



Mars Rover Celebration

Curriculum Module

Week 5: Designing and Building

Lesson 11: Brainstorm and Preliminary Design



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| Educational Product | |
| Educators & Students | Grades 3-5 |

Week 5: Designing and Building

LESSON 11: BRAINSTORM AND PRELIMINARY DESIGN

GRADE LEVEL: 3-5

LENGTH: 2 DAYS

VOCABULARY: evaluate
generate
select

MATERIALS:

- Computer with Internet access; projector and screen
- Chart paper or bulletin board paper (optional)
- Concept Map- one copy per team
- Science Notebooks

ESSENTIAL QUESTION:

Which step of the Engineering Design Process was the most difficult for your team? What made this step so challenging for you?

LESSON OBJECTIVE(S):

Students will be able to:

- Identify, become familiar with and use the Engineering Design Process
- Use the Engineering Design Process to sketch a reasonable drawing of the rover that will be built
- Use the steps of the Engineering Design Process to sketch their team's Mars Rover prototype
- Develop a concept map to communicate requirements and features of the rover

ENGAGEMENT

1. At the beginning of this lesson, and using the attached documents, present the Essential Question and Key Vocabulary for students to consider during the lesson.
2. Ask students to think about how a pencil is made and share their ideas. Solicit from students that a process is involved from first having the idea of a pencil through using one at school.
3. Show the video clip from Discovery's [How It's Made: Pencils](#) on the manufacturing of pencils (Runtime 2:47)

Note: Prepare this video prior to students arriving to avoid the ad at the beginning.

4. After watching the video, have students recall that pencils did not always exist. Elicit from students that a process is involved in moving from concept to idea to actually producing it to using it at school. Ask:
 - How do you think the pencil was invented?
 - Why would we need something like this? (*It solves a problem.*)

- What process do you think the inventor went through to create the pencil?
5. After discussing student responses, guide students through the graphic organizer in their Science Notebooks identifying the steps in the Engineering Design Process of how a pencil was invented. (1. State the Problem, 2. Generate Ideas, 3. Select a Solution, 4. Build the Item, 5. Evaluate, 6. Present Results) Be sure to ask students to ponder what happens when they reach Step 6. (The cycle begins again to improve the product.) Once students feel comfortable with the process, provide time for students to answer the two additional questions with their teams.

EXPLORATION

1. With students in their teams of 4-5, students should complete the Team Information section of their Science Notebooks. The teacher should circulate and approve before moving on.
2. Recalling the steps of the Engineering Design Process (State the Problem, Generate Ideas, Select a Solution, Build the Item, Evaluate, Present Results), students will begin to focus on building a rover to land on Mars. Using their Science Notebooks, students will work with their teams to select missions, determine requirements, and develop features of their Mars rovers.
3. While teams are working in their Science Notebooks, circulate the room and guide student discussions when appropriate. Ask students:
 - Which step of the Engineering Design Process are you working on?
 - Why is this step necessary/important?
 - How will this feature fulfill your rover's mission/requirement?
4. Once teams have satisfactorily completed this portion, pull students together to demonstrate how to complete a concept map.

EXPLANATION

1. Using the Concept Map mini-lesson, teachers should guide students through the process of correctly completing the first section of the concept map together. Students should then work with their teams complete the remainder of the concept map based on how many missions their team has chosen.

Note: Students should work with their teams to complete the Concept Map and tape the final copy, into their Science Notebooks when finished. To provide adequate room for brainstorming, students are encouraged to first draft their concept maps on blank chart paper or bulletin board paper.

2. Once teams have completed the Engagement, Exploration, and Explanation sections of their Science Notebooks, teams may begin sketching their prototype rovers. Circulate the room and guide student discussions when appropriate. Ask students:
 - Which step of the Engineering Design Process are you working on?
 - Why is this step necessary/important?
 - How will this feature fulfill your rover's mission/requirement?
3. Towards the end of the lesson, students should revisit their Science Notebooks to answer the Essential Question.

ELABORATION

1. Students may compile additional sketches (front view, top view, side view) of their rovers.
2. Students may also wish to further complete their concept maps by adding more details. As students do this, they should be focusing on whether or not these details are necessary and whether they meet the expectations of the criteria and constraints presented in their scientific or technological question.

EVALUATION

1. During this two day lesson, the teacher is encouraged to use formative assessments to determine and deepen student understanding. Teachers also may wish to grade students' Science Notebooks to establish student understanding.
2. Teachers are encouraged to create their own grade-level and ability-level assessments so as to best meet the needs of their students.

SUPPLEMENTAL RESOURCES

For Students

NASA BEST Engineering Design Process

<http://www.nasa.gov/audience/foreducators/best/edp.html>

NASA Engineering Design Process Image

<http://www.nasa.gov/audience/foreducators/plantgrowth/reference/index.html#1>

For Teachers

NASA Best- The Engineering Design Process

<http://www.nasa.gov/audience/foreducators/best/edp.html>

NASA Preliminary Design Phase

http://www.hq.nasa.gov/office/codeq/software/ComplexElectronics/I_prelim_design.htm

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Development of this lesson plan and supporting materials was made possible by NASA EPOESS Grant NNX12AB56G



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