**Oakland Schools Science Scope**

**Kindergarten**

**Unit 2 – Pushes and Pulls**

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**About Our Scope Unit/Lesson Template**

This template is designed to serve several teaching and learning principles considered as staples of state-of-the-art science instruction. Here are the key principles in summary:

* It’s critical to **elicit prior knowledge** as a unit or lesson begins.
* **Key questions** should drive student explorations and investigations.
* **Activity Before Concept** – Student inquiry-based explorations which give personal experience with phenomena and ideas should precede a presentation of science ideas.
* **Evidence is the heart of the scientific enterprise.** Students generate evidence and analyze patterns in data that help to construct scientific explanations around key questions.
* **Concept Before Vocabulary** – Attaching science vocabulary to concepts developed by student investigations yields more success than beginning a unit or lesson with a list of science vocabulary.
* **Talk, argument** **and writing** are central to scientific practice and are among the most important activities that develop understanding.
* **Application** of the ideas provides review, extends understanding, and reveals relevance of important ideas.
* **Assessment** of knowledge, skill, and reasoning should involve students throughout the learning process and be well aligned to the main objectives and activities of the unit.

The Scope Science template is designed to put these principles into practice through the design of the ***SCOPE LEARNING CYCLE FOR SCIENCE***. Each unit has at least one cycle. The components are listed below:

|  |  |
| --- | --- |
| The Key Question for the Cycle | Each cycle has one open-ended driving question that relates to all the content and skills of the unit. The Key Question is presented at the opening of the cycle and revisited at the cycle’s conclusion. |
| Engage and Elicit | Each unit begins with an activity designed to elicit and reveal student understanding and skill prior to instruction. Teachers are to probe students for detailed and specific information while maintaining a non-evaluative stance. They also can record and manage student understanding which may change as instruction proceeds.  |
| Explore  | A sequence of activities provides opportunities to explore phenomena and relationships related to the Key Question of the unit. Students will develop their ideas about the topic of the unit and the Key Question as they proceed through the Explore stage of the learning cycle.Each of the activities may have its own Focus Question or central task that will be more focused than the unit question. The heart of these activities will be scientific investigations of various sorts. The results, data and patterns will be the topic of classroom discourse and/or student writing. A key goal of the teacher is to reference the Key Question of the cycle, the Engage and Elicit of the students and to build a consensus especially on the results of the investigations. |
| Explain | Each unit has at least one activity in the Explain portion of the unit when students reconcile ideas with the consensus ideas of science. Teachers ensure that students have had ample opportunity to fully express their ideas and then to make sure accurate and comprehensible representations of the scientific explanations are presented. A teacher lecture, reading of science text, or video would be appropriate ways to convey the consensus ideas of science. Relevant vocabulary, formal definitions and explanations are provided. It’s critical that the activity and supporting assessments develop a consensus around the Key Questions and concepts central to the unit. |
| Elaborate  | Each unit cycle has at least one activity or project where students discover the power of scientific ideas. Knowledge and skill in science are put to use in a variety of types of applications. They can be used to understand other scientific concepts or in societal applications of technology, engineering or problem solving. Some units may have a modest Elaborate stage where students explore the application of ideas by studying a research project over the course of a day or two. Other units may have more robust projects that take a few weeks. |
| Evaluation | While assessment of student learning occurs throughout the unit as formative assessment, each unit will have a summative assessment. Summative assessments are posted in a separate document. |

**Kindergarten**

**Unit 2 – Pushes and Pulls**

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**Unit 2 – Pushes and Pulls**

**Unit Introduction**

This unit attends to the Michigan Grade Level Content Expectations as they are gathered in Kindergarten Unit 2 of the Michigan Department of Education Science Companion Document. Topically, the unit addresses concepts related to forces and motion, including how forces affect the motion of a variety of objects.

As teachers look for ways to have students use real-world data, apply interactive technology to real-world questions, and foster meaningful tasks for reading, writing, argumentation and mathematics and framed by the Common Core Curriculum Standards, the issues here provide abundant opportunity. The main limitation is the class time available given other content demands.

*On the Common Core State Standards for English Language Arts and Literacy in Science*

All science teachers will find the Common Core State Standards of ELA a tremendous asset for reaching learning objectives in science education. Reading, writing, argumentation and discourse are central proficiencies necessary for success in science. All teachers should become fluent with the document and will likely find it validating.

[**http://www.corestandards.org/assets/CCSSI\_ELA%20Standards.pdf**](http://www.corestandards.org/assets/CCSSI_ELA%20Standards.pdf)

These standards are best reached with science instruction that connects content to real-world problems and experiments, complimented with scientific writing, challenging questions, processes for classroom discussion and debate and use of scientific text.

**Unit 2 – Pushes and Pulls**

**Introduction**

In this physical science unit, students will investigate how forces affect the motion of a variety of objects in their world. They will distinguish between forces that pull objects and forces that push objects. Students will examine how pushing and pulling on an object can change the speed or direction of its motion. They will connect their understanding of forces that push and pull with how gravity affects the motion of objects by investigating how objects fall towards the earth.

**Learning Objectives**

Students will be able to:

* Describe the position of an object (above, below, in front of, behind, on) in relation to other objects.
* Describe the direction of a moving object (for example, away from or closer to) from different observers’ views.
* Demonstrate pushes and pulls on an object that can move.
* Observe how the shape and mass of an object can affect motion.
* Understand that objects initially at rest will move in the direction of a push or pull.
* Explain how pushes and pulls can change the speed or direction of moving objects.
* Observe how objects fall toward the earth.

**Advance Preparation for Entire Unit**

* Review activities for required materials.
* Make arrangements with school or local library to obtain copies of books prior to scheduled activities. If recommended titles are not available, locate appropriate alternative books. See list below:
* *Motion: Push and Pull, Fast and Slow* (Amazing Science) by [Darlene R. Stille](http://www.amazon.com/Darlene-R.-Stille/e/B001IXS2DK/ref%3Ddp_byline_cont_book_1)
* *Move It!: Motion, Forces and You* (Primary Physical Science) by [Adrienne Mason](http://www.amazon.com/s/ref%3Ddp_byline_sr_book_1?ie=UTF8&field-author=Adrienne+Mason&search-alias=books&text=Adrienne+Mason&sort=relevancerank) (Author), [Claudia Davila](http://www.amazon.com/s/ref%3Ddp_byline_sr_book_2?ie=UTF8&field-author=Claudia+Davila&search-alias=books&text=Claudia+Davila&sort=relevancerank) (Illustrator)
* *Forces Make Things Move (Let's-Read-and-Find-Out Science 2)*  by [Kimberly Brubaker Bradley](http://www.amazon.com/Kimberly-Brubaker-Bradley/e/B001ILFOVU/ref%3Ddp_byline_cont_book_1) (Author), [Paul Meisel](http://www.amazon.com/Paul-Meisel/e/B001IGLZ6I/ref%3Ddp_byline_cont_book_2) (Illustrator)
* *I Fall Down* by Vicki Cobb, published by HarperCollins.
* *Gravity* by Susan Canizares, published by Scholastic Inc*.*
* For addition useful ebooks go to <http://kids.mel.org/HomeworkHelpers> and click on the 4th link down – eBook K-8 Collection. Type push, gravity, force, motion, etc… in the search box. There will be many titles that will be useful.

**Key Question: How and Why Do Things Move?**

**Engage and Elicit**

**Activity 1 – Things That Move!**

**Purpose**

To elicit student ideas about how and why objects move.

**Activity Description**

In this activity, students are given a variety of objects that will move if pushed or pulled. Students will explore the motion of these objects through play.

**Focus Question**

How do things move?

**Duration**

One class session

**Materials**

* Collection of common items such as: balls, marbles, cylinders, zippers, flip top bottle caps (ie salad dressing, ketchup), toy cars, trucks or trains.

**Teacher Preparation**

1. Collect items for exploration. (Teacher may send home note asking each student to bring in a toy that moves to add to the collection.)

**Classroom Procedure**

1. Explain to students that they are going to have a chance to play with some different objects. Tell them they should explore different ways to make each object move. Remind students that it is important to share objects so that everyone has a chance to play with all of the items.
2. Put a variety of objects in an accessible area where students have enough space to play with and make the objects move in different ways.
3. Circulate while students are playing and ask students to describe how their object is or is not moving. Ask them what they are doing to make the object move. Accept all answers and ideas. Make note of students’ ideas about how and why objects move and the vocabulary they use to describe their thinking.
4. Gather students and the objects to a whole-group meeting area. Hold up one object at a time and ask which students played with that object. Call on students to describe if they were able to make it move. If they say yes, ask them what they did to make it move and how it moved. Record student answers on a class chart. Repeat with a few objects and accept all answers.
5. Have students individually draw a picture of an object that was the most fun to make move in their journals. Have them use arrows to show how the object moved.

**Explore**

**Activity 2 – Balloon Race**

**Purpose**

To investigate different ways to make an object move.

**Activity Description**

In this activity students will explore the different ways they can make a balloon move. They will participate in a team race, their breath to move the balloons across a section of the classroom.

**Focus Question**

How can I make things move?

**Duration**

One class session

**Materials**

* Balloons (at least one per student)
* Masking tape

**Teacher Preparation**

1. Fill balloons with air.
2. Mark a starting and ending point for the balloon race on the floor.

**Classroom Procedure**

1. Give each student a balloon. Tell them that later they will get to race their balloons but first they are going to investigate different ways that they can make their balloon move.
2. Give each student a balloon and encourage him or her to try to make it move with and/or without touching it.
3. Circulate the room and encourage students to try different ways of making the object move. *“What did you do to make your balloon move? Is there another way that you could make it move? Can you make it move without touching it? How can you make it go faster? Slower?”*
4. Bring students together as a group and have them share how they made their balloons move. *“Were you able to make your balloon move without touching it? What did you do that made your balloon move faster or slower?”*
5. Divide students into small groups for “race heats.” Tell students that they will be racing their balloons without touching them. Show students the start and finish line for their balloon race. Tell the rest of the class that they will be acting as scientists learning about motion of objects and their job is to observe how the students are making their balloons move.
6. Rotate roles until all students have had a turn racing their balloon. Optional: Have winners of each heat race against each other to get a class champion.
7. Bring students together as a whole group to discuss what they observed while watching the balloon races. *“How did the winning students make their balloons go faster? How did the winning students keep their balloons going straight? Is there something you would do differently if you participated in another balloon race?”*

**Explore/Explain**

**Activity 3 – Describing Motion and Position**

**Purpose**

To apply directional terms when describing an object’s relative position and motion

**Activity Description**

Teacher will introduce descriptive directional terms while students are observing how a ball moves when it is rolled back and forth between partners. Students will be introduced to positional terms while playing a game of Simon Says. They will practice using positional terms by describing the location of various classroom objects. Students will apply their understanding of using positional and/or directional terms to the motions described during a read aloud of informational text.

**Focus Question**

How do scientists describe the relative location and direction of a moving object?

**Duration**

Two class sessions

**Materials**

* Plastic golf balls, marbles, foam balls, or other small balls for each pair of students
* *Where’s the Bear* worksheet (one per student)

 Source: <http://www.greatschools.org/worksheets-activities/5350-wheres-the-bear.gs>

* *Over, Under & Through* by Tana Hoban (or other book with positional/directional terms)
* <https://www.youtube.com/watch?v=xKmhS4qLj_s> (addition resource)

**Teacher Preparation**

1. Make copies of worksheet.
2. Preview trade book on positional/directional terms deciding on where to pause for discussion
3. Prepare to add new terms with appropriate diagrams to class word wall

**Classroom Procedure**

**Day 1:**

1. Divide students into pairs and give each pair a ball and have them sit across from each other. Direct them to roll the ball back and forth.
2. Explain to the class that scientists have to agree on what words they will use to describe their observations so they can communicate with other scientists. *“Today you will be practicing using words that are good for communicating with others how an object moves.”*
3. Ask individual students to describe their ball’s relative change of position. Ask one student *“Did the ball move* ***away*** *from you or* ***towards*** *you?”* Then ask the partner the same question. *“Did the ball move away from you or towards you?”* Ask students why they have different answers (it depends on whether you are rolling the ball or catching the ball).
4. Have students continue to roll the ball back and forth while each stating “away” or “towards” each time the ball is rolled.
5. Ask students what words they would to describe the motion of a the ball if they were watching two people roll the ball back and forth from the sidelines. *(They would need to also need to describe from what perspective - goes toward Sue, goes away from Sue.)*
6. Have students return the balls and sit in a large circle. Practice using agreed-upon terms for describing the direction of moving objects from different observers’ views by handing classroom items (piece of paper, pencil, book, etc.) to several students *(the book moved toward me; the book moved toward Sue,* *depending on who is describing the motion*).

**Day 2:**

1. As a class, play Simon Says using positional words (*Simon says… put your hands on your head, put one hand behind your back, place one foot in front of the other*). When finished, make a list on a chart of the terms that were used to describe location (above, below, in front of, etc.).
2. Explain to the class that as scientists, it is important that they use common terms to describe an object’s location as well as its motion. Select an object in the room and model how to use the terms agreed upon to describe its location (the stapler is in front of the computer and above the desk). Have each student take a turn using terms from the chart to describing the position of an object. Add additional terms to the list as needed.
3. Read *Over, Under & Through* by Tana Hoban aloud for the class (or another book on positional terms). Stop periodically to discuss the terms used and how these terms could be used by scientists to describe the position and/or motion of an object.
4. Give each student a copy of the *Where’s the Bear* worksheet. Read the words to the class before they begin. Tell them to individually mark the box for each diagram that they think best describes the position of the bear in relation to other objects in the picture. Model the first one by saying: “*I see a bear and a mushroom in this picture. The bear is standing on top of the mushroom. Which word do I think best describes the bear’s position? “On” or “Next To?” I think “On” is the best, so that is the one I will select.”*
5. After students complete the worksheet, have volunteer students explain which term they used to describe each diagram and how they decided. Tell students that scientists use position words like these to describe the things they observe in their world. Put the terms on the class word wall or on a unit anchor chart.
6. Formative Assessment Journal Prompt: Direct students to find two objects near each other in the room and to draw the objects in their journals in a way that shows their positions. Tell students to circle one object they drew and use position words to describe the other object’s location. Model this sketching and labeling with an example in the room: *a coffee cup on the desk—circle the cup and label the desk as “under.”*

**Explore/Explain**

**Activity 4 – Shapes and Motion**

**Purpose**

To make and record purposeful observations on the movements of different sized and shaped objects.

**Activity Description**

In this activity, students will conduct experiments to discover how shape, weight and force affect an object’s motion. They will explore making solid shapes of various sizes and materials move. Students will discover that in order for an object to start moving on a flat surface, it will require a push and that heavier objects need a stronger push.

**Focus Question**

How do shape, weight and force affect an object’s motion?

**Duration**

Two class sessions

**Materials**

* Solid shapes: cube, sphere, cone, and cylinder in various sizes or materials such as wood, plastic, or foam for weight comparison. (Teacher may also use items such as a tissue box, tin can, marble, glue stick, etc. for more selections)
* Chart paper, marker
* *Testing Different Size Push and Pulls* record page
* Computer with projection system
* Pushes and Pulls Simulation:

 <http://www.bbc.co.uk/schools/scienceclips/ages/5_6/pushes_pulls.shtml>

**Teacher Preparation**

* 1. Gather a variety of solid-shaped objects for stations.
	2. Set up stations for small groups in different areas of the room. Put a variety of different shaped and sized objects at each station. (Make sure that each station has at least one cube, sphere, cone and cylinder-shaped object.)
	3. Copy “Testing Different Size Pushes and Pulls” record page (one per student).
	4. Set up computer and projections system for Pushes and Pulls simulation. Make sure that the site is not blocked.

**Classroom Procedure**

**Day 1:**

1. Tell students *“Today we are going to observe how different objects move when we push them across the classroom floor.”*
2. Model for students how they will select an item from their station and then investigate how it moves when they push it across the floor or table. Remind students that each person in the team should explore moving each item. Tell them to all pay particular attention to how they get the item to start moving, how the item moves, and how far the item moves with a push.
3. Split the class into small groups of students for the investigation and circulate as students are exploring the various items, encouraging them to try softer and harder pushes and pulls for the different items. Ask students: *“What started the objects moving? What might happen if you pushed harder/softer? Did the object roll or slide? Which item moves the farthest with a push? The least far?”*
4. Collect student observations on a class chart similar to the one below:

|  |  |  |
| --- | --- | --- |
| **Object** | **What we did** | **What we observed** |
| *Wood block* | *Pushed softly* | *Slides slowly* |
| *Wood sphere* | *Pushed hard* | *Rolls far* |
|  |  |  |

1. Review class chart and explain that scientists use their observations to make predictions. Show students the BBC Pushes and Pulls simulations and have them use the *Testing Different Size Pushes and Pulls* data chart to record their predictions before testing each example. Say: *“Do you think the truck will get to the red flag or the blue flag with a hard push? Put an X on the color flag you think is right.”* Then run the computer test and tell students to write “yes” if their prediction matched the results and “no” if the results were different. Repeat with all four examples.

**Note: Keep stations ready for second day of lesson.**

**Day 2:**

1. Review the results from the hard push, soft push, hard pull, and soft pull investigations. Ask students if they think anything other than a hard or soft push or pull affects how far the object goes (*a round object will go further than a flat object, a big object will not go as far*). Expect students to support their ideas with observations from the last session.
2. Tell students they will be using what they learned so far about pushes and pulls to find out how far one push can move the objects they investigated during the last session.
3. Number the objects on the class chart and ask students to discuss with their team which object they think will move the farthest if they use the same amount of push for each fair test. Have each team report what they predicted. Record the predictions with tally marks on the class chart.
4. Ask students what they will need to do to make sure each object is pushed in the same manner, fairly and consistently (*push the same way, push on the same surface, one person does all the pushing*). Record student ideas on a class chart.
5. Tell students that they will need to keep track of their results as a team so they can share what they learned with the other scientist teams in the class. Ask them for ways they think they can keep track of how far each object went, so they will be able to share their results with the other teams. Record student ideas on the class chart.
6. Collaborate as a class to decide on the procedure all teams will use for the investigation (for example, one person pushes each of the objects, a team member marks the floor with a piece of tape to show how far each object went, another team member labels the tape with the object’s number).
7. Assign a station with a set of objects to each team. Circulate the room and ask probing questions: *“Which is slowest, the cube or the sphere? What moves further, the wood cylinder or the foam cylinder? Is a shape that rolls faster than a shape that slides? If you pushed harder/softer can you change the distance the shape travels?”*
8. As a whole group, have students compare their results with their predictions. Highlight on the class chart the object that went farthest in each team’s “fair test.” Have a class “run off” fair test to compare the winning objects from each team. (Have students predict which object will go farthest before testing.)
9. As a class, construct a scientific explanation for what they learned: (Claim – Evidence) Example: *“Round objects need less force to move. Our evidence is that the sphere went farther than the cubes when pushed.* Repeat as needed to draw class conclusions about the effect of weight, size and/or shape on how the objects move.

**Explore**

**Activity 5 – On the Playground**

**Purpose**

To investigation how pushes and pulls affect everyday objects on playgrounds

**Activity Description**

In this activity, students will explore how force can change the motion of familiar objects found on playgrounds. As scientists, students will build on their common experiences with playground equipment by examining how a push moves an object away from the applied force and a pull moves an object toward the force. Students should discover that the size of the change in motion is related to the size of the force applied to the object.

**Focus Question**

How can we change an object’s motion?

**Duration**

Two class sessions

**Materials**

* Playground structures (swings, slide, etc.) and equipment (balls, Frisbees, tug-of-war rope)
* “On the Playground”record sheet

**Teacher Preparation**

1. Make a copy of the “On the Playground” record sheet for each student.
2. Collect playground equipment such as various balls, Frisbees, tug-of-war rope.

**Classroom Procedure**

**Day One:**

1. In the classroom, introduce this activity with the question: “*What is one way to start moving when you are on the swing set?”* Accept all ideas and answers. Tell students: *“Today you will be thinking like a scientist and investigating how a push or pull can change how things move on the playground.”*
2. Model for students how to explore playground equipment safely. Before taking students outside, remind them of appropriate behavior and that they are not going out to play, but to collect data as scientists.
3. Circulate while students are outside investigating playground equipment and ask probing questions related to how force can change the motion of an object.*“How would I go faster on the swings? How would I get the ball to go further? Can you go faster/slower on the slide? How? How did the swing move when you gave it a soft push? Which direction did the swing move when you pushed it?”*
4. After students have had enough time to investigate a variety of types of equipment, return to the classroom. Tell students that they will have the opportunity to share what they learned about push and pull on the playground the next day in class.

**Day Two:**

1. As a whole class, review what students explored on the playground. Ask individual students to describe a piece of equipment they investigated and what they observed about the motion when they pushed or pulled. Ask students: *“Which way did the equipment move?” (away from me, toward me) “What happened when you pulled/pushed harder?” (went farther, faster) “What did you do to make yourself go faster? Slower?”*
2. Give each student a copy of the “On the Playground” record sheet. Have them draw two pictures showing when they caused a change in motion by pushing, and when they caused a change in motion by pulling. Encourage students to use arrows and stick figures to show actions in their drawings. Circulate as students are working and ask them to explain their drawings.
3. Gather as a class and have volunteer students share and explain their drawings. Brainstorm a list of other things that can be moved by pushing and/or pulling. Collect the ideas on a class chart.

**Explain**

**Activity 6 – Push and Pull Picture Sort**

**Purpose**

To compare how pushes and pulls affect the motion of objects.

**Activity Description**

In this activity students, as a whole class, will sort pictures of objects which can be moved by a push and/or pull. Then small groups of students will be given a stack of picture cards to sort into piles according how they are moved, and explain their placements. During the second part of this activity students will coral read the lyrics of a song about how pushes and pulls can more objects as they sing along. Students will then listen to selected informational text samples which further explain how forces affect the motion of objects. They will discuss how the author used text features, especially diagrams and labeling, to help explain the topic to them. They will then demonstrate their understanding of targeted science terms by individually completing and sharing a Force and Motion mini-book.

**Focus Question**

What is the difference between a push and a pull?

**Duration**

Two class sessions

**Materials**

* “Push and Pull Large Picture Sort,” one set (or Promethean Picture Sort)
* “Push and Pull Small Picture Cards” for group sorting (one set per small group)
* *Force and Motion Book*, one per student
* *A Push Or A Pull* song about push and pulls by Peter Weatherall (<https://www.youtube.com/watch?v=FOcY37oGhj8>)
* Informational books about push and pull forces such as:

*-Motion: Push and Pull, Fast and Slow* (Amazing Science) by Darlene R. Stille

*-Move It!: Motion, Forces and You* (Primary Physical Science) by [Adrienne Mason](http://www.amazon.com/s/ref%3Ddp_byline_sr_book_1?ie=UTF8&field-author=Adrienne+Mason&search-alias=books&text=Adrienne+Mason&sort=relevancerank) (Author), [Claudia Davila](http://www.amazon.com/s/ref%3Ddp_byline_sr_book_2?ie=UTF8&field-author=Claudia+Davila&search-alias=books&text=Claudia+Davila&sort=relevancerank) (Illustrator)

*-Forces Make Things Move (Let's-Read-and-Find-Out Science 2)*  by Kimberly Brubaker Bradley  (Author), [Paul Meisel](http://www.amazon.com/Paul-Meisel/e/B001IGLZ6I/ref%3Ddp_byline_cont_book_2)  (Illustrator)

**Teacher Preparation**

1. Make one set of “Push and Pull Large Picture Sort”cards(or prepare set of Promethean Board Picture Sort cards).
2. Reproduce and cut apart “Push and Pull Small Picture Cards” into group sets for small groups.
3. Reproduce pages of *Force And Motion* *Book* back to back. Cut pages in half and staple together to make a book for each student.
4. Put words from *A Push Or A Pull* song by Peter Weatherall on a large class chart

 <https://www.youtube.com/watch?v=FOcY37oGhj8>.

1. Select an informational book from materials list above for read aloud and discussion.

**Classroom Procedure**

**Day One:**

1. As a class, use examples from playground and class chart to explain key terms:
* A force is a push or pull on an object.
* A push moves an object away from you.
* A pull moves an object towards you.
1. As a whole group, use large pictures to model how to sort pictures of objects into push and pull categories. Use a Promethean Board if available, or picture cards if not. Invite students’ participation, and have them take turns deciding how to sort examples.
2. Explain to students that now they will have a chance to sort sets of cards like the ones that they just used as a class. Group students in small groups of 4-5. Give each group a set of “Push and Pull Small Picture Cards.” Direct students to sort the cards according to how the item in the picture can be moved: by pushing the object, by pulling the object, or both. Encourage students to discuss each card with their group before deciding where it belongs.
3. Circulate as students are working and ask how they decided where to place pictures. Use responses as a formative assessment opportunity.

**Day Two**:

1. Gather students in a group and review the terms discussed at the last session by asking students to give an example of something in the room they can move with a push or pull force. Ask students to describe what they would have to do to make the object move faster, slower, and/or change direction.
2. Review words from *A Push Or A Pull* song by Peter Weatherall with the class before playing it. After listening to the song once, sing as a class while following along with the song’s words on the chart.
3. Read aloud and discuss the selected informational book with the class. Discuss with students how the information in the text about force and motion, as well as the key features, serve as an example of informational text (*how were pictures and diagrams used to explain the ideas? how were the diagrams labeled, etc.?).*
4. Show the class a page of the *Force and Motion* *Book*. Explain to students that each page has one important word missing and that their job is to decide what that word might be (push or pull).
5. Read the sentence on the first page aloud and have students talk with a partner to decide what word they think would best fit in the blank. Call on a volunteer to suggest a word. Have students signal with a thumbs up if they agree or thumbs down if they disagree. If there is a lot of disagreement, discuss the sentence and word selection as a class. *“Why do you think this is the best word for this sentence? What other word do you think might be better? Why do you think so?”* For example, push or pull might both be correct for a wagon, and it would depend on what the child in the picture is doing. Come to an agreement on what is happening in the picture before deciding on the correct word.
6. Model how to write the agreed-upon missing word in the sentence blank. Have students write the appropriate word in their personal copy of the book. Read the page aloud as a class with the word inserted in the blank. Ask students if there is any additional information that they, as authors, could add to the page to help a reader learn about forces (arrows, labels, etc.). Add the suggested features to the model page.
7. Have students return to their seats to read their book on their own and fill in the word push or pull to correctly complete each sentence. Have students add arrows and labels and color their pages. When finished, have partners share their books with one another.
8. Ask a volunteer to read his/her book aloud for the class. Ask students if they had any pages with different words in the blanks. Have students justify the words they used by physically modeling what they think is happening in the picture and explaining why they picked the different word.

**Explore/Explain**

**Activity 7 – Gravity**

**Purpose**

To observe that objects are pulled toward the earth.

**Activity Description**

Students will observe a variety of objects falling to the ground when dropped. They will then observe what happens to a thrown object when no one catches it. They will label the force that pulls objects to the ground as “gravity,” a special pulling force that the earth has. Students will imagine what it would be like to live on Earth without gravity.

**Focus Question**

Why do objects fall to the ground?

**Duration**

One class session

**Materials**

* “Explaining Gravity Chart” (view on overhead or Smartboard)
* *Gravity* diagrams
* Tennis ball (or other easy to catch ball)
* Plastic golf balls or bean bags (one for each student)
* Variety of objects with different masses (rock, pine cone, and ball)
* *Gravity* by Susan Canizares, published by Scholastic, Inc*.*

**Teacher Preparation**

1. Collect materials needed for gravity demonstrations
2. Obtain and review informational books on materials list to plan “stop-and-discuss” points during read aloud.
3. Prepare *Gravity* diagrams for class discussion.

**Classroom Procedure**

1. Gather students together as a group and introduce the lesson by telling students that today they are going to learn about a special kind of force. Ask a volunteer to play “catch” with you. Throw the student a ball that he/she can easily catch. Ask the class to describe what happened and what made it happen. Encourage them to use push and pull to describe how the ball started and stopped moving *(i.e., you pushed the ball when you threw it and the person who caught the ball stopped it by pushing the other way).*
2. Hold up four objects of different mass in front of the class (a rock, a pine cone, a feather and a ball). Ask students to predict what will happen when you let go of each object. Demonstrate what happens when you drop the objects one at a time.
3. Ask the students to explain what happened and what made it happen*. “Did the motion of the rock change when I let go? Did I push the rock? Did I pull the rock? What made the rock move the way it did?”* Accept all answers at this time.
4. Read aloud *I Fall Down* by Vicki Cobb. Stop and demonstrate actions from the pages in the book (throw an object upwards and ask why it never falls up).
5. Pass out plastic golf balls or bean bags for hands-on investigation on gravity. Allow students to practice experimenting with what happens when they throw objects straight up in the air (they push the object up, it goes up, and then it stops and comes back down).
6. Introduce the term “gravity.” Explain that the earth pulls on all objects with a force. Scientists call this pull force “gravity.” Ask students what they think would happen if you threw the ball in the air without gravity *(would keep going up because there is nothing to stop it).*
7. Read *Gravity* by Susan Canizares or another similar book on gravity. Use information from the text to explain what happened in your earlier examples and demonstrations.
8. Show the class the set of *Gravity* diagrams. Have students turn to a partner and practice explaining they think is happening in each situation. Encourage them to use the words push, pull, up, down and gravity in their explanation. Circulate and listen for evidence of student understanding: *gravity is an example of a pull that makes objects fall to the ground.*
9. Have student volunteers describe each picture for the class. Ask probing questions as needed: *“What is happening to the football? Which footballs go straight? Why do you think this would happen? How could you make the football go higher? Farther?
Which footballs would go up and then fall down? Why? Could the football go only up?”*
10. Have students return to their desks and draw a picture of a world without gravity. Circulate as they are working, asking students to explain their illustrations.

**Elaborate**

**Activity 8 – Push and Pull Inc.**

**Purpose**

To plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

**Activity Description**

Students use the engineering design process to plan, construct and name a toy that can be moved across the floor in different directions with a push and/or a pull.

**Focus Question**

How do engineers use their understanding of push and pull forces to design toys?

**Duration**

Three class sessions

**Materials**

* Items such as egg cartons, tissue boxes, cereal boxes, cardboard, tubing, string, paper towel tubes, empty spools, lids, pipe cleaners, straws, empty plastic jars, balls, marbles, and toy cars (teacher may request items to be donated)
* Tape, paper, scissors, duct tape and crayons for toy construction
* *Push and Pull Inc.* (toy design planning sheet)

**Teacher Preparation**

* Review NGSS Grade K Force and Motion Performance Expectations Appendix

 <http://www.nextgenscience.org/kfi-forces-interactions-pushes-pulls>

* Review NGGSS Appendix I for background on the engineering design process and engineering learning expectation for K-2 students <http://www.nextgenscience.org/sites/ngss/files/Appendix%20I%20-%20Engineering%20Design%20in%20NGSS%20-%20FINAL_V2.pdf>
* Gather a large variety of construction materials for toy designs.
* Copy *Push and Pull Inc*. (toy design sheet) for each student
* Ensure tape, paper, scissors, pencils and crayons are available for students.

**Classroom Procedure**

**Day One:**

1. Introduce this project by explaining that today students will be working as engineers. Explain that engineers use what they know about science to build things that solve problems.
2. Tell students that a company called Push and Pull Inc. learned that this class knows a lot about how things move, and the company has asked for their help in making a new toy that is fun to move on the floor in different ways with a push and/or a pull.
3. Show students the collection of materials available to them to build their toy Tell students they will be working with a partner to make a plan and then build a model of their toy’s design.
4. Remind students that first they need to review what they’ve learned about push and pull forces and how this understanding will help them design a toy. Have them talk with a partner about how toys can be made to move in different ways with pushes and pulls.
5. Tell students that before they can build a model of their design they must make a plan. They must draw and label a diagram of their toy on their design sheet.
6. Give each team of students a copy of the Push and Pull Inc. planning sheet and tell them to discuss possible design ideas with their partner before deciding on one to draw and label as a plan.
7. Circulate as students work, asking questions about the process. *How many different ideas did you have? How did you decide that this one is best? How will push and pull forces be used to make this design move? Can it be made to go faster? Slower? Change direction? How?*

**Day Two:**

1. Explain to students that after engineers finish planning, they create a model of their design. Review with students how to work collaboratively and safely with their partner as they build their model. Tell them that during the next class session they will get to demonstrate how their toy works for the class.
2. Set out materials and give students ample time to create their model toys. Circulate and ask probing questions as students work. Revisit the criteria for the that students were expected to follow (design a toy that moves different ways across the floor with a push and/or a pull, is made of the available materials and follows a plan).
3. As students are working, encourage them to test their models, record notes on how the models work in their journals (sketches with labels), and make changes based on their test results.
4. When students are satisfied with their models, have them name their toy and rehearse how they will share what they created and learned with the class.

**Day Three:**

1. Review with the class what engineers do. Use the graphic help illustrate the steps that they all used in designing their toys. Explain that now it is time to share their products with fellow engineers.



1. Use the criteria established for the project to evaluate students’ knowledge and understanding of pushes and pulls as they present their projects to the class.

**Evaluate**

**Activity 9 – What Makes Things Move?**

**Purpose**

To assess student understanding of how push and pull forces cause objects to move.

**Activity Description**

In this activity, students will draw themselves giving a push and doing a pull and be able to explain the difference.

**Focus Question**

How would one describe the motion of an object?

**Duration**

Two class sessions

**Materials**

* Chart Paper/Marker
* *Things Move with a Push or a Pull* worksheet – 1 per student
* *I Can Identify Push and Pull Forces* worksheet – 1 per student

**Teacher Preparation**

1. Make copies of each worksheet for all students

**Classroom Procedure**

**Day One:**

1. As a whole group, discuss the types of objects students can move by using a push or a pull, and list on chart paper (examples: zippers, doors, chairs, socks, lights, phone, kite, hair, etc.).
2. Have students complete the worksheet *Things Move with a Push or a Pull* by writing push or pull under each picture and drawing an arrow to show what direction the objects will move.

**Day Two:**

1. Review Push/Pull chart from Day One. Have students complete the worksheet *I Can Identify Push and Pull Forces* by drawing or writing four things they can move with a push or a pull.
2. Have students share and explain their answers with the class. Use as a summative assessment.



**Science Scope on Atlas Rubicon Curriculum Manager:** <http://oaklandk12.rubiconatlas.org/public/>

**Oakland Schools:** <http://www.oakland.k12.mi.us/>