Grade 3
Forces Causing Movement
Mini-Unit on Batteries

Overview

This mini unit was developed to be a part of your Grade 3 science unit on **Forces Causing Movement**. It can be used to restart your class after the Winter break and to remind them about the battery drive contest. This mini-unit was written to progress from lesson to lesson in a logical way, with each lesson building on the ones before it. However you may feel free to pick and choose or rearrange the lessons in any order to suit the needs of your classroom. Every effort was made to cite any external sources referenced. If I have missed any please let me know and I will make every effort to rectify the problem.

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Lesson #1 - Introduction - Movement as Energy - Energy as Movement

Ontario Curriculum connections:

Science:

Forces Causing Movement:

The Big Ideas

1. There are several types of forces that cause movement.
2. Forces cause objects to speed up, slow down, or change direction through direct contact or through interaction at a distance.

Overall Expectations

Investigate devices that use forces to create controlled movement.

Demonstrate an understanding of how forces cause movement and changes in movement.

Specific Expectations

2.3 - **conduct** investigations to determine the effects of increasing or decreasing the amount of force applied to an object.

2.5 - **use** appropriate science and technology vocabulary, including push, pull, load, distance, and speed, in oral and written communication.

3.4 - **explain** how forces are exerted through direct contact or through interaction at a distance .

Health and Physical Education:

Movement Skills:

Specific Expectations

B 1.3 - perform a variety of locomotor movements with and without equipment, alone and with others, moving at different levels, using different pathways, and travelling in different directions.

B 2.2 - apply a variety of simple tactics to increase their chances of success during physical activities.

Activation:

- There are several ways to start students thinking about movement as energy and energy as movement. You could discuss wind and windmills, waterfalls or rushing rivers.
- Begin by asking the students if they have ever been outside when it was really windy. What did they notice? Can they see the wind? Can they see what the wind is doing?
- What sorts of things did they see the wind blowing? Could they make things move like that using their breath?

- Has anyone been at a beach or wave pool and been pushed or knocked over by waves? Has anyone put their hand in the stream of water from the tap in the bathtub, or stuck their hand out of the window while the car is moving? What happened?

Activity:

- **Put students in groups of 2. Have the partners sit facing each other with their toes touching and lean forward to hold each others hands. Tell them that they need to work together to both stand up. Rules: Their toes must always be touching, they are not allowed to let go of each others hands, and their hands cannot touch the ground.**
- **Debrief what worked and what didn't.**
- **Did you have to work together? Communicate? Did you have to go slow? What happened when you tried to go fast? Why did it work better when you both pulled equally against each other? What can they try next time that may help?**
- **Tell them that they will have a similar challenge and to use some ideas from the first challenge to help them accomplish this second one.**
- **Have them sit back to back with their feet flat on the floor and interlock their elbows and try to stand up together. Rules: Their elbows must remain interlocked, neither their hands nor their knees may touch the ground.**
- **Debrief once again what worked and what didn't.**

Consolidation:

- **Discuss the two forces used in the activities (push,pull) and how they require energy.**
- **How many people got tired or were breathing hard during the activity?**
- **Discuss how pushes and pulls are used to move things and do "work". Relate this to the simple machines unit from Grade 2**
- **Have the students think back to the Activation** discussion. Were those things (water and wind) pushing or pulling forces? Explain.
- Have them think about all of the places and things that use pushes and pulls to help people do work.
- They can complete the worksheet (**appendix 1.1**) as a whole class by taking answers and writing them on the board/chart paper while the students write them down on their own worksheet. You could also have them work on it in pairs and then come back to the whole group to share ideas and complete their worksheets that way.

Lesson #2 - Elastic Energy Experiment

Ontario Curriculum connections:

Science:

Forces Causing Movement:

The Big Ideas

There are several types of forces that cause movement.

Specific Expectations

2.1 - follow established safety procedures during science and technology investigations.
2.2 - **investigate** forces that cause an object to start moving, stop moving, or change direction.
2.3 - **conduct** investigations to determine the effects of increasing or decreasing the amount of force applied to an object.
2.5 - **use** appropriate science and technology vocabulary, including push, pull, load, distance, and speed, in oral and written communication.

Math:

Measurement:

Specific Expectations

- **estimate**, **measure**, and **record** length, height, and distance, using standard units.

Supplies:

Rulers, elastics, tape measures

Activation:

- Give every student a ruler, wooden or plastic does not matter.
- Tell the students to hold their ruler flat on the desk with one end hanging off, how far off is up to them. Holding the part on the desk firmly, have them press the overhanging part of the ruler down with their other hand. Remind them not to press too hard or they will break their ruler. Once pressed they will let the overhanging end go.
- Have the class describe what happened to the ruler when they did this. You are looking for ideas about pushing or pulling and exerting force.

Activity:

- Tell the students that they will be doing an experiment on elastic force. You can put the students into small groups. The groups will need 1 ruler and one or two elastics of the same size.
    1. Explain the experiment and have the students create a hypothesis for what they think will happen as the pullback distance increases. This is also a good time to touch on the idea of dependent and independent variables if you have not done so yet in your science units.

2. Using a tape measure on the floor each group will launch their elastics from the zero mark on the tape measure.
3. Each time they launch an elastic they will pull it back to a different number on their ruler. (Perhaps starting at 10cm and increasing by 5 each time)
4. They should launch 5 elastics in this way and record the distance each elastic travelled on **appendix 1.2**.
5. Discuss the results and draw conclusions as a large group.
6. Repeat the experiment but this time use elastics of different sizes and all elastics must be pulled back the same distance. (Your choice, dependent on the sizes of elastics used.
7. Have the students come up with a hypothesis about what they think will happen this time.
8. Perform the experiment and record the results.
9. Discuss the results and draw conclusions.

Consolidation:

- **Compare the results of the 2 experiments. Ask for theories as to why the size of the elastics mattered to the distance travelled and why the pullback distance mattered?**
- **Could they get the largest elastic to go as far as the smallest? How?**
- **Test the ideas in front of the class.**
- **The important idea to bring out from this lesson is that the elastic is "storing" the energy. The farther back that they pull the elastic, the more energy that is being stored.**
- **What else can store energy?**
- **If an elastic can store energy is it like a battery?**
- **You can ask the students to bring in a toy from home that moves in some way but does not use batteries, if you want, but this is not necessary.**

Lesson #3 - Storing Energy
Pullback Car Design and Build

Ontario Curriculum connections:

Science:

Forces Causing Movement:

The Big Ideas

There are several types of forces that cause movement.

Specific Expectations

2.1 - **follow** established safety procedures during science and technology investigations.
2.2 - **investigate** forces that cause an object to start moving, stop moving, or change direction.
2.3 - **conduct** investigations to determine the effects of increasing or decreasing the amount of force applied to an object.
2.5 - **use** appropriate science and technology vocabulary, including push, pull, load, distance, and speed, in oral and written communication.

Supplies: varies depending on the type of car you choose to build.
see the links below to the instructions for the different types of cars.

Activation:

You may need a windup toy and/or pullback car from the dollar store for this lesson.

- Ask the student to think about the experiment from the previous lesson.
- Ask the students to think about toys they own or have seen that move in some way. Can they think of any that do so without the use of batteries. Or use any that students brought in to show the class.
- If there are none, or they have a difficult time thinking of any pull out a windup toy and/or a pullback car and show the students how they work.
- Talk about how the toys store the energy that you put into them and then release the energy when you let them.

Activity:

Building a pullback car:

This activity could take a few periods, and you may have to help some students who have fine motor issues. There are many guides online already as to how to design and build simple pullback cars so I will link the ones that I found the easiest to find supplies for and complete.

Most just involve cardboard, straws, tape/glue (hot glue is very useful to speedup the build) or stickytac/modelling clay, an elastic band, and either CDs or large bottle caps.

Give each student the same size elastic band, unless they ask for a different kind after the **Consolidation.**

https://diy.org/rabinovitch/63115

My new favourite - https://www.youtube.com/watch?v=jmvqN3M1OoI He doesn't secure the elastic to the back axle, but I would with the students just for ease of wrapping the elastic on the pullback motion.

Most fast food chains or big name convenience stores will give you the cups and lids for free if you tell them what it is for.

Consolidation:

- Tell the students that when the cars are complete that you will have a test track to see who can make their car travel the 5 m in the shortest amount of time.
- Ask them to think about the elastic launching experiment and to think about any change they may want to make to their car to help it travel that distance more quickly.
- Allow students time after this discussion to switch to shorter/longer/thicker/thinner elastics or to alter their cars in any way. Try to encourage them to keep the wheel the same size as that would take the focus away from the stored elastic energy and switch it more to a gear focus.

Lesson #4 - Racing for Distance

Ontario Curriculum connections:
Science:

Forces Causing Movement:

The Big Ideas

There are several types of forces that cause movement.

Specific Expectations

2.1 - **follow** established safety procedures during science and technology investigations.
2.2 - **investigate** forces that cause an object to start moving, stop moving, or change direction.
2.3 - **conduct** investigations to determine the effects of increasing or decreasing the amount of force applied to an object.
2.5 - **use** appropriate science and technology vocabulary, including push, pull, load, distance, and speed, in oral and written communication.

Math:

Measurement:

Specific Expectations

- estimate, measure, and record length, height, and distance, using standard units.

Activation:

- Remind the students that they will be racing their cars today to see whose can go 5 m in the shortest amount of time.
- Have the students finish and test their cars, making any final adjustments necessary.

Activity:

- Set up a start and finish line in the classroom or the hallway, room permitting.
- There should be a "judge" at the finish line to determine the winner.
- Run as many heats as you need to get through everyone.
- Take the top 1 or 2 from each heat and run a final race.
- Look at the winning car(s) and discuss how they are different or the same as other peoples cars.
- Have each student fill in a worksheet (**appendix 1.3**) on how their car is similar to or different from the winning car(s) and how they could improve theirs.

Consolidation:

- Discuss the students' ideas about how to make their car travel the distance more quickly.
- Try to guide their thinking toward the idea of how they can store more energy in their elastic band.

- Did the faster cars have shorter or longer elastics? How many time did they wind up their wheels?
- Did anyone use a thicker elastic? Do they think that might make a difference?
- Allow the students to replace their elastic with a thicker one if they have not already and to see what difference that makes.
- Ask the class why they think thicker elastic holds more energy than the thinner one?
- Remind them that the elastic is really just doing the job of a battery by holding on to energy that you put into it and letting it out when you want it to.
- Ask them it there are different sizes of batteries and which batteries they think are able to hold or release more power.
- If anyones axle (skewer) broke or elastic pulled off of the car from winding the elastic too tight ask the students why they think this happened. The skewer was not strong enough to hold back the amount of energy in the elastic.

Lesson #5 - Different Ways to Store Energy

Ontario Curriculum connections:

Language:

Reading:

Overall Expectations

Read and **demonstrate** an understanding of a variety of literary, graphic, and informational texts, using a range of strategies to construct meaning.

Specific Expectations

1.6 - **extend** understanding of texts by **connecting** the ideas in them to their own knowledge and experience, to other familiar texts, and to the world around them.

3.2 predict the meaning of and rapidly solve unfamiliar words using different types of cues.

Writing:

Overall Expectations

Generate, **gather**, and **organize** ideas and information to write for an intended purpose and audience.

Specific Expectations

1.3 - **gather** information to support ideas for writing in a variety of ways and/or from a variety of sources.

3.1 - **spell** familiar words correctly.

3.2 - **spell** unfamiliar words using a variety of strategies that involve understanding sound-symbol relationships, word structures, word meanings, and generalizations about spelling.

3.3 - **confirm** spellings and word meanings or word choice using several different types of resources.

Activation:

- Ask students to think about their cars and how the energy to make them move got stored and where it was stored. Answer: By stretching the elastic the energy got stored in the elastic.
- Remind the students that a battery is just an object that stores energy that can be used later, just like the elastic in your pullback car.
- Ask the students if they can think of any other places or things that can store energy. Write answers on the board or on chart paper. Possible answers might include: batteries, plants, muscle, fat, coal, wood, oil, gas, spring, sun, water, and numerous others.

Activity:

- Now we want to focus the students thinking on their bodies and how their bodies get energy and where that energy came from.
- Ask the students if they think that they are like a battery. Do they store energy? Where does the energy come from? Where do they store it how do they get the energy back out?
- Discuss calorie (energy) intake and energy output (exercise).
- Talk about the importance of exercise and movement as a healthy part of their lives.
- Tell the class that in order to learn about the importance of different foods in charging their bodies batteries they are going to fill out an information sheet (appendix 1.4)on the different nutrients in the foods they eat.
- Lay out or post the food group information sheets (appendix 1.5) in different areas around the classroom and allow the students to move in groups to read and fill in all of the answers.
- If you have students who struggle with reading/writing, allowing the students to work on this in groups will give stronger students the opportunity to help weaker ones with the reading and writing of the information required.

Consolidation:

- When the students are finished bring them back to a full class setting and ask what new or cool things they learned about nutrients in their foods.
- Explain that they use all of these nutrients to make their bodies work. Some of these nutrients (zinc, manganese, and potassium) are even used in batteries to help them deliver energy to your toys, tools, and electronics.
- We know how useful batteries are but the most useful battery in your life is you and you need to power it well with good food and healthy living.

Appendix 1.1

What is a Force

Think about the activities we tried today involving pushing and pulling. Look around the classroom and think about your home and the world. What other things are examples of pushing or pulling forces? Try to think of as many as you can to fill the table below.

Pushing Forces	Pulling Forces

Define the following terms

Force: _____

_____

_____

Movement: _____

_____

_____

Push or Pull

Push or Pull

Appendix 1.2

Elastic Band Experiment #1

Hypothesis: I think that the farther back I pull the elastic _____

_____

_____

Elastic pulled back	Distance travelled
10 cm	
15 cm	
20 cm	
25 cm	
30 cm	

Conclusion: The farther back I pulled the elastic _____

_____

_____

Elastic Band Experiment #2

Hypothesis: I think that the larger the elastic _____

_____

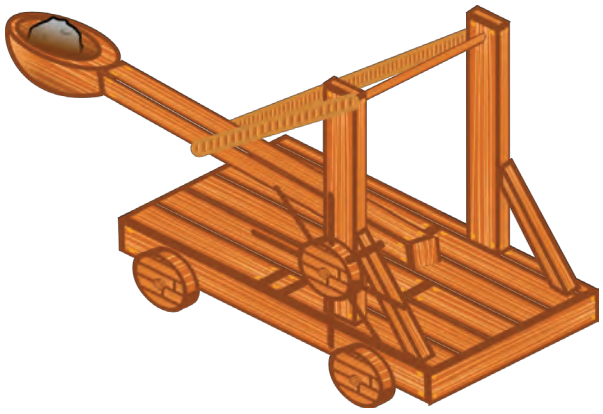
_____

Elastic by size	Distance travelled
Elastic #1	
Elastic #2	
Elastic #3	
Elastic #4	
Elastic #5	

Conclusion: The larger the elastic _____

_____

_____



Appendix 1.3

Pullback Car Design

How is my car **similar**?	How is my car **different**?

What can I change on my car to make it go faster?:

_____

_____

_____

_____

_____

Appendix 1.4

Nutrients in Food

Meat: Protein: _____

_____

Iron: _____

_____

Zinc: _____

_____

Fruits & Vegetables: Iron: _____

_____

Folate: _____

_____

Vitamin A: _____

_____

Vitamin C: _____

_____

Grains: Fibre: _____

_____

Magnesium: _____

_____

Zinc: _____

_____

Manganese: _____

_____

B Vitamins: _____

_____

Dairy Products

Calcium: _____

_____

Potassium: _____

_____

Phosphorus: _____

_____

Vitamin D: _____

_____

Niacin: _____

_____

Meats

- **Protein** is a part of every cell in our bodies. Without enough of this essential building block, your body could not maintain or repair itself.

- **Iron** is important because it carries oxygen to all your body parts. It also helps to prevent anemia that can make you feel tired.

- **Zinc** is needed for proper growth and helps your body fight infections.

Fruits & Vegetables

- **Folate**: lowers a woman's risk of birth defects.

- **Iron**: needed for healthy blood and normal functioning of all cells.

- **Vitamin A**: keeps eyes and skin healthy and helps protect against infections.

- **Vitamin C**: helps heal cuts and wounds and keeps teeth and gums healthy.

Grains

- **Fiber:** helps you feel full faster and longer; it also aids digestion and helps prevent constipation.

- **Magnesium:** required for converting food into energy and maintaining a strong immune system.

- **Zinc:** helps your immune system fight off bacteria and viruses, and wounds heal. Zinc is also needed for your sense of taste and smell.

- **Manganese:** is essential to the formation of healthy cartilage and bone.

- **B Vitamins:** help with breaking down food into energy. They also help maintain healthy skin, hair and muscles.

Milk and Dairy

- **Calcium**: helps to build and maintain healthy bones and teeth.

- **Potassium**: helps maintain normal blood pressure. It's also needed for muscle activity and contraction.

- **Phosphorus**: helps strengthen bones and generate energy in the body's cells.

- **Vitamin D**: helps promote the absorption of calcium and enhances bone strength.

- **Niacin**: helps bodies digest sugars and fatty acids.

Appendix 1.6

Quiz

1. In the elastic band launching experiment when you pulled the band back farther along the ruler what was the result?

    a. The elastic flew a shorter distance.
    b. The elastic flew a longer distance.
    c. The distance did not change.
    d. The elastic got stuck.

2. When you used different sized elastics but pulled them back the same distance…

    a. the longer elastics flew the shortest distance.
    b. the smallest elastic flew the shortest distance.
    c. the mid-sized elastic flew the farthest.
    d. the smallest elastic flew the farthest.

3. We have learnt that an elastic band can store _____.

    a. information
    b. time
    c. movement
    d. energy

4. What was the main factor in determinig how fast your pullback car would go?

    a. The size and shape of the elastic.
    b. The colour of your car.
    c. The shape of your car.
    d. None of the above.

Short Answer

5. Explain, using scientific terms learned in class, why the distance the elastic is pulled back matters when launching elastics.

_____

_____

_____

_____

_____

_____

_____

_____

6. Describe how you would design a pullback car that would beat all of the other cars in your class.

_____

_____

_____

_____

_____

_____