STEM Virtual Learning- IMPACT

2nd & 3rd Grade Structural Engineering

Lesson 3: Tunnels

April 20, 2020

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Learning Targets:
Students will…

- Understand force & constraints on building structures
- Understand challenges of engineers and the Engineering Design Process

Background: **This is a review lesson from 2nd Grade Civil Engineering**

- Students learn the impact of force on designs
- Students learn about tunnels
- Students learn to overcome challenges

Let's Get Started:

Watch & Read-

1. Tunnel Construction
2. Tunnel Basics

Vale Tunnel, KCMO

Monday-

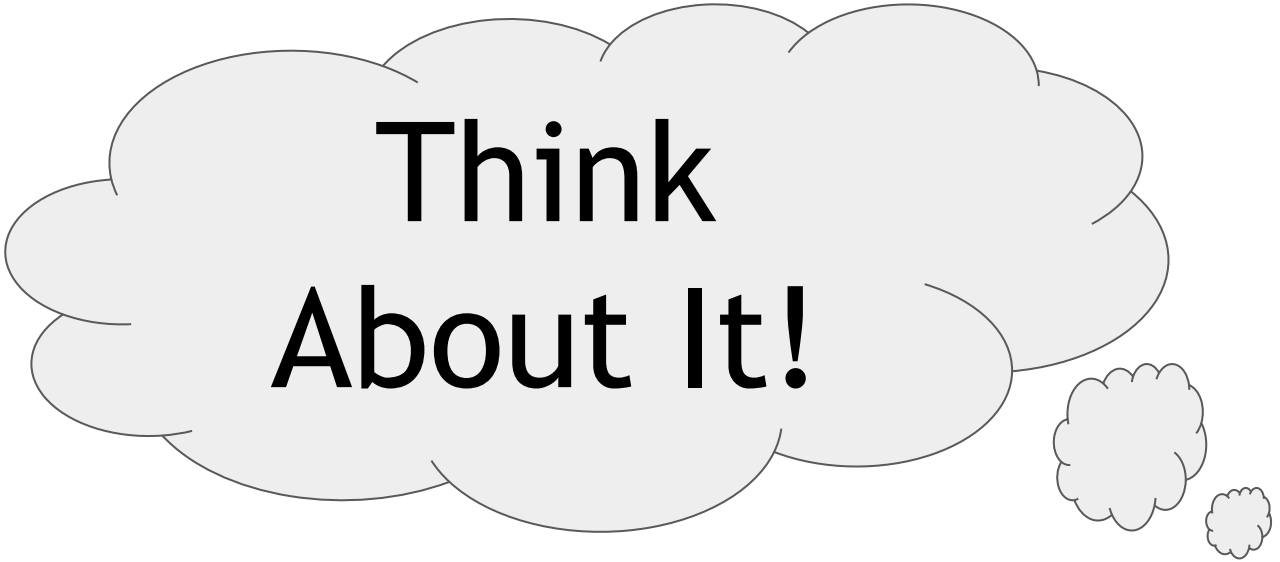
Practices:

Click the link and complete the 3 challenges.

Remember, forces that act on structures are called *loads*.

Monday-

TUNNELS



Can you list at least *three* things you learned from the practices?

Tuesday-

Practice on your own:

Go to this website to learn more about tunnels.

- What are some reasons a tunnel may need to be built?
- How long can it take to plan for a tunnel?
- What and where is the longest tunnel in the world?

Taipei Metro in Taiwan

Tuesday-

MORE Practice on your own:

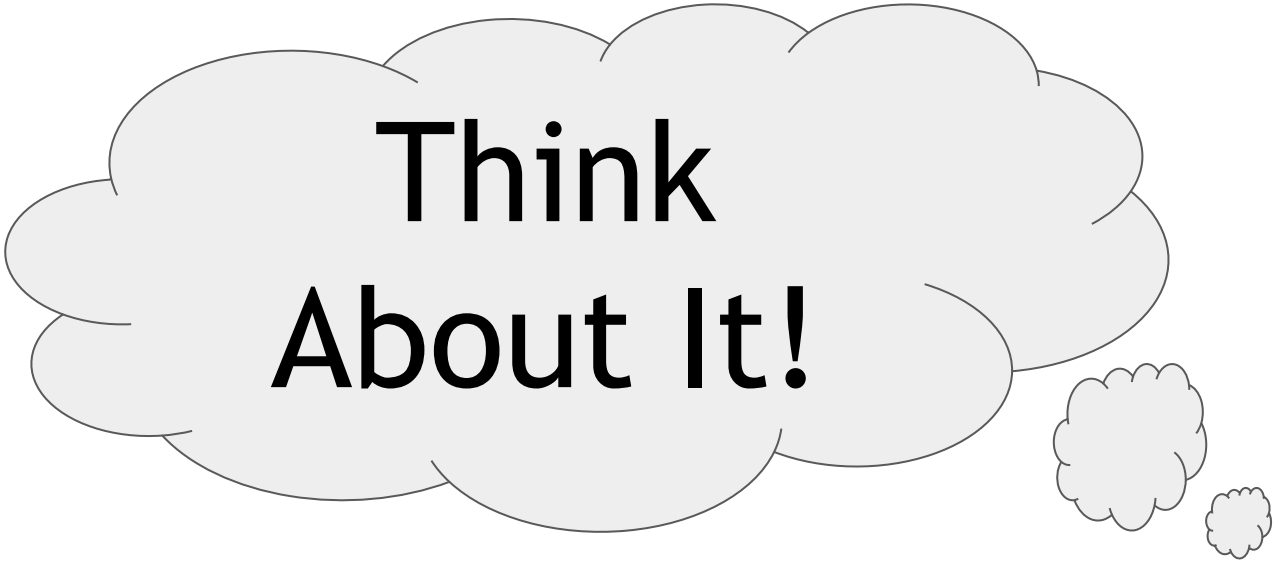
Watch this video about building tunnels underwater!

- What kind of machine was created to dig underwater?
- What was the main issue they ran into during the dig?
- What objects did they find underground that told them they were at the correct depth?
- How long did it take both sides digging to meet in the middle?
- Today, how long is a ride through the tunnel?

English Channel Tunnel

Tuesday-

TUNNELS



What some other issues that may come up in building a tunnel underwater?

Wednesday-

Project Introduction

The Chesapeake Bay bridge in Virginia is one of the bridges in the world that turns into a tunnel. Read about the bridge-tunnel, then watch this timelapse video of what it's like to drive through it.

Wednesday-

Prompt:

Your research and tests for the longest bridge in the world was very impressive! However, your contractor has another request. Like the Chesapeake Bay bridge, there needs to be a tunnel that goes under the lake! Boats serve a great purpose in making deliveries to different areas across Lake Michigan. Your bridge's current design blocks large boats from reaching their destinations. You have been asked to redesign your bridge with the addition of a mile long underwater tunnel. As the Engineering Design Process explains, many revisions and improvements are needed to get the perfect result. Again, your team thinks it's best to run some tests before commiting to a final design.

Chesapeake Bay bridge-tunnel with a crossing boat

Wednesday-

Recap from last week's research:

1. Lake Michigan's greatest depth is 925 feet.
2. Lake Michigan's greatest width is 118.1 miles.
3. Lake Michigan sees all four seasons.
4. Parts of Lake Michigan freezes in the winter.
5. These are important factors to consider because they could create issues when constructing the bridge and tunnel.
6. The type of bridge that would be the best for this construction is the suspension or stayed cable bridge.

Sunshine Skyway stayed cable bridge in Tampa, Florida

★ **Draw a plan for your bridge-tunnel.**

Thursday-

Project:

The Mile Long Bridge-Tunnel

Rebuild a bridge with the addition of a tunnel.

Materials:

- A large clear container
- Cardboard (cereal boxes or tissue boxes open flat will work)
- Pencil
- Scissors
- Tape
- Dirt
- Water
- Measuring cup
- Paper to record results

Hampton Roads underwater bridge-tunnel in Norfolk, Virginia

Thursday-

Procedure:

*This is a messy experiment that may need to be done outside or on a surface easily cleaned.

- Use the materials you have collected to create a bridge that spans a large container.
  - Remember that part of the bridge needs to be a **tunnel** so should go down into the container then back out again. It should also be hollow for “cars to drive” through.
- Use the measuring cup to measure out one cup of dirt. Pour it on top the tunnel until it is covered.
  - On a sheet of paper record how many cups of dirt you put on top the tunnel.
  - If the tunnel collapses, dump out the container and start over with a new, better design.
  - Do this until the tunnel holds dirt without collapsing.
- Now, use the measuring cup to measure one cup of water.
  - Pour the water into the dirt on top the tunnel.
  - If the tunnel collapses or floods, you will need to start over again.
  - Record how much water the tunnel holds on top.
- You will have succeeded when your tunnel holds dirt and water without collapsing or flooding.

*The container does not have to be completely full with dirt and water. Just enough to cover the tunnel.

Thursday-

Self Check:

IMPACT students, make a video or report in Seesaw.

Answer the following questions:

- ❏ What did you learn about tunnels?
- ❏ What specifically did you learn about bridge-tunnels?
- ❏ What are some challenges an engineer might face building underwater?
- ❏ Describe your experiment.
- ❏ How many times did you have to make improvements to your design?
- ❏ Did you succeed?

Seesaw

Friday Funday-

Water Wonders

Follow the directions in this video to make your own sensory bottle.

- What fun items will you put in your bottle?
- Why do some items float in the water while others sink?

Friday Funday-

Math Game of the Week!

It's in the Cards

A twist on the traditional card game, War.

Rules:

- Assign values of 1 to the ace, 11 to the jack, 12 to the queen, and 13 to the king, and face value for the cards 2 through 10.
- With two players, each person lays two cards face up, then subtracts the lower number from the higher.
- Whoever has the *higher* answer gets all four cards.
- If the totals are the same, the players flip over two more cards and repeat.
- Whoever has the most cards at the end, wins!
- **Challenge-** Use the two cards to form a fraction, and then compare to see who has the larger fraction. If they are equivalent, repeat until someone wins the round.