Science Grade 1

Forces and Motion

Description: The students in this unit will use their inquiry skills to explore pushing, pulling, and gravity. They will also explore the different variables which affect the movement of objects, including weight, shape, surface resistance, and gravity. They will also explore how gravity aids in the movement of objects down a slope.

Standards Aligned With This Unit

CT State Science Standards:

Content Standard:

- Forces and Motion – What makes objects move the way they do?

Expected Performances:

- A10. Describe how the motion of objects can be changed by pushing and pulling.

Grade Level Expectations (1st Grade):

- 1.1 Motion is caused by a push or a pull. A push or pull is called a force.
- 1.1 Pushes and pulls can start motion, stop motion, speed it up, slow it down or change its direction.
- 1.1 An object can be set in motion by forces that come from direct contact, moving air, magnets or by gravity pulling it down toward the earth.

Science Integration:

Science Inquiry: Students in this unit will be **experimenting** with a variety of different materials to see the ways they move in response to force. They will be **recording** what they see and then **organizing their data**. They will also be **making predictions** and then using what they know to **create models**.

Science **Literacy**: In this unit students will read fiction and non-fiction texts related to the unit. They should be encouraged to identify the main idea (**A1 Literacy Standard**) of the text, and to make connections (**C1 Literacy Standard**) with what they have learned about in class and other texts. The teacher can also question the students about why the author included specific sections in the book (**B2 Literacy Standard**).

Science **Numeracy**: The students will be using math skills such as examine attributes of objects and describing the relationships (CT Math Standard1.1), describing, naming and interpreting direction and position of objects (CT Math Standard 3.2), collecting, organizing, recording and describing data (CT Math Standard 4.1), organizing data in tables and graphs and making comparisons of the data (CT Math Standard 4.2), and determining the likelihood of certain events through simple experiments and observations of games (CT Math Standard 4.3).

SCIENCE CONTENT STANDARD 1.1

CONCEPTUAL THEME:	**GRADE-LEVEL CONCEPT 1:** ◆ An object's position can be described by locating it relative to another object or the background	**CMT EXPECTED PERFORMANCES**
Forces and Motion - What makes objects move the way they do?	**GRADE-LEVEL EXPECTATIONS:** 1. An object's **position** can be described by comparing it to the position of another stationary object. One object can be *in front of, behind, next to, inside of, above or below* another object. 2. The description of an object's **position** from one observer's point of view may be different from that reported from a different observer's viewpoint. For example, a box of crayons between two students is near Susan's left hand but near John's right hand. 3. When an observer changes **position**, different words may be needed to describe an object's position. For example, when I am sitting on the bench the sun is "behind" me; when I move to the slide, the sun is "in front of" me. 4. The same object when viewed from close up <u>appears</u> larger than it does when viewed from far away (although the actual size of the object does not change.) For example, a beach ball held in one's arms appears larger than it does when viewed from across the playground. 5. An object's **position** can be described using words ("near the door"), numbers (10 centimeters away from the door) or labeled diagrams.	A 10 Describe how the motion of objects can be changed by pushing and pulling.
CONTENT STANDARD:	**GRADE-LEVEL CONCEPT 2:** ◆ An object's motion can be described by tracing and measuring its position over time. **GRADE-LEVEL EXPECTATIONS:** 1. Things **move** in many ways, such as spinning, rolling, sliding, bouncing, flying or sailing. 2. An object is in **motion** when its position is changing. Because the sun's position changes relative to objects on Earth throughout the day, it appears to be moving across the sky. 3. Motion is caused by a push or a pull. A push or pull is called a force. 4. An object can be set in motion by forces that come from direct contact, moving air, magnets or by	

	gravity pulling it down toward the earth. 5. Pushes and pulls can start motion, stop motion, speed it up, slow it down or change its direction. **KEY SCIENCE VOCABULARY:** position, motion, shadow, push, pull, force	

Unwrapped Conceptual Ideas:

- Pushing and Pulling are the ways that people and machines exert force.
- Shape has an effect on how objects move.
- Weight has an effect on how objects move.
- Resistance keeps an object from moving as far or as quickly.
- Gravity is a different type of force which pulls everything down to the earth.

Unwrapped Major Skills:

- Student will be able identify objects they push and pull.

- Students will define force.
- Students will measure and record how different objects move.
- Students will create models in which they apply the rules of movement they have learned.

Common Misconceptions:

- Objects which are not in motion have no force applied to them.
- The surface on which an object rolls does not affect its motion.

Instructional Strategies That Work:

Letting students lead the discussion with the teacher acting as a guide, allowing students to experiment and then demonstrate their findings, providing students with a variety of materials to experiment with, allowing students to work together cooperatively, encouraging students to record data and use math skills to quantify data.

Vocabulary Words:

Push, pull, force, data, organize, Venn diagram, weight, shape, round, edge, surface, balanced, unequal, movement, gravity, earth, slope, flat

Connections to Literature:

Real Science 4 Kids, Rebecca Keller
Eyewitness: Force and Motion, Peter Lafferty
Motion, Darlene Stille
Experiments with Motion, Salvatore Tocci
Move It! Motion Forces And You, Adrienne Mason

Overview of Lessons:

Lesson One: What is Pushing and Pulling
Lesson Two: What do we Push and Pull
Lesson Three: Organizing our Data
Lesson Four: Moving our Bodies
Lesson Five: Weight, Force, and Movement
Lesson Six: Shape, Force, and Movement

Lesson Seven: Surface, Force, and Movement
Lesson Eight: Balanced and Unbalanced Forces
Lesson Nine: Introduction to Gravity
Lesson Ten: Gravity and Slopes

Culminating Activity: Students will create a motion station. In this setup and object of their choice moves the farthest with the least amount of force. This demonstrates their awareness of how shape, weight, surface, and gravity affect motion.

Lesson One: What makes things move?

Student Goals:

1. Students will understand what pushing is.
2. Students will understand what pulling is.

Vocabulary: push, pull, force

Materials: computer with internet access, access to www.unitedstreaming.com, projector you can hook up to monitor (if available)

Procedure:

1. Ask the students what they know about how things move. Discuss the different ways that things move (spin, twirl, roll, slide, etc.). Ask the students for specific examples of things they have seen, or even to get up in front of the class to demonstrate.
2. Explain to the student that although all things move in different ways, everything that moves is being either pushed or pulled. This is also known as force. Ask for a student to demonstrate pulling. See if they can name several things we pull every day (shoe laces, opening draws or doors). Then ask a student to demonstrate a push. Ask if they can name several things they push regularly (swings, pencil into pencil sharpener, etc.).
3. Tell the students that you will be watching a video designed to teach us a little bit about how different things move in different way as the result of pushing or pulling.
4. Go to www.unitedstreaming.com and play the video titled "How things Move". Click on the link to play the video on a full-screen, and if available hook up the monitor to a projector for most visibility.
5. After the video review some of the main concepts with the students. Ask them to push a pencil across their desks, and then pull it back.
6. Have the students fill out their "What is pushing and pulling?" worksheet.

Lesson Two: What do we push and pull?

Student Goals:

1. Students will identify many objects in our daily lives that we push and pull.
2. Students will understand that if we did not exert force on these objects we would not be able to manipulate them.

Materials: two differently colored packs of sticky notes, marker, one clipboard

Procedure:

1. Review the previous lesson with the students. Ask them to define pushing and pulling. Ask them to tell you some of the things they push or pull often.
2. Tell the students they will be going on a push and pull scavenger hunt today. Show the students the two differently colored sticky notes. Tell them that one color is going to stand for push, and one will stand for pull. Make sure to explain that there are several things which can be pushed or pulled, so it's ok if there is more then one color sticky note on an object. Tell them they can work in groups of three and go around the room. They can write the word push on one color sticky notes and attach it to any thing they push, and do the same for anything they pull with the other color notes.
3. Provide the students with enough time to label as many different things as possible.
4. After the students have returned review where all the notes have been placed. Some of the students can volunteer where they placed their notes and why they thought the note was appropriate. During this time the teacher should correct any misplaced notes.
5. Tell the whole class they did so well with that, you are going to go around the school and place appropriate labels around the building.
6. Lead the class around the building, encouraging them to point out where they think labels should be placed. As the children place labels, the teacher should keep a list of all the locations we found where we push, pull, or both. The teacher should suggest some places the kids miss, and ask for opinions.
7. After you return to the classroom, list off the places you put the notes, and have the students try to remember if it was a push or a pull.
8. Ask the students how their lives would be different if we did not push or pull these things. What would we no longer be able to do? Explain that by exerting force upon these objects, we are able to move things in our environment.

Lesson Three: Organizing Our Data

Student Goals:

1. Students will understand why scientists organize data.
2. Students will organize previously collected data.

Vocabulary: data, organize, Venn diagram

Materials: chart paper with a blank Venn diagram, marker, "What Pushes and What Pulls?" worksheet

Procedure:

1. Review the previous lesson with the students. Discuss all the things that you found in the classroom (notes should still be up) and in the school (use the list compiled by the teacher as a guide) that are pushed and pulled.
2. Tell the students that as scientists it is important that we organize our data. Explain that data is information you have collected by observing. Tell them that one way to organize data is with a Venn diagram. Ask the student if they are familiar with a Venn diagram or where they may have seen one before.
3. After some responses, bring out a large piece of chart paper with a blank Venn diagram. Title it "What Pushes and What Pulls". Model for the students how to fill out the diagram. Write the name of one object which pushes, one object which pulls, and one which does both in the appropriate sections. Then allow the students to fill out their own Venn diagrams.
4. After the students have filled out their own Venn diagrams, encourage them to share where they have placed a variety of items on their Venn diagram, and as they share responses write them on the diagram on the chart paper.
5. Remind students that the reason for making this type of diagram is to organize our data, which means writing it in a way that it's easy to understand quickly. Tell them they will be using their Venn diagrams to do the next part of the lesson.
6. Pass out the Force Sentence Frames worksheet. Tell the students to reference their Venn diagrams to complete their sentences (more advanced students may be able to write the sentences without the frames).
7. Allow the students enough time to complete the sentence frames, and then share them with the class. Explain to the students that organizing their data allowed them to easily see which things are pushed, pulled, or both. Ask them to share other places where data is organized (grade book, report cards, lunch menu, graphs, etc.). Again, explain that the reason we organize data in these different ways is because it makes information easier to understand. Ask the students how it was easier to complete the sentences after they had a completed Venn diagram.

Name_____

What Pushes and What Pulls

1) One thing which I push is

2) One thing which I pull is

3) One thing which I push is

4) One thing which I push is

5) One thing which I pull is

*Think: How did your Venn diagram help you answer these questions?

Lesson Four: Moving our bodies – Pushing and Pulling

Student Goals:

1. Students will understand that all movement is caused by pushing and pulling.
2. Students will understand that moving their bodies is the result of pushing and pulling.

Materials: chart paper, playground (optional)

Procedure:

1. Review the previous lesson with the students. Have a few of the students model how things in the classroom are pushed and pulled. They can also share things they remember from around the school which were identified as items they push or pull.
2. Explain to the students that everything that moves is the result of some sort of push or pull. Review the word force, and explain that nothing can move without force. You may want to take some time here for children to give you several examples of things that move and you can explain how they are the result of pushing or pulling. If they bring up more complex machines like trucks or trains, explain to them that those machines run on motors which push or pull them forward.
3. Lead the discussion to the topic of how people move their bodies. Have the students brainstorm a list of the different ways that they move. After you have a significant list, ask the students to go through the list and guess how this movement is caused by pushing or pulling. Model in front of the class that when you walk your foot is actually pushing you forward. Explain that when you ride your bike your foot pushes a pedal, which in turn pushes the wheel. As this discussion develops be sure to emphasize the fact that ALL movement is caused by pushing or pulling.
4. After some time give the students some time to get up and experiment with movement. This may be a fun activity to do on the playground. Different types of equipment may provide the opportunity for children to explore movements caused by pulling. Encourage them to identify the pushing or pulling. As they are experimenting travel around to make sure they understand how pushing and pulling are causing their movements.

Lesson Five: Weight, force, and movement

Student Goal:

1. Students will understand how weight affects force and movement.

Vocabulary: weight

Materials: "How Easy is it to Move?" worksheet, empty soda cans, full soda cans, empty soup cans, full soup cans, empty and full water bottles, chart paper, marker

Procedure:

1. Review the previous lesson. Ask the students to name things that move, and see if they can explain how those movements are the result of pushing or pulling. Reinforce that all movement is the result of Pushing or pulling.
2. Explain to the students that some things may be easier to move than others. Show the students the T-chart on chart paper titled "How Easy is it to Move". Briefly demonstrate how to fill out the chart (book goes under easy, couch goes under difficult). Then pass out the "How Easy is it to Move?" sheet, and allow the students time to brainstorm things which are easy to move and things which are difficult to move.
3. Monitor the class and make sure that they are not having trouble coming up with ideas.
4. After they have had enough time to fill out an appropriate amount of the chart, have them share responses they came up with. As they reply, record their responses on the chart paper.
5. Ask the students if they can see any patterns. Lead the discussion to the conclusion that heavier things are more difficult to move than lighter things. Ask the students to identify several things which are heavy and difficult to move, and then several things which are light and easy to move. Tell students we will be doing an experiment with pushing and pulling heavy and light objects.
6. Break students up into groups of three or four. Pass out corresponding (empty and full) types of different types of round bottles (as many as you could gather). Tell the students to test how these different things move when they are pushed or pulled. They should make sure to push the bottles with the same amount of force (explain what this means).
7. After they have had time to experiment, ask them to share their findings. Listen to several responses, and then guide the discussion to reach the conclusion that heavier objects do not move as far as lighter objects when the same force is applied to them. Explain that this force could be pushing or pulling, and demonstrate both. Also demonstrate exerting force on a variety of similar objects with different weights, and show the students that if the same force is exerted on heavy and light objects, the light objects will move more easily.
8. After the students understand this concept, you can show them that although heavier objects require more force to move, they can also require more force to stop. Roll a full bottle into someone's hand and an empty version of the same bottle. Ask them which one presses up against them with more force. Remind them that this force they feel is a form of pushing.

Name_____

How Easy is it to Move?

Easy	Difficult

Lesson Six: Shape, Force, and Movement

Student Goal:

1. The students will understand the effect shape has on movement and force.

Vocabulary: shape, round, edge

Materials: “Shape and Movement” recording sheet

Procedure:

1. Review the previous lesson with the students. Ask them how weight can affect how something moves. Also ask them if it can affect how easily something stops.
2. Ask the students if they can think of any way that other factors might affect how something moves. After a few responses tell the students that today we will be looking at how shape affects an object's movement. Ask them to brainstorm how they think shape might make it easier or more difficult to move something when force is exerted on it. Explain that this is what they will be experimenting with today.
3. Break the students up into groups or pairs and pass out a full water bottle to each group. Show the students that the water bottle has a round side (the cylindrical part) and a side with and edge (the side on which you can set it down if you want it to stand up). Tell the students to experiment with pushing and pulling the bottle when it is stood up on its side with an edge. Then instruct them to experiment with pushing and pulling the bottle when it's laid down on its rounded side. Have the students draw a picture of what happens in each case on their "Shape and Movement" recording sheet.
4. After the students have had time to experiment and record, ask the students what they found. See if they can describe the fact that the bottle rolls more easily on the rounded side as opposed to the side with a defined edge.
5. Lead a discussion in which the conclusion is reached that this rule can apply to other objects as well. Explain that the reason we put things on wheels is because round objects are easier to move than objects with an edge. Discuss things which are heavy, but easy to move because they are round (a heavy cart on wheels, cars, etc.)

Name_____

Shape and Movement Recording Sheet

How did the bottle move when	How did the bottle move when

you exerted force on the round side?	you exerted force on the side with an edge?

Lesson Seven: Surface, force, and movement

Student Goal:

1. The students will understand the effect that surface has on how an object moves when force is applied.
2. Students will understand what resistance is and the effect it has upon movement.

Vocabulary: surface, resistance

Materials: full water bottles, jackets and desks (or a flat paved and grassy area outside)

Procedure:

1. Review the last two previous lessons. Ask the students to explain in their own words how weight and shape can affect the way an object moves when it is pushed or pulled.
2. Ask the students if they can think of any other factors which might affect the way that an object moves when force is exerted on it. If they need some prompting ask them if they can ride a sled on the snow in the winter (yes). Then as if they can ride the same sled on the grass in summer (no). Ask them if they can identify why not. Lead the discussion to come to the realization that the surface on which an object travels can affect its movement. Tell the students that this is what we will be experimenting with today.
3. Break students up onto pairs or groups, and ask the students to get their jackets out of the closets, and spread one out on their desks (if it's warm out and the students don't all have jackets, you can take them outside provided there is flat grassy and paved are they can use).
4. Pass out water bottles to each group, and tell them that they will be experimenting with rolling the bottles on different surfaces and seeing how the bottles move differently. Tell them to place the bottles on their round sides, and roll them on their desks covered with a jacket (or the grass if you're outside). Make sure every student has a chance to try at least a few times. Ask them to describe in their own words how the bottle moves.
5. Then instruct the students to take the jacket off the desk (or move to the paved area) and repeat the experiment. Make sure they understand that for the experiment to work they need to push the bottle with the same amount of force. Ask them again to describe in their own words how the bottle moves. Again, make sure each student has an opportunity to try.
6. After enough time has passed ask the groups to share their results. See if they can explain in their own words that the bottle rolls easier on a flat and smooth surface, and stops sooner on a bumpier or rough surface. Explain to the students that something which stops an object from moving as far is called resistance. The less resistance there is the farther an object will travel when the same force is applied.

Lesson Eight: Balanced and Unbalanced Forces

Student Goals:

1. Students will understand that unbalanced forces result in motion.
2. Students will understand that balanced forces result in no motion.

Vocabulary: balanced, unequal, movement

Materials: jump ropes, “Balanced or Unbalanced Forces” worksheet

Procedure:

1. Review the previous lesson with the students. Ask them to name the different things you have learned about so far which can change the way an object moves when force is exerted on it (weight, shape, surface / resistance).
2. Explain to students that what we have seen to far is that when something is pushed or pulled, it moves. Ask the students if they can think of a time in which something would not move even if it was being pushed or pulled. Some responses might include if it is not being pushed or pulled hard enough, or if it is stuck.
3. Tell students that this can also happen if the force (push or pull) on an object is being balanced by an opposite force (push or pull). Give a demonstration. Ask a student volunteer to come up to the front of the class. Ask them to take one end of a jump rope while you take the other. Ask the student to pull (not too hard) one their end while you pull on the other. Each of you should be pulling on the rope, but not so hard that either of you move or fall over.
4. Ask the students if they can tell if you are pushing or pulling. After they respond “pulling” ask then why the rope is not moving if you are both exerting force on the rope. Lead the discussion to the fact that the rope is not moving because you are both pulling with the same force. Explain that this means the forces are balanced.
5. Put the students in pairs and give each pair a jump rope. Remind them that they should not be pulling on the rope too hard, or the forces will not be balanced. Allow them time to experiment.
6. After some time pass out the “Balanced and Unbalanced Forces” worksheet. Have some students come up and model balanced pulling on the rope. If they do it correctly have the students draw what it looked like when the forces were balanced. They can write the words “no movement” above the picture.
7. Ask the students if while they were experimenting they ever had unbalanced pulling. If so, ask them to describe what happened. Then ask a student to volunteer while you give a demonstration of unbalanced forces. To do this you will have to pull with more or less force than the student volunteer. Lead a discussion to again reinforce that when the forces are unequal an object (the rope) will move, but when forces are equal (balanced) the object will move. Students can then record what happened on their “Balanced and Unbalanced Forces” worksheet. They can write the word “movement” over the picture.

Name_____

Balanced and Unbalanced Forces

What happened when the	What happened when the

forces were balanced?	forces were unbalanced?

Lesson Nine: Introduction to Gravity

Student Goals:

1. Students will be introduced to the concept of gravity.
2. Students will be able to predict how life would be different if there were more or less gravity on earth.

Vocabulary: gravity, earth

Materials: "Zero Gravity Classroom" worksheet, colored pencils or crayons, computer with internet access, united streaming user name and password, overhead projector linked to monitor (if available)

Procedure:

1. Hold up a pencil and drop it to the ground. Ask the students if they can explain why the pencil fell to the floor. Remind them that we have already learned that nothing moves unless it is pushed or pulled. Ask them if they can guess what is pushing on the pencil. Allow a few students to respond, and then ask them if they have ever heard of the word "gravity".
2. Explain to the students that gravity is a force on earth which pulls everything to the ground. Make sure they understand that gravity pulls on all objects on earth, even though we cannot see what is causing this pull like we could see who was pulling on the rope.
3. Tell students that gravity is not the same on other planets. On some there is very little gravity which means nothing is really pushed to the ground at all. Ask them if they can imagine how things would be different if there was no gravity on earth. Lead a discussion in which they envision this.
4. Pass out the "Zero Gravity Classroom" worksheet. Allow some time for the students to draw what they think their classroom would look like if there were no gravity and nothing was pulled to the ground. When they are finished allows some students to come up to the front of the class and share their pictures. They should be able to explain why they drew specific parts of their picture.
5. Ask students to imagine what it would be like if there was even more gravity on earth than we really have. Remind them that gravity is a force that pulls us down, so they have to imagine what it would be like if everything was very heavy. Lead a discussion about how things would be different.
6. Tell students that they will be watching a video about gravity. Go to www.unitedstreaming.com and play the video titled "The Magic School Bus Gains Weight". If one is available, you can hook up the computer monitor to an overhead projector for better visibility. If there is no projector click the button to view the video in full screen mode so students can see.
7. After the video review the major concepts covered today about gravity.

Name_____

Zero Gravity Classroom

What would our classroom look like with no gravity?

Lesson Ten: Gravity and Slopes

Student Goal:

1. Students will understand what a slope is.
2. Students will understand how the effect of gravity upon objects on a slope.

Vocabulary: slope, flat

Materials: pencils, blocks (if none are available you can use books), ping pong balls

Procedure:

1. Review what the students learned yesterday about gravity. See if they can explain what it is in their own words.
2. Tell the students that they are going to be experimenting with some of the ways that gravity can affect how things move. Put the students in pairs or groups and tell them to go back to their desks. Make sure the desks are cleared off. Have the students place a pencil at the top of the desk, but not in the indentation made for the pencil to stay in. ask them if the pencil moves (no). Ask them to give the desk a little shake, and see if the pencil moves any more.
3. Now take the blocks and put one under each of the back legs of the desk so the desk is on a slant. Explain to students that this is called a slope. Ask the students to predict what will happen when they place the pencil at the top of the desk now (again, not in the notch meant for the pencil). Listen to a few responses and then allow them time to try. If the pencil does not roll right away, encourage them to give the desk a little shake to get it started.
4. After all students have had time to experiment ask them what they saw. Guide a discussion to reach the conclusion that the pencils rolled on the sloped desks, but not the flat desks.
5. Repeat steps 2, 3, and 4 with the ping pong balls.
6. Ask the students to make guesses about why this happened. If they are having a hard time, tell them to think about how gravity pulls things down. Lead a discussion to reach the conclusion that objects move easier on a slope because gravity pulls them down, and the slope of the surface pushes them forward.
7. Have the students share several places where they have seen slopes. Discuss the different reasons people use slopes.

Culminating Activity

Materials: full and empty water bottles, full and empty soda cans, different types of balls, chalkboard erasers, empty DVD cases, blocks, any other materials which were used during this unit, any supplemental objects you would like to add

Procedure:

1. Tell the students that today they will be using what they have learned so far about how things move. Tell them that each student will be setting up a movement station at their desk. Point out the supplies at the front of the room. Tell them they can use whatever they would like to create a station in which whatever object they select moves the farthest with the least amount of force (pushing and pulling).
2. The students may choose to use any of the objects and set up their desks any way they like. Provide enough time for the students to experiment with a variety of objects and setup, and then when they are done they should draw a picture of their setup and label it on the My Motion Station" worksheet.
3. When the students are finished have them explain to the class (or just the teacher) how their station works. They should be able to explain how they used the elements of weight, surface resistance, shape, and gravity to create a station where the least amount of pushing or pulling is required to make their object. Use their explanations to assess their understanding of these concepts.

1	2	3	4	5
The student showed no understanding of any of the four factors which affect movement.	The student showed understanding of one of the four factors which affect movement.	The student showed understanding of two of the four factors which affect movement.	The student showed understanding of three of the four factors which affect movement.	The student showed understanding of all of the four factors which affect movement.