

**(B) Teacher Resource. Note-taking Key (1 of 2)**

Topic	Notes
Sun	<ul style="list-style-type: none"> <li>• ¼ amount of power from solar energy</li> <li>• Mars is 1½ times farther away from sun than Earth</li> <li>• This makes Mars colder too</li> </ul>
Temperature	<ul style="list-style-type: none"> <li>• Mars is colder than Earth.</li> <li>• -190 to 75 degrees F</li> <li>• Farther from sun</li> <li>• Atmosphere doesn't trap warmth from sun</li> </ul>
Seasons	<ul style="list-style-type: none"> <li>• Martian seasons last 2 times as long as Earth</li> <li>• Martian year = 687 Earth days</li> <li>• Martian year = 669 sols</li> <li>• Sol = Martian day</li> </ul>
Radiation	<ul style="list-style-type: none"> <li>• Mars has thin atmosphere</li> <li>• Mars doesn't have a magnetic field</li> <li>• Radiation levels are twice as high on Mars</li> <li>• Metal conducts radiation</li> <li>• Hydrogen protects from radiation</li> </ul>
Atmosphere & Oxygen	<ul style="list-style-type: none"> <li>• The air of Mars is mainly carbon dioxide (95%). Only 0.1% is oxygen.</li> <li>• No oxygen to breathe</li> <li>• Earth's atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor</li> <li>• The atmosphere changes at different elevations</li> </ul>
Atmospheric Pressure	<ul style="list-style-type: none"> <li>• Atmosphere is thin</li> <li>• Only 1/100 of Earth's surface pressure</li> <li>• 15 lbs of pressure on Earth</li> <li>• 0.15 lbs of pressure on Mars</li> </ul>

**(B) Teacher Resource. Note-taking Key (2 of 2)**

Topic	Notes
Water	<ul style="list-style-type: none"> <li>• Little, if any, liquid water on surface now</li> <li>• There was probably water long ago</li> <li>• There is water ice below the surface of the planet</li> </ul>
Soil	<ul style="list-style-type: none"> <li>• Toxic</li> <li>• Hard to grow plants in Martian soil</li> </ul>
Wind & Dust	<ul style="list-style-type: none"> <li>• Mars has reddish-brown dust</li> <li>• Winds blow dust around</li> <li>• wind speed increases to 50-100 meters per second during dust storms</li> <li>• sometimes almost the whole planet is covered in dust storms</li> </ul>
Gravity	<ul style="list-style-type: none"> <li>• Mars has 1/3 the gravity of Earth</li> <li>• You could jump 3 times as high</li> <li>• Astronauts lose muscle and bone mass at 0 gravity</li> <li>• They exercise 2 hours a day</li> <li>• Gravity is a force that causes two objects to pull toward each other.</li> <li>• It keeps planets in orbit around the sun and governs the rest of the motion in the solar system.</li> <li>• It holds us to the earth's surface</li> </ul>
Landforms on Mars	<ul style="list-style-type: none"> <li>• Volcanoes</li> <li>• Olympus Mons is 3 X taller than 3 Everest &amp; flat</li> <li>• Plains               <ul style="list-style-type: none"> <li>○ Nothing grows there</li> <li>○ Low and flat</li> <li>○ Opportunity saw its heat shield at Meridiani Planum</li> </ul> </li> <li>• Craters               <ul style="list-style-type: none"> <li>○ Gusev Crater was possibly a water source</li> </ul> </li> <li>• Canyons               <ul style="list-style-type: none"> <li>○ Valles Marineris is bigger than the Grand</li> <li>○ 2,000 miles long</li> </ul> </li> </ul>



### (C) Teacher Resource. Discover Rubric

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 categorize environmental data

##### National Science Education Standards (NSES)

##### (A) Science as Inquiry: Use Appropriate Tools and Techniques to Gather, Analyze, and Interpret Data.

The use of tools and techniques, including mathematics, will be guided by the question asked and the investigations students design. The use of computers for the collection, summary, and display of evidence is part of this standard. Students should be able to access, gather, store, retrieve, and organize data, using hardware and software designed for these purposes. (Grades 5-8: A1c)

##### National Science Education Standards (NSES)

##### (D) Earth & Space Science:

**Structure of the Earth System** (landforms and the processes that created them, water, atmosphere); **Earth in the Solar System** (gravity, sun's influence on seasons) (Grades 5-8: D3a; D3d)

##### National Science Education Standards (NSES)

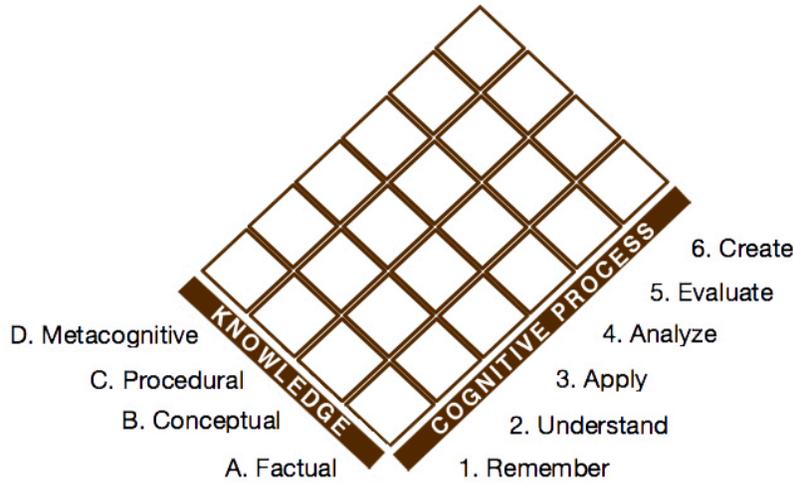
##### (F) Science in Personal and Social Perspectives: Personal Health

Natural environments may contain substances (for example, radon and lead) that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air. (Grades 5-8: F1g).

Learning Outcome	Expert	Proficient	Intermediate	Beginner
<b>LO1a: to identify relevant environmental data</b>	Learner always knew when key data appeared and identified it.	Learner mostly knew when key data appeared and identified it and rarely included incorrect data.	Learner often knew when key data appeared and identified it, and sometimes included incorrect data.	Learner did not often identify key data and often included incorrect data.
<b>LO1b: to represent relevant environmental data</b>	Information was placed in correct category with all relevant details.	Information was mostly placed in correct category with most relevant details.	Information was mostly placed in correct category with most relevant details.	Information is not represented correctly and completely.
<b>LO1c: to execute data collection skills</b>	Learner listened assiduously and always took notes when data appeared. Notes were extremely precise and complete.	Learner listened attentively and always took notes when data appeared. Notes were mostly precise and mostly complete.	Learner listened somewhat and often took notes when data appeared. Notes were precise and complete.	Learner did not listen carefully and often did not take notes. Notes were is not precise and not complete.



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

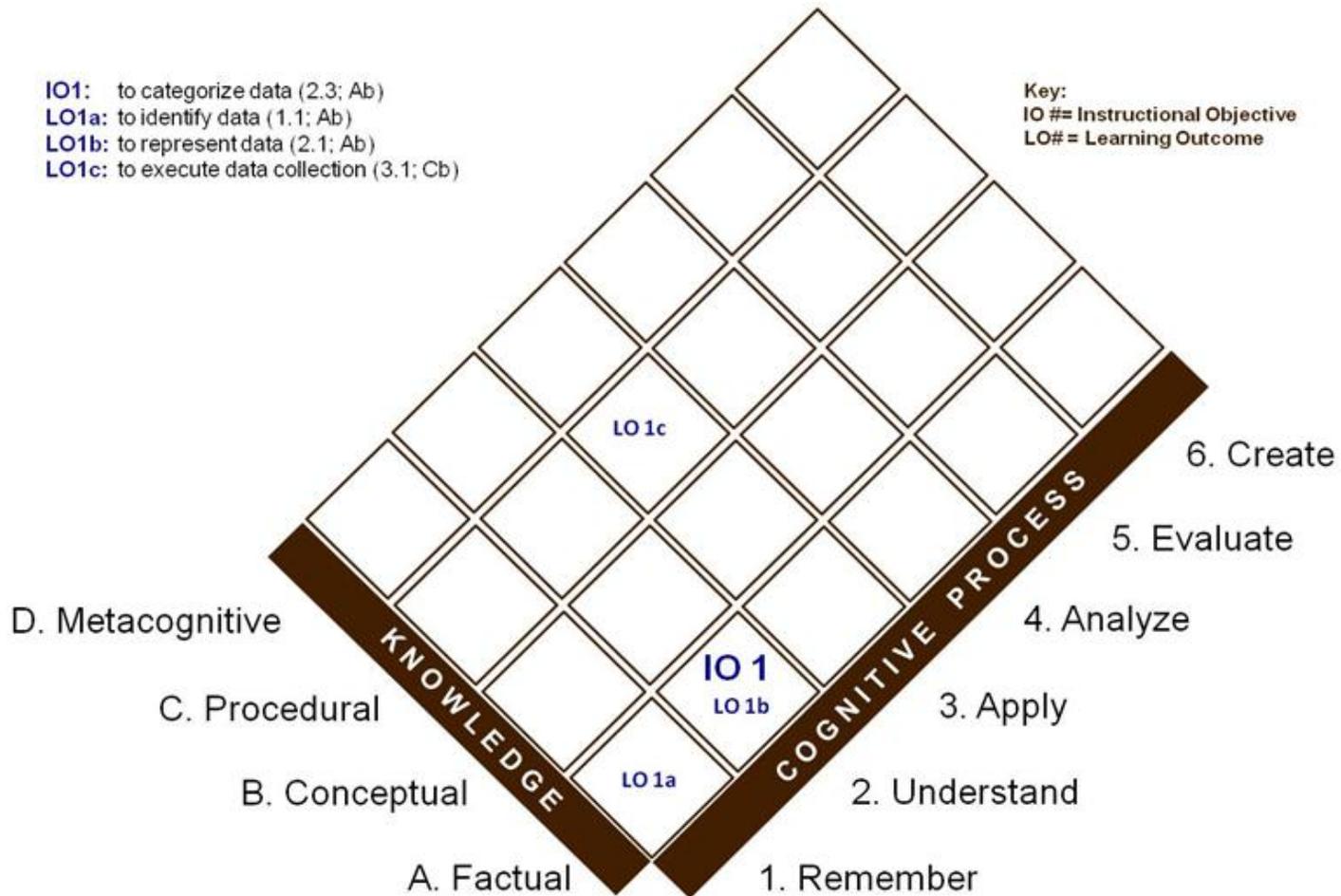


This lesson adapts Anderson and Krathwohl’s (2001) taxonomy, which has two domains: Knowledge and Cognitive Process, each with types and subtypes (listed below). Verbs for objectives and outcomes in this lesson align with the suggested knowledge and cognitive process area and are mapped on the next page(s).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

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



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



**(D) 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 Section 5.0 *Procedures*) and the formative assessments (worksheets in the Student Guide and rubrics in the Teacher Guide) are written to support those instructional objective(s) and learning outcomes. Refer to (D, 1 of 3) for the full list of categories in the taxonomy from which the following were selected. The prior page (D, 2 of 3) provides a visual description of the placement of learning outcomes that enable the overall instructional objective(s) to be met.

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**At the end of the lesson, students will be able**

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**IO1: to categorize data**

2.3: to categorize

**Ab:** knowledge of specific details and elements

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

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**LO1a: to identify data**

1.1: to identify

**Ab:** knowledge of specific details and elements**LO1b: to represent data**

2.1: to represent

**Ab:** knowledge of specific details and elements**LO1c: to execute data collection**

3.1: to execute

**Cb:** knowledge of subject-specific techniques and methods