



Mars Rover Celebration

Curriculum Module

Week 5: Designing and Building

Lesson 11: Brainstorm and Preliminary Design



Educational Product	
Educators & Students	Grades 6-8

Week 5: Designing and Building

LESSON 11: BRAINSTORM AND PRELIMINARY DESIGN

GRADE LEVEL: 6-8

LENGTH: 2 DAYS

VOCABULARY: consider
evaluate
process

MATERIALS:

- Computer with Internet access; projector and screen
- Chart paper or bulletin board paper (optional)
- Concept Map- one copy per team (optional)
- 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 a 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 consider 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](#) series 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, ask students to use the graphic organizer in their Science Notebooks to identify the steps in the Engineering Design Process of how a pencil was invented.
6. As a whole group, review responses and correct any misconceptions. Have students correct any incorrect answers in their Science Notebooks so that they can refer back to this page. (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 get to Step 6. (*The cycle begins again to improve the product.*)

EXPLORATION

1. With students in their teams of 4-5, students should recall the steps of the Engineering Design Process (State the Problem, Generate Ideas, Select a Solution, Build the Item, Evaluate, Present Results), to focus on building a rover to land on Mars. Using their Science Notebooks, students will work with their teams to sketch how their rover should look. Students should refer back to their Missions, Requirements and Features to help them determine how their rover will look.
2. While teams are working in their Science Notebooks, circulate the room and guide student discussions when appropriate. Approve team sketches 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. Throughout this process, the teacher should circulate the room assisting when necessary. Once teams have satisfactorily completed this portion, the teacher should pull students together to demonstrate how to complete a concept map.

EXPLANATION

1. Using the Concept Map mini-lesson as a guide, 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 to draw and complete the remainder of the concept map based on how the mission their team has chosen.

Note: To provide adequate room for brainstorming, students are encouraged to draft their concept maps on blank newsprint paper or bulletin board paper. Students may also choose to use the full page concept map. When finished, students should copy their final concept map neatly into their Science Notebooks (or, if using the full page concept map, students may choose to tape it in their Science Notebooks.)

2. Once teams have completed the Engagement, Exploration, and Explanation sections of their Science Notebooks, students may begin sketching their prototype rovers in detail. 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. If time allows, 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. Students should focus on evaluation of these details to systematically determine how well each one meets the criteria and constraints of 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 may wish to the Mars Rover Rubric to assess the progress of team models and/or 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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