles for better instrumentation and technique. Technology is essential to science, because it provide instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size, and speed. Technology also provides tools for investigations, inquiry, and analysis. (Grades 5-8: E1c)

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

Learning Outcome	Expert	Proficient	Intermediate	Beginner
LO1b: to explain how different types of engineering and technological solutions help answer different science question	Explanation is complex and thoughtful.	Explanation is thoughtful.	Explanation is somewhat thoughtful.	Explanation is basic.

(H) Teacher Resource. Strange New Planet Rubric (3 of 3)

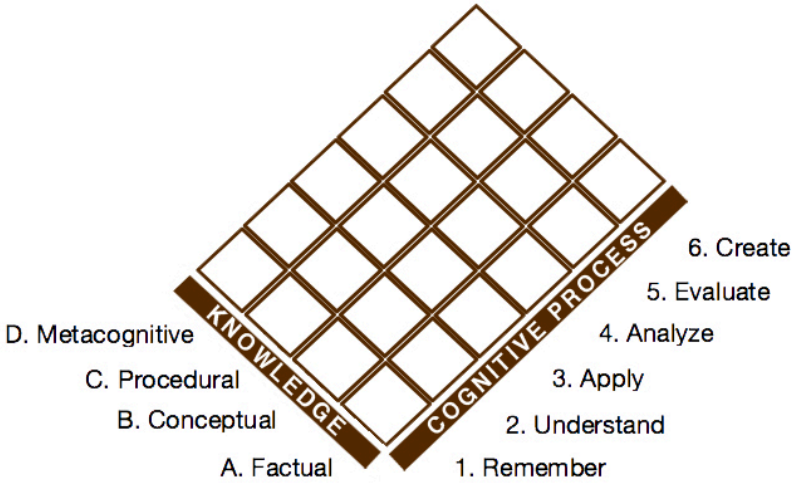
National Science Education Standards (NSES)
(E) Science and Technology: Understandings About Science & Technology
Scientists and engineers often work in teams with different individuals doing different things that contribute to results. This understanding focuses primarily on teams working together and secondarily on the combination of science and engineering teams. (Grades K-4: E1c)

Women and men of all ages, backgrounds, and groups engage in a variety of scientific and technological work. (Grades K-4: E1c)

Many different people in different cultures have made and continue to make contributions to science and technology. (Grades 5-8: E1b)

Learning Outcome	Expert	Proficient	Intermediate	Beginner
LO1c **to explain the advantages of working in teams**	Explanation of advantages shows a high level of respect for the contributions of others.	Explanation of advantages shows respect for the contributions of others.	Explanation of advantages shows some respect for the contributions of others.	Explanation of advantages shows little respect for the contributions of others.

(I) Teacher Resource. Placement of Instructional Objective and Learning Outcomes in Taxonomy (1 of 3)

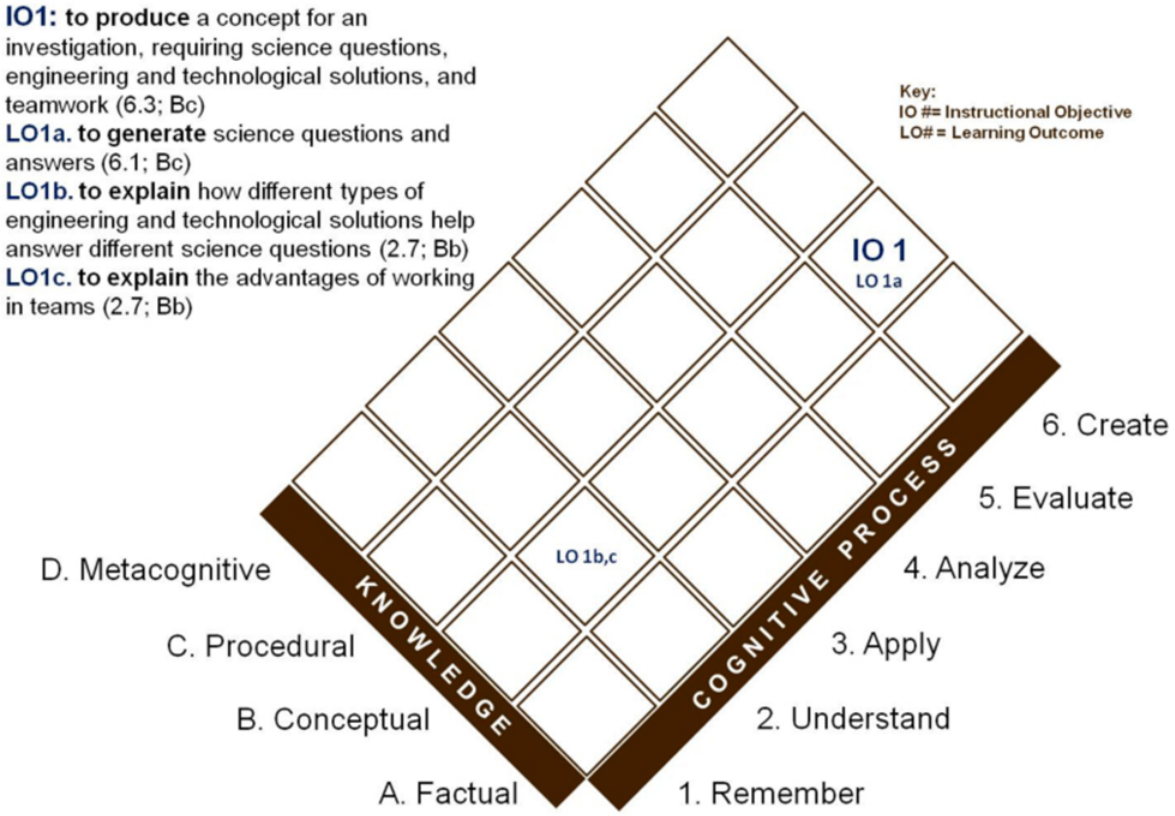


This lesson adapts Anderson and Krathwohl's (2001) taxonomy, which has two domains: Knowledge and Cognitive Process, each with types and subtypes (listed below). Verbs for objectives and outcomes in this lesson align with the suggested knowledge and cognitive process area and are mapped on the next page(s). Activity procedures and assessments are designed to support the target knowledge/cognitive process.

Knowledge	Cognitive Process
A. Factual **Aa:** Knowledge of Terminology **Ab:** Knowledge of Specific Details & Elements **B. Conceptual** **Ba:** Knowledge of classifications and categories **Bb:** Knowledge of principles and generalizations **Bc:** Knowledge of theories, models, and structures **C. Procedural** **Ca:** Knowledge of subject-specific skills and algorithms **Cb:** Knowledge of subject-specific techniques and methods **Cc:** Knowledge of criteria for determining when to use appropriate procedures **D. Metacognitive** **Da:** Strategic Knowledge **Db:** Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge **Dc:** Self-knowledge	**1. Remember** **1.1** Recognizing (Identifying) **1.2** Recalling (Retrieving) **2. Understand** **2.1** Interpreting (Clarifying, Paraphrasing, Representing, Translating) **2.2** Exemplifying (Illustrating, Instantiating) **2.3** Classifying (Categorizing, Subsuming) **2.4** Summarizing (Abstracting, Generalizing) **2.5** Inferring (Concluding, Extrapolating, Interpolating, Predicting) **2.6** Comparing (Contrasting, Mapping, Matching **2.7** Explaining (Constructing models) **3. Apply** **3.1** Executing (Carrying out) **3.2** Implementing (Using) **4. Analyze** **4.1** Differentiating (Discriminating, distinguishing, focusing, selecting) **4.2** Organizing (Finding coherence, integrating, outlining, parsing, structuring) **4.3** Attributing (Deconstructing) **5. Evaluate** **5.1** Checking (Coordinating, Detecting, Monitoring, Testing) **5.2** Critiquing (Judging) **6. Create** **6.1** Generating (Hypothesizing) **6.2** Planning (Designing) **6.3** Producing (Constructing)

(I) Teacher Resource. Placement of Instructional Objective and Learning Outcomes in Taxonomy (2 of 3)

The design of this activity leverages Anderson & Krathwohl's (2001) taxonomy as a framework. Pedagogically, it is important to ensure that objectives and outcomes are written to match the knowledge and cognitive process students are intended to acquire.



(I) Teacher Resource. Placement of Instructional Objective and Learning Outcomes in Taxonomy (3 of 3)

The design of this activity leverages Anderson & Krathwohl's (2001) taxonomy as a framework. Below are the knowledge and cognitive process types students are intended to acquire per the instructional objective(s) and learning outcomes written for this lesson. The specific, scaffolded 5E steps in this lesson (see 5.0 Procedures) and the formative assessments (worksheets in the Student Guide and rubrics in the Teacher Guide) are written to support those objective(s) and learning outcomes. Refer to (I, 1 of 3) for the full list of categories in the taxonomy from which the following were selected. The prior page (I, 2 of 3) provides a visual description of the placement of learning outcomes that enable the overall instructional objective(s) to be met.

At the end of the lesson, students will be able

IO1: to produce a simple concept…
6.3: to produce
Bc: knowledge of theories, models, and structures

To meet that instructional objective, students will demonstrate the abilities:

LO1a: to generate science questions and answers
6.1: to generate
Bc: knowledge of theories, models, and structures

LO1b: to explain types of solutions…
2.7: to explain
Bb: knowledge of principles and generalizations

LO1c: to explain advantages…
2.7: to explain
Bb: knowledge of principles and generalizations