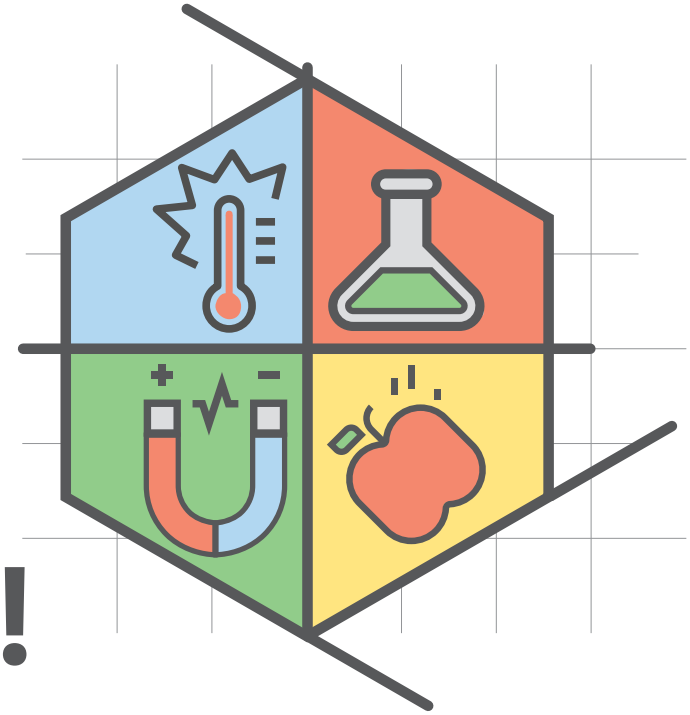
Catch Me If You Can!



Kindergarten STEM Storyline Unit to Support the BBS Push, Pull Go *kit and FOSS,* Balance & Motion *kit*

STEM

ABOUT THIS UNIT

We are pleased to present this STEM Storyline Unit to help support educators in our region as we shift towards providing students with NGSS-aligned, phenomenon-based and project-based learning experiences. Our vision is to provide students with high-quality and equitable learning experiences that empower them to develop fluency in STEM and literacy. This unit strives to engage students in problem-solving to create the perfect snack for the 1st graders in their school.

This unit also contains links to online resources created by other organizations which may use a different license. Please make sure that you understand the terms of use of third-party resources before reusing them. Prior to publishing this unit of study, we have reviewed the content of this unit to ensure that all materials are in accordance with creative commons regulations. If you notice that a part of this unit infringes another's copyright, please contact us.

A digital copy of this document is available on the STEM Materials Center website at:
https://www.stemmaterials.org/catchmeifyoucan

ATTRIBUTION

This unit is a result of a collaborative effort between Educational Service District 112 and educators and specialists from other school districts and agencies.

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Concept derived from NSTA's Engineering Encounters: Catch Me If You Can!, December 2013

STEM
Science
Technology
Engineering
Math

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OSPI

CLIME TIME
CLIMATE SCIENCE LEARNING

UNIT OVERVIEW

For your convenience, all resources have been uploaded to this Google drive folder, Catch me if you can! bit.ly/esd112catchmeifyoucan for easy access. Since curriculum revision during the school year will be limited, any additional resources and changes will be reflected in the live file folders on the Google drive. You may also make comments for suggested revisions on these documents. In order to modify the Google resources to make changes, click "file" and "make a copy." This will create a copy in your drive that you can edit to fit your needs or to share with your students on the Google platform.

LESSON 1: Attack of the Gingerbread Man *pg. 6*

In this lesson, students can work individually and in small groups to develop and communicate an initial sketch of a design to solve a problem.

Session	Materials Needed	Page
1. Defining the problem (30 min)	• Class OWL chart • Crayons, colored pencils, etc for sketching • Class driving question board • Class criteria chart • Student notebooks or packets	**7**
2. What makes a good trap? (30 min)	• Chart paper and markers • Students' initial sketches	**8**

LESSON 2: Forces All Around *pg. 12*

In this lesson, students will engage in an investigation on forces and will be able to explain that a force is a push or a pull.

Session	Materials Needed	Page
1. Just for kicks (45 min)	• Outdoor or gym space • Rubber balls or kick balls (1 per group of 3) • Colored cones (borrowed from P.E. teacher) • Tennis ball • Poster board • Markers • Tape	**13**
2. Making observations outdoors and around school (45 min)	• Clipboards • Scavenger hunt graphic organizer	**14**

UNIT OVERVIEW (cont.)

LESSON 3: Roll with It *pg. 19*

In this lesson, students construct an explanation for the causes and effects of the strengths and direction of pushes and pulls.

Session	Materials Needed	Page
1. Rolling spheres OR Push, pull, roll (30 min)	• Foss Materials from *Spheres* **OR** • BBS Materials from *Push, Pull, Roll*	**20**
2. Move that turnip!	• Computer with internet access • Paper and markers	**21**
3. Progress monitoring toward objectives	• Assessments	**22**

LESSON 4: Twirling through New Designs *pg. 24*

In this lesson, students plan and conduct an investigation to determine that a bigger push or pull makes things speed up or slow down more quickly.

Session	Materials Needed	Page
1. Spinners OR Push, pull, swing (30 min)	• FOSS Materials from *Spinners* **OR** • BBS Materials from *Push, Pull, Swing*	**25**
2. Sheep in a Jeep? (45 min)	• Large paper • Markers or crayons	**26**

LESSON 5: Balance and Stable Designs *pg. 24*

In this lesson, students plan and conduct an investigation to determine how forces affect balance, and how the structure of their design will affect its function.

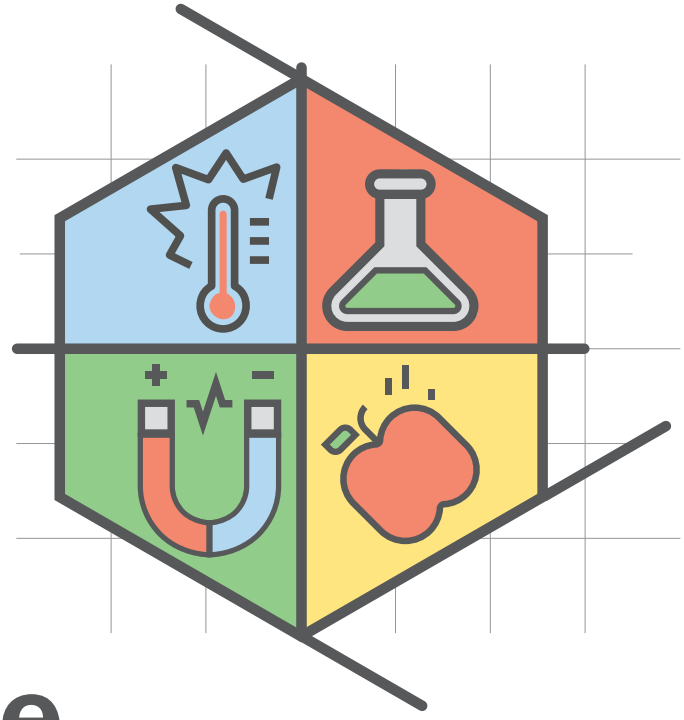
Session	Materials Needed	Page
1. Zoomers, rolling wheels and balance OR Push, pull, tumble and spin (30 min for each investigation)	• FOSS Materials from *Zoomers, Rolling Wheels and Balance* **OR** • BBS Materials from *Push, Pull, Tumble and Spin*	**25**
2. Revising initial designs (45 min)	• Initial design materials	**26**

UNIT OVERVIEW (cont.)

LESSON 6: Becoming engineers *pg. 28*

In this lesson, students plan and conduct an investigation to determine that a bigger push or pull makes things speed up or slow down more quickly.

Session	Materials Needed		Page
1. What does an engineer do? (35 min)	• Book • Card Game copies • Questions for card game • Large piece of cardboard • Wire from kit or hanger	• Hole punch • Strong tape • Clear or paper cups • Bead or fastener	**29**
2. Revising initial designs (45 min)	• Book • Card Game copies • Questions for card game • Large piece of cardboard • Wire from kit or hanger	• Hole punch • Strong tape • Clear or paper cups • Bead or fastener	**30**



LESSON 1: Attack of the Gingerbread Man

STRATEGY: ENGAGE

In this lesson, students can work individually and in small groups to develop and communicate an initial sketch of a design to solve a problem.

STEM

SESSION 1: Defining the problem (30 min)

Engage

Prepare the classroom the night before you want to begin the storyline by sprinkling broken gingerbread around the room, knocking over chairs, books, etc. Gather the class together and elicit some ideas about what might have happened to the classroom. Present your idea (or hopefully one of the students has the thought that the gingerbread man is the culprit), and start by either reading aloud "The Gingerbread Man" Loose or show students a read-along video such as https://www.youtube.com/watch?v=hsEorBffl3o&t=25s (There are multiple versions, accents, etc. - choose the best version for your class.) ***Pause the story before the end (prior to meeting the fox, you'll want to come back to this later)***.

Explore

Present students with the driving question: "How can we design a trap to catch the gingerbread man?" Begin the class OWL (Observe-Wonder-Learn) chart and lead the group through discussing some initial trap ideas. Then, ask students what they are wondering about or curious about in designing a trap. These points are entered on the Wonder column of the chart.

Explain

Individually, students draw and label their initial idea for a trap. They should label parts and press them to think through what materials in the class we could use the build the trap. There is no formal sharing at this point, but do allow students to talk, share and learn from each other. Introduce the idea of collaboration - how designers, inventors and engineers often work to gather ideas from each other. Collect and save the initial sketches for revision, if not using a science notebook.

Extend

Students will have a chance to share their initial thoughts on how to trap the gingerbread man and also provide some input to others on their ideas. Be sure students have ....?

Essential question for the week: What is a force and how will it help our trap designs?

Materials Needed

- Class OWL Chart
- Class driving question board
- Student notebooks or packets
- Crayons, colored pencils, etc for sketching
- Class criteria chart

SESSION 2: What makes a good trap? (45 min)

Extend (15 min)

Ask students to share their initial thoughts on how to trap the gingerbread man and also provide some input to others on their ideas. Be sure students have their sketches and gather them together. Explain that we are going to share our trap ideas and think about what a good trap design would include. To do this, we will meet with a small group of friends and explain how our trap would work and what you think the best part of the design is. Provide a few minutes for students to prepare their response to these prompts. Have students discuss their designs in groups of 2-3. Use your favorite protocol (ex. Talking stick) to make sure that each student is having a chance to share. You can increase accountability here by also asking students to report on their partner's designs.

Materials Needed

Chart paper and markers
Students' initial sketches

Structured whole-group discussion (15 min)

Gather students together as a whole group and begin to build a class consensus chart—a simple T-chart that lists the NEEDS of the design (criteria or requirements) and the WANTS of the design (things we'd like to include but are not critical to how it works). Remember that the gingerbread man seems to only visit the class when no one else is around so our design will have to work without anyone in the room (it will have to be triggered). Did anyone include this type of design? Leading students through their examples, build a list of criteria that is separate from our desires.

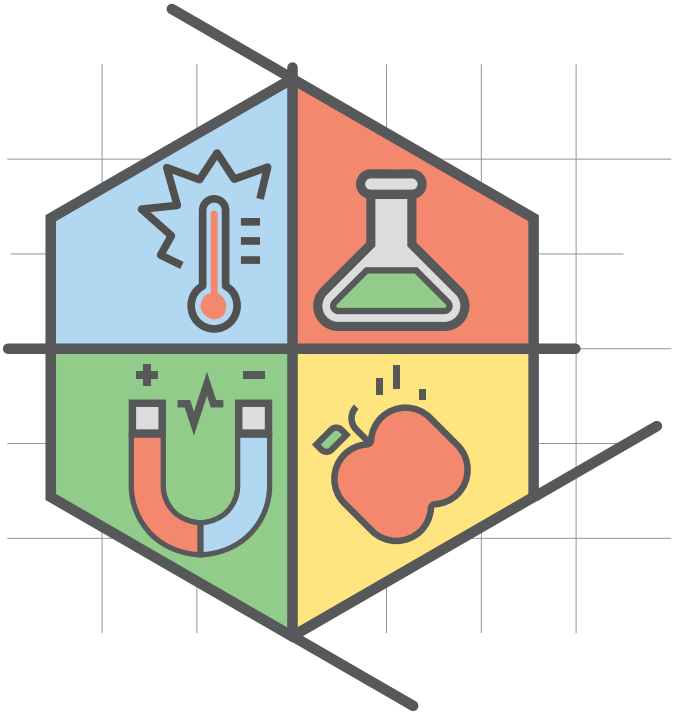
Guiding group discussions using accountable talk sentence frames such as:

- *I agree with _____ because _____.*
- *I have questions about _____.*
- *I disagree with that because _____.*
- *I don't know what you mean by _____.*

Evaluate (15 min)

After building the class criteria list, have students revise their initial sketches to include at least 2 of the criteria - using a new color to visibly represent changes in thinking. There are a few opportunities to assess group collaboration during this session. Begin by having students assess themselves using a Rubric.

Formative Assessment: Have students complete this probe individually or use it to guide discussion on initial ideas about pushes and pulls.



LESSON 2: Forces All Around

STRATEGY: EXPLORE

In this lesson, students engage in an investigation on forces and are able to explain that a force is a push or a pull.

STEM

SESSION 1: Just for kicks (45 min)

Adapted from Siemens STEM Day

Teacher prep: *Draw a target for the tennis ball on the poster board large enough to be seen.*

Engage

Begin the lesson by reminding students of our driving question (maybe have the gingerbread man make another surprise visit overnight!). Re-engage with the criteria chart and point out that we decided that the trap must have some kind of movement. Today we are going to explore the causes of movement or motion. Demonstrate the tennis ball target using steps 1-3 on page 3 of the "Just for Kicks" lesson

Explore

Beginning with step 4 on page 3 of "Just for Kicks" and move students to an open space to conduct their investigation (eliminate the suggestion for second grade - there is no need to explain Newton's Laws of Motion!). You can also eliminate steps 7 & 8 for time, and use them later.

Explain

Back in the classroom, gather students together and discuss the activity. We investigated three types of motion: rolling, kicking and throwing. What caused each of these movements? (the force of their bodies) What effect did each of these forces have on the ball? (different speeds, different accuracies to hit the target) What do all of these forces have in common? (they are all pushes - a force that moves away from us) What is the opposite force of a push? (a pull) How can these forces be useful in our trap design?

Essential question for the week: What are some ways we can use pushes and pulls in our trap designs?

Materials Needed

- Outdoor or gym space
- Rubber balls or kick balls (1 per group of 3)
- Tennis ball
- Poster board
- Markers
- Tape
- Chart paper
- Colored cones (ask the PE teacher to borrow)

SESSIONS 2: Making observations outdoors and around school (45 mins)

Extend

Field STEM opportunity:

We want students to build on our knowledge of forces and motion by looking around for evidence of other pushes and pulls. Take them on a scavenger hunt of pushes and pulls. On the playground, this can be a great way to engage in discussion about playground conduct and appropriate use of force - the swings, slide, etc. In nature, this can be tricky but still valuable - does the wind push or pull the leaves? Do birds push the air with their wings?

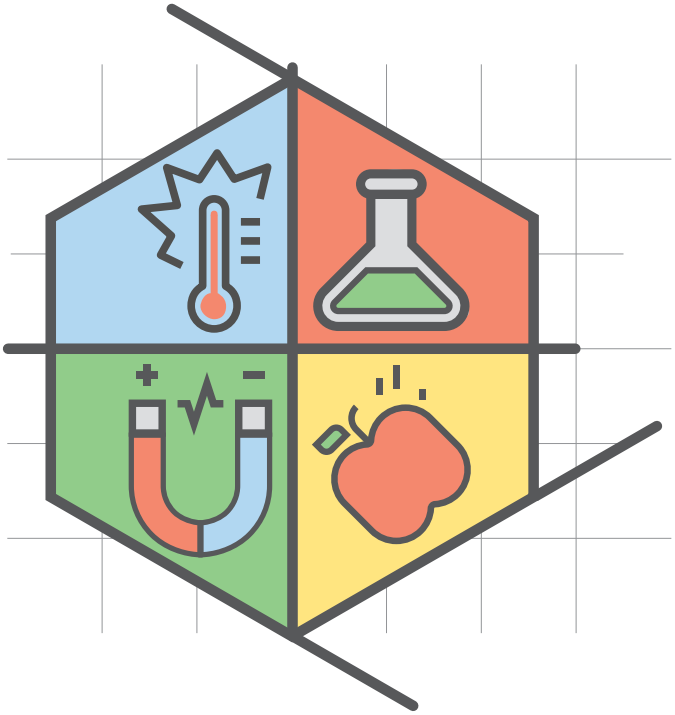
Evaluate

Create an "OWL" Chart by making three columns titled "Observe," "Wonder," and "Learn." It may also be helpful to write the driving question on the top of the chart to remind students. Bring students inside and ask them to turn-and-talk with a partner about their observations while they were outside. What were they observing, what observations did they make? Did they see any pushes or pulls on the playground? What are some examples? Add these to the 'O' column on the OWL chart. Additionally, have students add push and pull labels to their initial design sketches. Suggest that the class revise the driving question so that their trap must include pushes or pulls.

Modified driving question: How can we use pushes, pulls to create a trap to catch the Gingerbread Man?

Materials Needed

- Clipboards
- Scavenger Hunt graphic organizer



LESSON 3: Roll with It

STRATEGY: EXPLAIN

In this lesson, students construct an explanation for the causes and effects of the strengths and direction of pushes and pulls.

STEM

SESSION 1: *Rolling Spheres* OR *Push, Pull, ROLL* (30 mins)

This lesson will use materials from the Kindergarten FOSS/BBS kit that you received. Depending on the FOSS/BBS kit materials you have received, use either:

- Balance and Motion - Investigation 3, Part 3 (Rolling Spheres)
- Push, Pull, Go - Investigation 1 (Push, Pull, ROLL)

Materials Needed

FOSS Materials from Spheres Investigation

OR

BBS Materials from Push, Pull, Roll Investigation

Engage

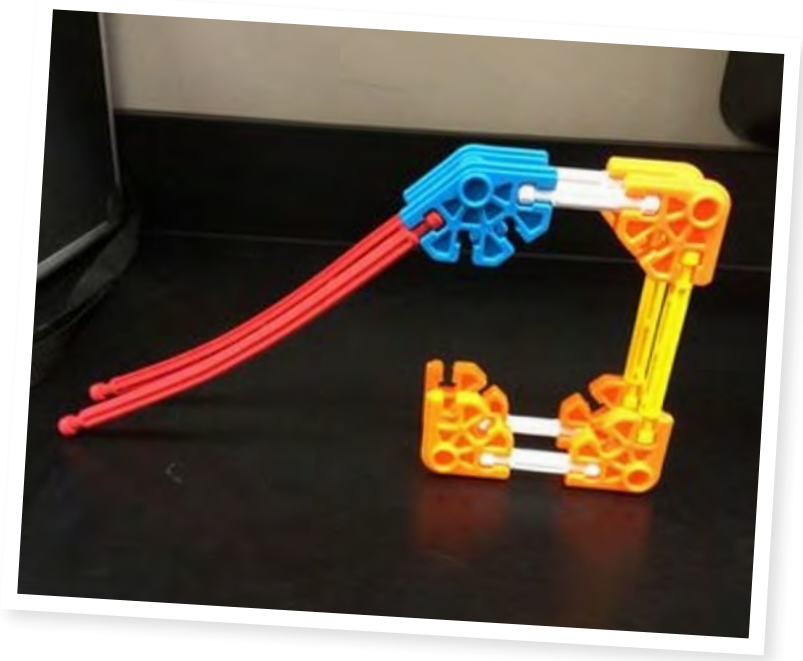
Gather students together and ask them to think of ways that they will be able to use pushes and pulls in our trap designs. Have students share from their revised models their current ideas. "What are the ways that we tried using these forces in the previous lesson (rolling)? Today, we're going to spend some time investigating how objects roll and how we can change the speed, direction or length an object travels. Be sure to think of how some of these tricks can be used to trap that pesky gingerbread man!"

Explore

Implement the FOSS lesson above. After, be sure to come back and add to the OWL chart so that students can connect their learning to the driving question.

Math connection: Have students collect data on this distance each ball rolls and how they change their systems. Use a simple T-chart, or the student sheets included in your kit to document using non-standard units such as unifix cubes. What did we figure out?

Essential question for the week: What are the most important characteristics of teamwork when trying to solve a problem?



SESSION 2: Move that turnip! (20 min)

Explain

Share the story "The Enormous Turnip" by Alexei Tolstoy (retold by Irene Yates).
Lead a science circle with students to make connections to the strength of forces in the story and what we have observed, wondered and learned as part of our trap designs. How does the strength of the force you use to pull or push make a difference on how far an object moves?

Materials Needed

- Computer with internet access
- Paper and markers

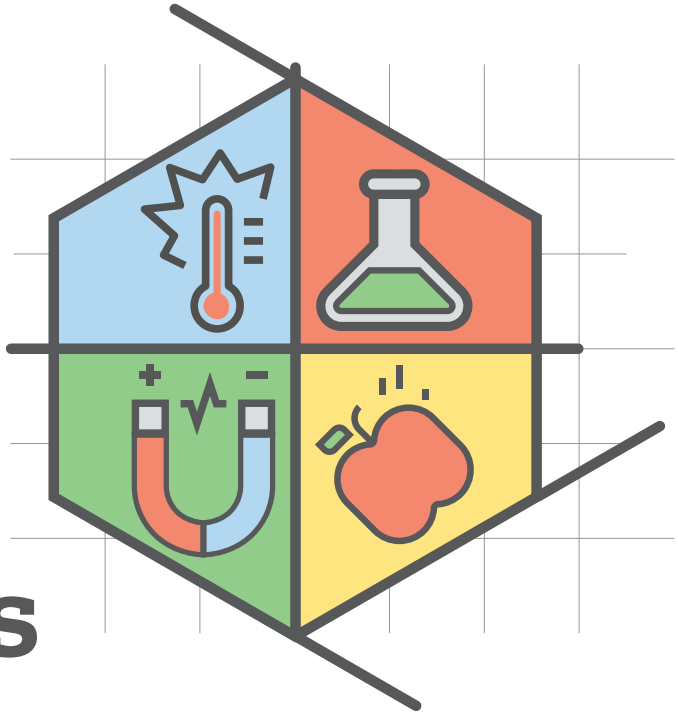
Extend

Revisit the theme of teamwork and collaboration in the story. What did it take for the characters to be able to pull the turnip? Using the Teamwork Rubric (Lesson 1 above) have students draw a picture of a team developing their designs together and write a sentence about what the most important part of teamwork is.

Evaluate (optional)

If using the Balance and Motion kit, you can use Student Sheet #10 as a formative assessment toward the DCI PS2.A. If using Push, Pull, Go you can print an image (see resources below, and have students draw the ball and direction, and a sentence on an idea on how to change the direction of the ball.

LESSON 4: Twirling through New Designs



STRATEGY: EXPLAIN

In this lesson, students plan and conduct an investigation to determine that a bigger push or pull makes things speed up or slow down more quickly.

STEM

SESSION 1: *Spinners* OR *Push, Pull, SWING* (30 mins)

Depending on the kit materials you have received, use either:

- Balance and Motion - Investigation Part 2, Part 1 (Spinners)
- Push, Pull, Go - Investigation 2 (Push, Pull, SWING)

Materials Needed

FOSS Materials for *Spinners*

OR

BBS Materials for *Push, Pull, Swing*

Engage

Reviewing the OWL chart, what are some of the science ideas we've learned about forces (pushes, pulls, how height affects distance and speed of an object)? Are we missing some possible ways that objects move? What are some other ways that we might want to explore? Today, we're going to spend some time investigating how objects swing, spin and twirl and how we might speed them up or slow them down using pushes and pulls.

Explore

Implement the suggested FOSS/BBS lesson. If using Balance and Motion - this is a great time to read the FOSS Science Story "Pushes and Pulls" to reinforce concepts and vocabulary. After, be sure to come back and add to the OWL chart.

Math connection:

In Balance and Motion, have students record the length of the shaft and the size of the disk they use against the time it spins. In PPG, have students mark the distance of the pull back on the swing with masking tape, verses how far the swing moves forward. Record these in the group or class table. What did we figure out?

Essential question for the week: What forces of a trap design are most important to include?

SESSION 2: Sheep in a Jeep? (45 mins)

Explain

Share the story "Sheep in A Jeep" by Nancy Shaw. Lead a science circle to make connections to the concepts of force and motion, as well as problem solving. How did the sheep get into this problem? What did the sheep do to solve their problem? What are some things we've learned about force and motion that could have helped the sheep?

Materials Needed

- Large paper
- Markers or crayons

Extend

Use this story to emphasize safety as well as to build on teamwork skills and application of concepts, put students into groups of 3. Have them brainstorm ways they could design to protect the sheep (seatbelts, parachutes, bumpers, etc.). Once they have had time to brainstorm ideas, introduce the term "Criteria" - something each design has to include. Student groups should draw their designs and label them with at least 1 push and 1 pull, and how they will slow down the Jeep. Provide each group with large paper (or half a sheet of chart paper).

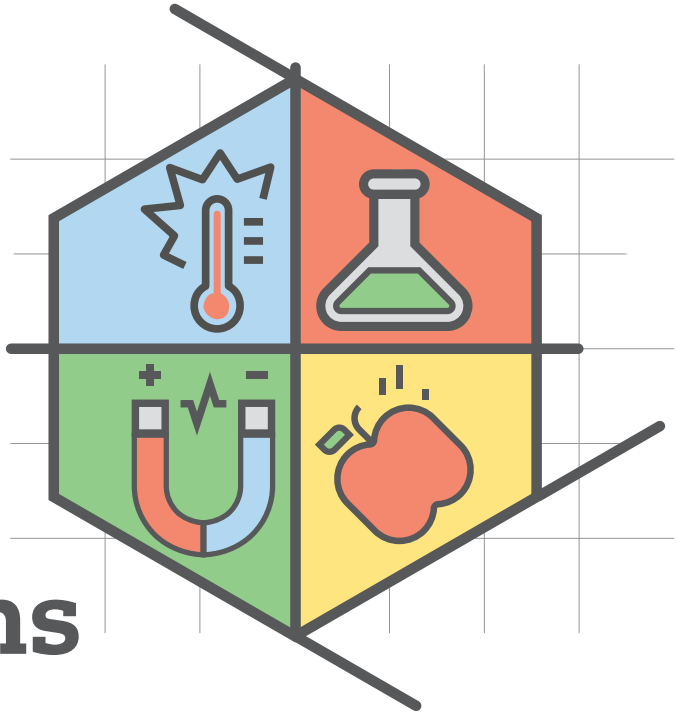
SESSION 3: Presenting our designs to protect the sheep (cont. From session 2, 45 mins)

Have student groups present their designs. Keep a class record of what our designs had in common (similarities) and the differences.

Materials Needed
Student designs

Evaluate

As students present their designs, keep a student record of progress toward unit goals.



LESSON 5: Balance and Stable Designs

STRATEGY: EVALUATE

In this lesson, students plan and conduct an investigation to determine how forces affect balance, and how the structure of their design will affect its function.

STEM

SESSIONS 1-3: *Zoomers, Rolling Wheels and Balance* OR *Push, Pull, Tumble and Spin* (30 min ea)

The purpose of Lesson 5 is to deepen experiences with the concepts of force, motion and balance and apply these to the Gingerbread Trap designs. Depending on time and the fluency of your group choose the investigations that best meet your needs.

Depending on the kit materials you have received, use either:

- FOSS Balance and Motion - Investigation Part 2, Part 2 (Zoomers), Investigation 3, Part 1 (Rolling Wheels) and/or Investigation 1, Part 1 (Balance)
- BBS Push, Pull, Go - Investigation 3 (Push, Pull, Tumble) and Investigation 4 (Push, Pull Spin)

Materials Needed

FOSS Materials from Balance and Motion *Zoomers, Rolling Wheels and Balance*

OR

BBS Materials from *Push, Pull, Tumble and Spin*

Engage

Place an empty chair in front of the class, and ask them if any forces that we have been investigating are acting on the chair (push, pull - or roll, spin, swing)? *It's possible that some students may offer gravity as an explanation. Acknowledge that this is probably a very good explanation but gravity as a force is not necessary as a kindergarten science concept.*

Explore

Implement the lesson(s) above. After, be sure to come back and add to the OWL chart after each.

Essential question for the week: How will we create a trap that is balanced and stable?

SESSION 4: Revising initial designs (45 mins)

Explain

It's time for students to revisit their initial trap designs and revise them with new information that we've gathered about force and motion. Students should revise their original trap designs to demonstrate how they will use a push or pull to trigger the trap, and how it will balance. Sketches should be labeled and a sentence or two included to describe it's structure and function.

Materials Needed
Original Trap Designs Materials to test ideas

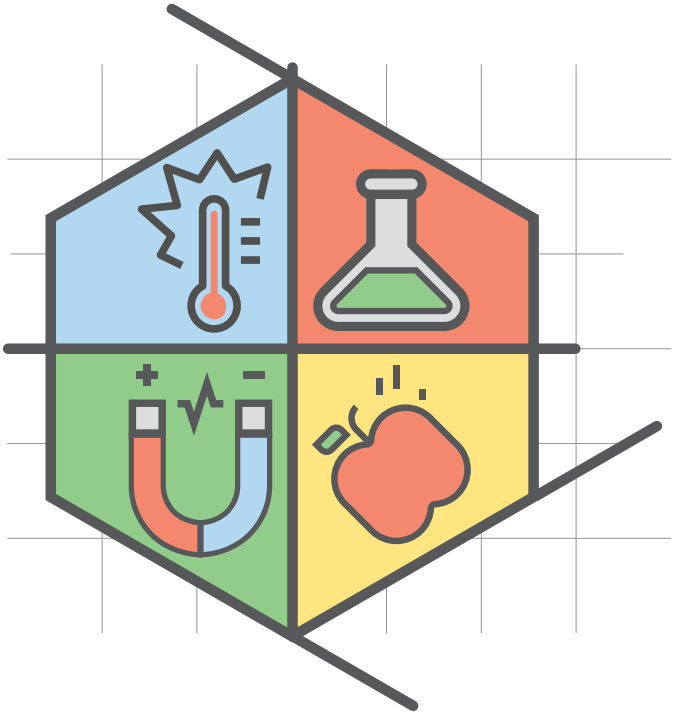
Extend

Place students into groups of 3 (this will be their final design group). Together they must share each design, explaining how the trap will function and where they included pushes, pulls and how it will be balanced. The group will need to combine the most effective parts of their trap into one shared design. What process will they use to determine the best parts? Students can use the 'Useful Properties' sheet to record their thinking.

*It may be useful for students to have objects to manipulate during this process so that they can explain their evidence for the design's function. Reuse parts of your kit or provide recyclables to develop mini explanatory models.

Evaluate

Use assessment tools included in your respective kit for each science investigation. As student groups meet to evaluate their designs, circulate the room listening for queues on use of force concepts and terms, as well as teamwork.



LESSON 6: Becoming Engineers

STRATEGY: EVALUATE

In this lesson, students learn about engineering as a career and apply engineering design to the class gingerbread trap design.

STEM

SESSION 1: What does an engineer do? (35 min)

Engage

Ask students if they know of people that are scientists? What about engineers? (Or use any type of biography of a scientist or engineer to introduce the idea.) Have we been using some of the skills of scientists or engineers in our work?

Read the Scientist, Inventor, and Engineer Book. Hold up the picture of each job as they share their ideas so that they can start making the connection between the picture and the job.

Explore

Explain that we are going to play a card game. Have the children use their scissors to cut apart the three cards. They will bring them to the floor to play the game. Read each scenario aloud and have the children decide who is most responsible for each of the different statements – the scientist, inventor or engineer. Children can hold up the correct card (picture of scientist, inventor or engineer) that corresponds with the scenario. When the game is finished, have students draw a picture of themselves as either a scientist, inventor or engineer, and include the tool, idea, or problem they would solve. After, be sure to come back and add to the OWL chart.

Essential question for the week: What are the most useful features for a trap designed to catch the gingerbread man?

Materials Needed

Scientists, Inventors, and Engineers Book

Card Game copies

Questions for card game

Design:
Large piece of cardboard
Wire from kit or hanger
Hole punch
Strong tape
Clear or paper cups
Bead or fastener

SESSION 2: Revising initial designs (45 mins)

Explain

It's time for students to combine all of our most useful ideas into one solution that the class can test out. Present the students with the materials and explain that though some of them may have included lots of other materials, sometimes engineers are limited (constrained) by what they are able to use. Student groups will share their best designs as you draw a class consensus model on chart paper. A consensus model is a model that is created together as a class based on the ideas that each group shares. Be sure to introduce the concept of a trigger if it has not come up in science circle. Have students reference their ideas for which materials to use in each part of the model. (They can be recording on their own as you are working through the class design.)

- The following day, have the trap ready to demonstrate to students. As you work through the model, have students identify where the design uses pushes, pulls and also how it is balanced.

Materials Needed

Scientists, Inventors, and Engineers Book

Card Game copies

Questions for card game

Design:
Large piece of cardboard
Wire from kit or hanger
Hole punch
Strong tape
Clear or paper cups
Bead or fastener

Extend

Once we have a working *prototype* for our trap, we need to see if the Gingerbread Man will enter it. How will we attract him to the trap? (We need bait to attract him.) We might need to try several types of bait and we'll need to keep track of what works and what doesn't just like an engineer would to test our design. Present students with options you would like to use (whatever you have around, but include 2-3 options).

Math connection:

You will need to develop a class chart to record whether or not your bait traps the Gingerbread Man, and how much was used.

Evaluate

Use the Driving Question to have students respond using a Claims-Evidence frame. Students should be able to articulate how pushes and pulls function in the trap to create both balance and the trigger to trap the Gingerbread Man. Sample rubrics are included in the Kindergarten Pushes and Pulls folder. These should be revised to meet your context.

Teacher Instructions for Trap Design (Basic)

1. Cut poster board into strips about 12 in x 22 in. Bend poster
2. across width at about the 6" mark of the length to create a base for the trap. (Blue).
3. Bend hanger into "C" shape and create a loop for string at top. (Black)
4. Tape hanger onto poster board using strong tape. (Purple)
5. Attach string (Red) to the bottom of a clear cup. (Green) Punch holes in the poster board at X's and feed the string through as shown in the diagram. Then place a bead at the opposite end of the string.
6. Glue two small clear cups together end to end to form a bait holder.
7. (Yellow) Place bead under bait holder to set the trap.

SESSION 2: Revising initial designs (45 mins)

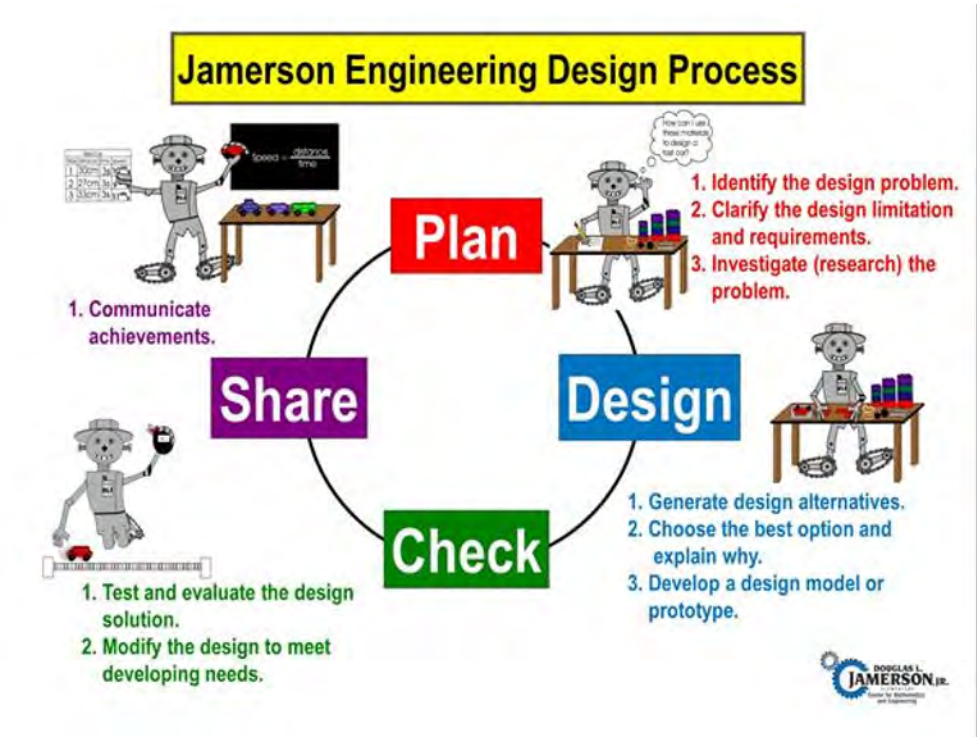
Concluding the Unit:

Once you've decided which bait will trap the Gingerbread Man, be sure to include a memorable conclusion by going back and finishing the story to see what happened to the Gingerbread Man, leaving a letter written by him letting the students know that they were just to smart for him, and/or enjoying some ginger snap cookies as a celebration!

Optional Extension Lessons:

1. **COMPUTER SCIENCE INTEGRATION.** If you have had robotics training from ESD112, borrow a class set of Bee Bots. Using the blank challenge mats, place cards of each character in the Gingerbread story in places around the map. In teams of 2-3, have students program the Bee Bot to demonstrate the sequence of characters the Gingerbread Man meets along his path to escape!

2. **A BOAT THAT CAN FLOAT!** After students have completed the final design challenge, revisit the story of the Gingerbread Man, but pause again when he gets to the river. Using recyclables and any materials left over in your kit, have students use the Engineering Design Process to design a system that will carry the Gingerbread Man across the river and away from the fox!



ENGINEERING DESIGN PROCESS
Image created by Douglas L. Jamerson, Jr. Elementary Center for Mathematics and Engineering