Danger Zone (Lesson 1)

Essential Question: How can scientists study dangerous environments?

Lesson Overview

This lesson will focus on introducing students to the module, setting up the scenario and task that students will design their robot to complete, and making the initial connections between the mathematics, science, and engineering concepts that are integrated throughout the module.

Base Length: 1 hour

Key Vocabulary

- Volcano
- Drone
- Task
- Engineer
- Robot
- Program
- Prototype
- Research
- Design
- Test
- Constraint
- Collaboration

Resources

- Lesson 1 PowerPoint
- My Design Journal (1 per student or 1 per student group)
- Optional: Copies of Handout 1.1 and Handout 1.2 for My Design Journal Alternative
- Additional Resources:
  - NY Times Article: Robot Set to Explore a Volcano that's Too Dangerous for Humans to Enter
    By WARREN E. LEARY, Published: July 24, 1994
    http://www.nytimes.com/1994/07/24/us/robot-set-to-explore-a-volcano-that-s-too-dangerous-for-humans-to-enter.html
  - Robovolc System
    http://www.robovolc.dees.unict.it/system/system.htm
  - USGS FAQs about Volcanoes
    http://volcanoes.usgs.gov/about/faq/
  - Videos of robots exploring volcanoes
    http://thewatchers.adorraeli.com/2014/10/15/drones-and-robots-to-monitor-active-volcanoes/
  - Images of Mt. St. Helens on Full Screen 360
    http://www.fullscreen360.com/mt-st-helens-compare
  - Additional Robotics Activities for Students
    http://education.nationalgeographic.com/education/activity/?ar_a=1

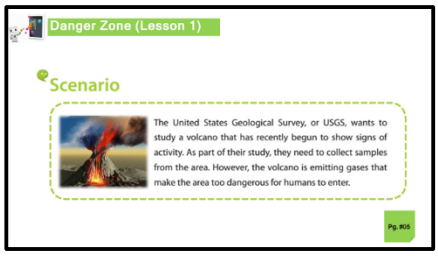
The Corresponding Engineering Design Process for This Lesson

Identify, Define, & Research Problem	List Requirements & Constraints	Develop Solutions	Evaluate Solutions	Construct Prototype	Evaluate Prototype	Modify Design & Produce Solution	Communicate Solution

A robot needs to collect samples from a dangerous environment. It has to collect samples from three sites and return to base.

Lesson Launch (15 minutes)

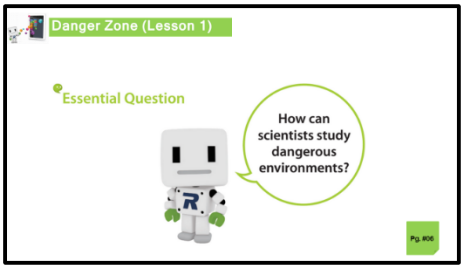
Begin the lesson by introducing and/or reviewing information about volcanos with students, include what volcanos are and the risks that they pose to both humans and the environment.



Introduce the main lesson scenario found on page 5 of the My Design Journal. (**NOTE:** Based on your curriculum, you may change the volcano scenario to any other environment that is too dangerous for humans.)

My Design Journal Alternative: If they will not be writing in their My Design Journal, have students write the Main Lesson Scenario in their class or project notebook.

Main Lesson Scenario
The United States Geological Survey, or USGS, wants to study a volcano that has recently begun to show signs of activity. As part of their study, they need to collect samples from the area. However, the volcano is emitting gases that make the area too dangerous for humans to enter.



Pose the lesson's Essential Question: ***How can scientists study dangerous environments***. The Essential Question can be found on page 6 of the My Design Journal. Allow students to brainstorm responses as a whole class and as students respond, create a master list of ideas on the board or on chart paper. Examples of students' answers might include: remote testing or monitoring equipment, telescopes, drones, remote controlled devices, etc. (**Note:** If students are unable to come up with

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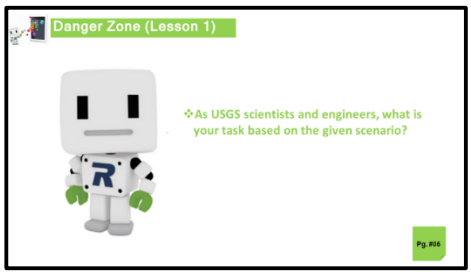
robots as one of their answers, summarize what they have provided and then ask how robots could be used to study dangerous environments. If students provided robots as one of the answers ask them how they think robots could be used.)

My Design Journal Alternative: If they will not be writing in their My Design Journal, have students write the Essential Question in their class or project notebook.

Now, explain the next part of the scenario found on page 6 of the My Design Journal.

The USGS, plans to use a robot to complete the sampling event. The scientists have designed a robot for the task, and now they need the robot to be able to move from a safe starting point to three different sampling spots and then back to the start site so they can retrieve it and the samples.

My Design Journal Alternative: If they will not be writing in their My Design Journal, have students write the next part of the scenario in their class or project notebook.



Explain to students that they will be taking on the role of USGS scientists and engineers to accomplish the task in the scenario. Then, have students answer the following question found in their My Design Journal on page 6. **My Design Journal Alternative: If they will not be writing in their My Design Journal, have students answer the question in their class or project notebook.**

As USGS scientists and engineers, what is your task based on the given scenario?

An example student response is, “Build a robot so that it can collect samples from the volcano. The robot has to start from a safe area, collect samples from three sites and return to the starting point.”

If students are not able to arrive at a similar response, ask the following:

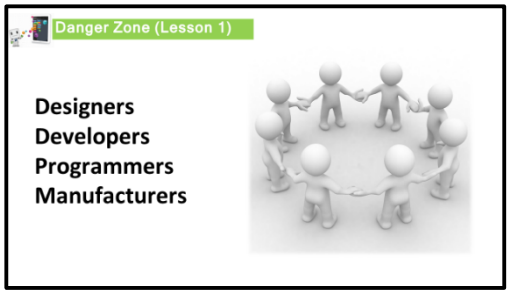
- Who is the story about? (the USGS)
- What is their problem? (they want to collect samples but the environment is too dangerous)
- What is their solution? (use a robot)
- What does the robot have to do? (start from a safe area, collect samples from three sites and return to the starting point)

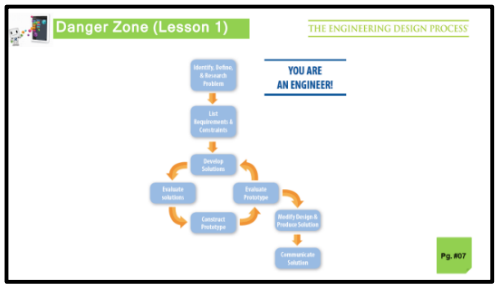
Clarify any misconceptions and then move into the Student Work phase of the lesson**.**

Student Work (30 minutes)

A robot needs to collect samples from a dangerous environment. It has to collect samples from three sites and return to base.

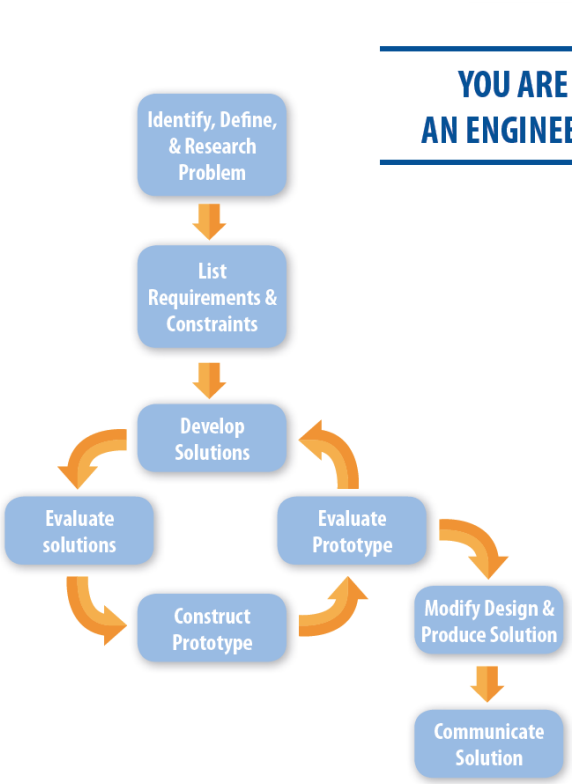
Begin this phase of the lesson by explaining to students that in the real world there would be multiple teams working on each stage of the overall task. For example, there would be a team whose special area of expertise is in robotics design and they would be the group that would design the actual robot based on the needs of the USGS and the volcanic terrain. They would have a team to build the robot based on the robot design. And, there would be a team whose area of expertise is computer programming who would be responsible for programming the robot to complete the task.





Have students turn to page 7 in their My Design Journal. Explain that each group follows a problem solving process in their work called the Engineering Design Process. Go over each phase of the process so that all students understand how this is used by different teams based on their specific role.

The Engineering Design Process



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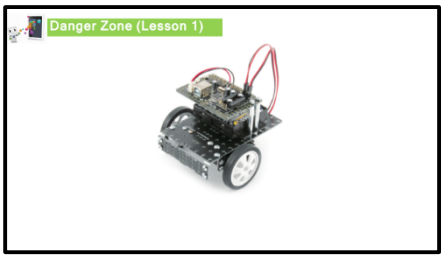
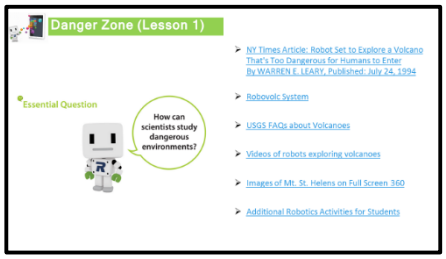
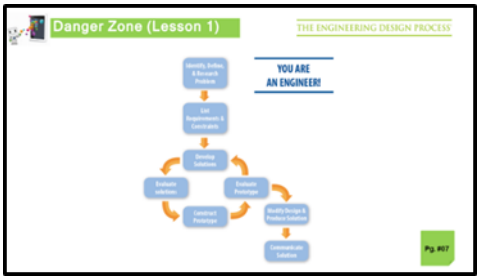


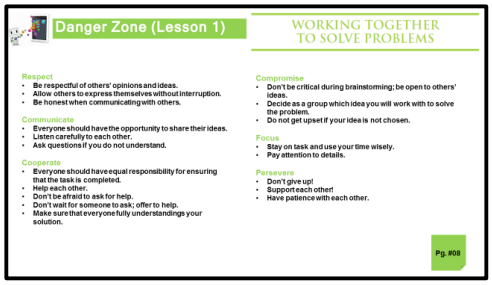


Show students the picture of the robot that they will be building and using to complete their task as the programming team. Then, play one of the videos (from the resource list at the beginning of this lesson) of robots gathering samples within a volcano. After the video, have students discuss what obstacles their robot may encounter during the sample collection.



Put students in groups and have them return to the Engineering Design Process on page 7 in the My Design Journal. Ask each group to take a few minutes to think about how they will work through the Engineering Design Process as they work to program their robot to complete the sample collection task. Explain that they can make notes on pages 10 and 11 in their My Design Journal. **My Design Journal Alternative: If they will not be writing in their My Design Journal, distribute a copy of Handout 1.1 found in Appendix A of the Teacher Guide.**

Note: Try to limit he group size to no more than four students per group so that everyone has the opportunity to participate in all parts of the module.



Go over students' responses and then explain to them that as they work in their groups they will need to make decisions on the steps they will take and there may be times when they do not agree on those steps. Go over the Guidelines for Group Work, shown on page 8 in the My Design Journal, so as to provide students with the expectations for how they will work together. **My Design Journal Alternative: If they will not be writing in their My Design Journal, distribute a copy of Handout 1.2 found in Appendix A of the Teacher Guide.**

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WORKING TOGETHER TO SOLVE PROBLEMS

Respect.

- Be respectful of others' opinions and ideas.
- Allow others to express themselves without interruption.
- Be honest when communicating with others.

Communicate.

- Everyone should have the opportunity to share their ideas.
- Listen carefully to each other.
- Ask questions if you do not understand.

Cooperate.

- Everyone should have equal responsibility for ensuring that the task is completed.
- Help each other.
- Don't be afraid to ask for help.
- Don't wait for someone to ask; offer to help.
- Make sure that everyone fully understands your solution.

Compromise.

- Don't be critical during brainstorming; be open to others' ideas.
- Decide as a group which idea you will work with to solve the problem.
- Do not get upset if your idea is not chosen.

Focus.

- Stay on task and use your time wisely.
- Pay attention to details.

Persevere.

- Don't give up!
- Support each other!
- Have patience with each other.

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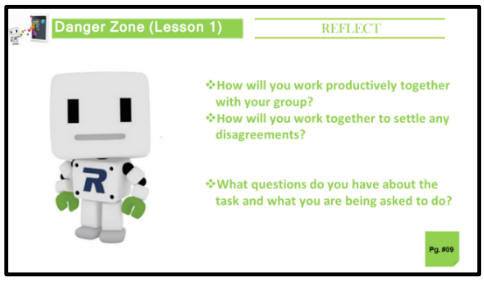
Go over the My Design Journal and the expectation that students are to work in their journal (or class/project notebook) during every lesson. The design journal will help them to keep track of ideas, notes, strategies that they will try, and outcomes of their trials. Transition to the Summarize and Next Steps portion of the lesson.

Summarize and Next Steps (15 minutes)

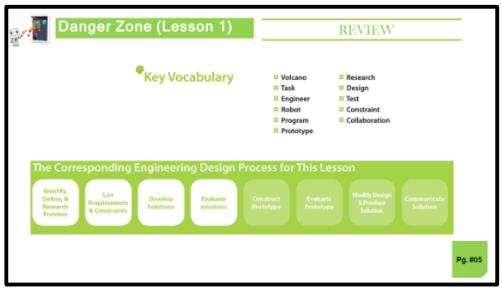


Allow students to answer the following questions on page 9 in their My Design Journal:

- ***How will you work productively together with your group?***
- ***How will you work to settle any disagreements?***
- ***What questions do you have about the task and what you are being asked to do?***

My Design Journal Alternative: If they will not be writing in their My Design Journal, have students answer the questions in their class or project notebook.

Allow volunteers to share their responses to the assigned questions.



After groups have had a chance to share, bring them back together as a whole class and spend time reviewing the key vocabulary and the steps of the Engineering Design Process covered in this lesson.

Wrap up the lesson by letting students know that in the next lesson they will be building the robot that they will use to complete the programming task.

Extension

Based on your students, you may increase the level of the base task as needed by including things such as they must navigate around a set number of obstacles, or provide a minimum total distance that the robot must travel, and so forth.