Hoist Design Challenge (grades 4-8)

Materials Needed
<u>For Facilitator *</u> • Introduction to the Engineering Design Process (optional) • Hoist Challenge Facilitator Slides <u>For Students</u> • Several sheets of paper • Pencils • Building materials- Identify materials that you have access to. (The recycling bin is a great place to start.) You will need to represent the following major components: shaft, cage/load, and rope (Be creative with additional materials to make your idea reality)

* If your students are already familiar with the Engineering Design Process the Intro to EDP is not required but may be a good review.

Sample Schedule

Pre-work: Introduction to the Engineering Design process (~15 minutes)

Students think about engineering and the design process

Part 1: The Challenge (~30 minutes)

Students learn about Sanford Underground Research Facility (SURF) and the challenge of safely traveling between the surface and the underground.

Students are presented with the design challenge

Students have time to ask questions

Individual work time (over several days)

Students will design and create a hoist apparatus- include time to brainstorm, find/create necessary materials, test, and improve.

Part 2: Design Solutions (~30 minutes)—will vary with class size

Students will share their design solution, discuss challenges and resolutions.

Students will then see the lots of pictures of the real-life design.

Students have time to ask questions

Optional (but encouraged) Virtual Hoistroom tour (~10 minutes)

Design Challenge

	Design and Build a Hoist
Overview	**Overview** During this challenge students will design, test, and build an apparatus that is capable of lifting a load (weight) to the top of a shaft. The design must also include some sort of brake that will hold the load at the top of the shaft. This would allow for easy unloading of the cage at the top of the shaft (the surface). Students will utilize the engineering design process. • Identify • Imagine • Design • Create • Test • Improve • Share
Background Information	Sanford Underground Research Facility (SURF), located in the former Homestake Gold Mine in Lead, South Dakota, hosts world-leading research experiments in physics, biology, geology, and engineering. The main level for science is 4850 feet below the surface. For the science to be successful, equipment, supplies, and of course, researchers need to travel safely to and from the underground on a daily basis. The Yates Shaft is 5,000 feet (1,524 meters) deep. Inside the shaft, the cage transports people and supplies from the surface to the 4850 Level and back. The cage connects to a 6,000-foot (1,829 meter) hemp and steel rope that is part of the hoist system.
Questions	**Questions to Ponder** • What is your task? • What are your design constraints? • How will you determine the success of your design? • What aspect(s) of your design do you think worked best? Why? • What challenges did you have? How did you resolve them? • If you could use another material(s) what would you like to try? How do you think this might help with the challenge? • Now that you have some experience, what might you change to optimize your apparatus?

Design Challenge

Launch (~15 minutes)	
Engagement and Communication	**Introduction to the Engineering Design Process** During this challenge students will utilize the engineering design process. It is recommended that time be set aside to ensure students have a basic understanding of the process. Below are links that can be used in a variety of learning situations. • Introduction to EDP (synchronous)
The Challenge (~30 minutes) plus time to work	
Procedure	**The Challenge- Part 1** Students will design, test, and build an apparatus for the people at the Sanford Underground Research Facility (SURF) to get from the underground back to the surface :0) The facilitator's slides contain an introduction to SURF and associated challenge- part 1. There will need to be time for students to work on the challenge before part 2. Your challenge is to use your engineering skills to design, test, and build an apparatus that is capable of lifting a load (weight) to the top of a shaft. Your design must also include some sort of brake that will hold the load at the top of the shaft. This would allow for easy unloading of the cage at the top of the shaft (the surface). After students learn about the challenge, make sure to share the Design Challenge overview to help students work through the process. **Reminder to students:** If your design doesn't work as well as you hoped, you can always redesign and try again! If you are looking for ideas about questions to help students move forward or get unstuck, we have some ideas. See *Questions to help students get unstuck*
Share (~30 minutes)	
Communicate	**Design Solutions- Part 2** Students will share design solutions and debrief the challenge. This would be an ideal time to invite a member from SURF education and outreach to join your class :0) Authentic audiences help connect the classroom and the real-world and provide an opportunity for students to connect personally with a presenter who can answer their questions and share real-life experiences and design solutions.

Optional (but encouraged) Virtual Hoistroom tour (~10 minutes)