Forces

Teacher's Notes

Ontario Science and Technology Curriculum 1999
Strand: Energy and Control
Topic: Forces and Movement
Grade: 3

Overall Expectations:
-demonstrate an understanding of how movement is caused by forces and by energy that is stored and then released
- investigate how different forces affect the operation of everyday devices, and design and construct devices that use a form of energy to create controlled movement
- identify objects, devices, and systems in everyday life that are affected by forces and movement and explain in what ways they are useful to us
* All specific expectations are covered by this unit and are mentioned at the end of each activity with the exception of the following one which is covered by all activities.
EC8:plan investigations to answer some of these questions or solve some of these problems, and explain the steps involved.

Materials box	
Each group of scientists will be issued a "Forces materials box"(shoe boxes make good kit boxes). Several of these will be needed depending on how many groups you choose to create (A * indicates one is needed for every student) - paper clip * - a piece of string tied in a loop * - rubber ball - clear plastic egg carton with small pieces of tissue paper inside - a piece of polar fleece - a magnet * - toy car - ball of plasticene * - elastic * - cotton cloth - sealed bag of iron filings (* if possible) - sealed bag of sugar (* if possible) - film canister * - metal nut * - match sticks (small and large)*	What the teacher needs - marble - magnetic car indy set - comb - polar fleece - soccer ball - wooden rectangular prism - wooden plank - text books - polar fleece wrapped around poster board - cellophane wrapped around poster board - tissue paper wrapped around poster board - construction paper wrapped around poster board - poster board - paper - junk box (full of nice junk)

Dear Parent or Guardian,

We are beginning our next Science and Technology Unit, Energy and Control, Forces and Movement. By the end of this unit, your child will:

- demonstrate an understanding of how movement is caused by forces and by energy that is stored and then released;
- investigate how different forces affect the operation of everyday devices, and design and construct devices that use a form of energy to create controlled movements;
- identify objects, devices, and systems in everyday life that are affected by forces and movement and explain in what ways they are useful to us.

As outlined in the Science and Technology Curriculum, Ministry of Education , 1999.

Home Links:

To help your child further their understanding in this science unit, here are some fun activities for you and your family.

- go skating and talk about friction
- play with or take apart wind up toys
- visit a recycling plant
- visit the web site www.howstuffworks.com on the internet

Happy Adventures,

Forces and Movement
Our New Science Words

Grade 3 ECglossary covers:
EC9:use appropriate vocabulary in describing their investigations, explorations, and observations (eg. use terms such as push, pull, load, distance, speed when describing the effect of forces on an object)

Forces and Movement
Pushing your Leg!

Purpose: *To explore forces in our world.*

Materials:
1) paper clip
2) a piece of string tied in a loop
3) you

Method:
1) With your index finger push the paper clip along your desk. What happens to the paper clip?
It moves.

2) Slip the paper clip onto the string tied in a loop.
3) Pull the string. What happens to the paper clip?
It moves.

4) Fill in the chart below:

If you PUSH the paper clip to the RIGHT it moves . . .	*Right*
If you PUSH the paper clip to the LEFT it moves . . .	*Left*
If you PULL the paper clip to the RIGHT it moves . . .	*Right*
If you PULL the paper clip to the LEFT it moves . . .	*Left*

Does your finger need to use force to move the paper clip? *Yes*

Is the force big or small? *Small*

If you were pushing a car down the street, would the force you use need to be big or small? *BIG*

To move the paper clip do you need to touch it? *Yes*

This motion is caused directly, that is, you are physically touching the object to make it move. Let's write down the definition of FORCE.
The force is the push or pull that makes an object start moving, slow down, speed up, change direction, stop or change shape.

Grade 3 ECactivity001 covers:
EC1:identify force as a push or pull by one body on another
EC6:investigate the effects of directional forces (eg. left push for left movement) and how unbalanced forces can cause visible motion in objects that are capable of movement (eg. an object pushed over a smooth floor)

Forces and Movement
May the Force be with YOU!

Purpose: *To find out the different kinds of forces around us.*

Materials
1) a rubber ball
2) clear plastic egg carton with tissue paper pieces inside
3) a piece of polar fleece
4) paper clip
5) magnet
6) a toy car
7) plasticene
8) elastic
9) a cloth

Method:
1) Drop the ball. Fill out the chart below.
2) Rub the top of the egg carton with the piece of polar fleece. Fill out the chart below.
3) Pick up the paper clip with the magnet. Fill out the chart below.
4) Push and pull the toy car with your finger. Fill out the chart below.
5) Push your thumb into the plasticene. Fill out the chart below.
6) Stretch out the elastic. Fill out the chart below.
7) Twist the cloth like you were wringing out water. Fill out the chart below.

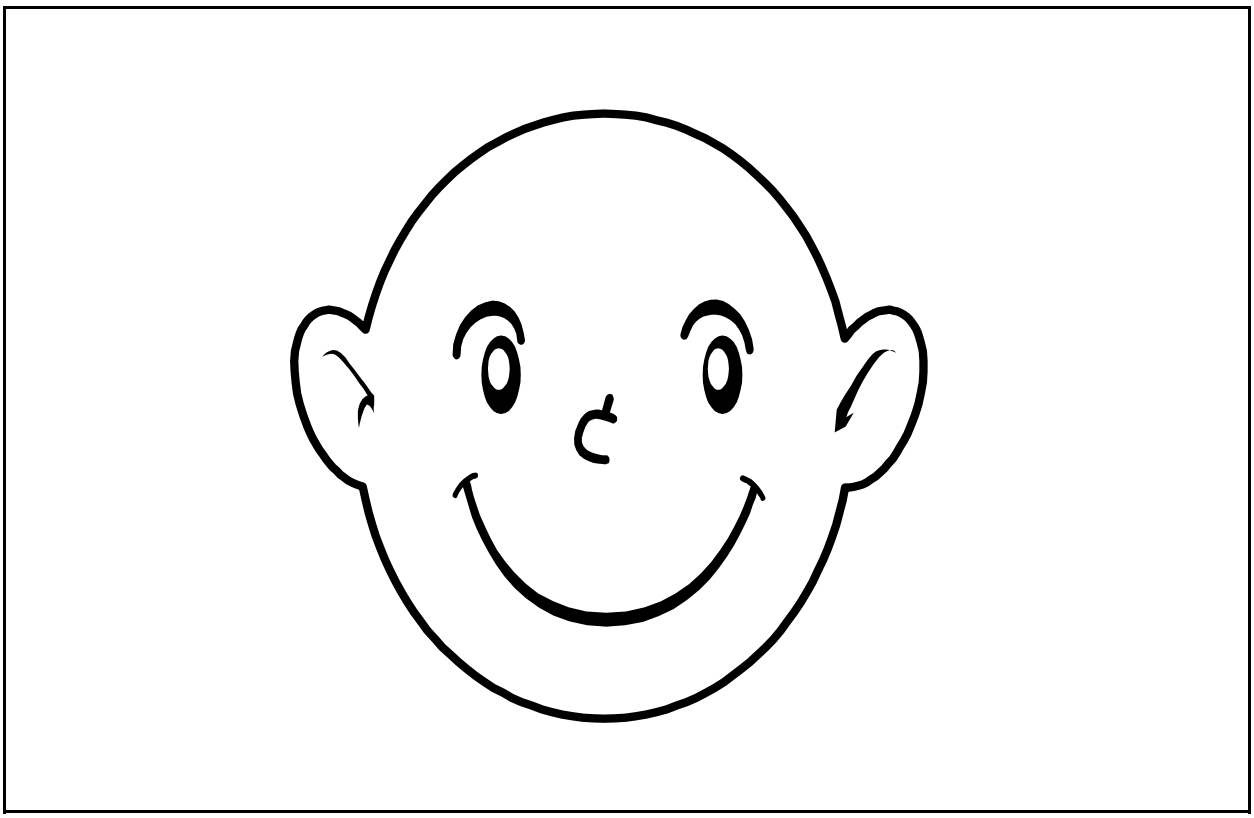
Object or Objects	The Force	Is the motion caused *indirectly* or *directly*
A dropped rubber ball	*gravity*	*indirectly*
Egg carton with tissue paper pieces rubbed with polar fleece	*static electricity*	*indirectly*
Paper clip and magnet	*magnetic*	*indirectly*
Pushing and pulling the toy car	*pushing and pulling forces*	*directly*
Pushing the plasticene	*Compression*	*directly*
Stretching out the elastic	*tension*	*directly*
Twisting the cloth	*Torsion*	*directly*

Grade 3 ECactivity002 covers:
EC5:distinguish between kinds of motion and indicate whether the motion is caused indirectly (eg. by gravity, static electricity, magnets) or directly (eg. by applied force)
EC13:descibe the visible effects of forces acting on a variety of everyday objects (eg. a toy car goes forward when pushed; a ball falls down when dropped)

Forces and Movement
Magnetic Sam

Materials:
1) a bag of black powder
2) a bag of white powder
3) a magnet
4) Sam's Face

1) Pick either the bag of white powder or the bag of black powder.
2) Lay the bag over Sam's Face.
3) With your magnet, give Sam some hair.
4) Try the bag of powder you didn't pick.



Was the white powder magnetic? *No.*

What was the white powder? *Sugar.*

Was the black powder magnetic? *Yes*

What was the black powder? *Iron filings*

Grade 3 ECactivity003 covers:
EC3:investigate the effect of magnets and electrically charged objects on the motion of different materials (eg. iron filings will be moved by a magnet, whereas grains of sugar will not)

Forces and Movement
Toy Time!

Purpose: *To build a toy that stores energy and creates movement.*

Materials:
1) a film canister with a hole punched in the lid and a large needle hole in the bottom.
2) elastic
3) metal nut
4) a small match stick (the kind that can't be lit - or a used one)
5) a large match stick (the kind that can't be lit - or a used one)
6) construction paper, stickers, junk from the junk box, etc.

Method:
1) Thread the elastic through the needle hole in the bottom of the film canister so that there is a small loop hanging out.
2) Slide the small match stick into the loop. Pull tight on the elastic.
3) Thread the elastic through the hole in the cannister lid.
4) Thread the elastic through the metal nut so that there is a small loop hanging out.
5) Slide the big match stick into the loop.
6) Make sure the elastic is tight around both match sticks
7) Twirl the big match stick around.
8) Let it go. What happened?
The big match stick spun around

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9) Make your creation into any toy your imagination can think of by decorating it with the construction paper, stickers, and junk from the junk box.
10) Fill in the chart below.

PART	What the part does . . .
Cannister	*Provides a body and stability.*
Elastic	*Stores energy and releases energy to move the big match stick.*
Small match stick	*Provides a stable base so that the elastic can be twirled and store energy.*
Big match stick	*Answers will vary depending on the toy they create.*

Grade 3 ECactivity004 covers:
EC4:identify, through observation, different forms of energy and suggest how they might be used to provide power to devices and to create movement (eg. the release of energy from a tightly wound rubber band or spring would create movement in a wind-up toy)
EC17:identify parts of systems used in everyday life, and explain how the parts work together to perform a specific function (eg. a subway system, a plant, a wind-up-toy)

Forces and Movement
Moving Around

Purpose: *To see how different forces can change the speed or direction of objects.*

Materials:
1) marble
2) magnetic car Indy Set **(a race track drawn on cardboard elevated by paper towel tubes with metal cars and a magnet to move them)**
3) comb
4) polar fleece
5) running water
6) soccer ball

Method:
1) Roll the marble along a desk. Let it fall off. Fill out the chart below.
2) Race magnetic cars around the Indy track. Fill out the chart below.
3) Rub the comb with polar fleece. Turn on a tap of water (slow flow). Hold the comb up to the water. Fill out the chart below.
4) Make a circle and kick the soccer ball around. Fill out the chart below.

What Force acted on the object?	How did it change the direction or speed of the object
gravity	*It made the marble fall to the floor.*
magnetic	*If you moved the magnet faster, it dragged the cars faster. You could control the direction of the cars.*
static electricity	*It pushed the water away.*
pushing (muscular force)	*The harder you kicked the ball, the faster the it went. The direction of your foot changed the direction of the ball.*

Grade 3 ECactivity005 covers:
EC2:investigate the ways in which different forces (eg. magnetism, static electricity, muscular force, gravitation force) can change the speed or direction of a moving object.

Forces and Movement
Friction

Rub your hands together really fast. What happens? *My hands get warm.*

Let's write the definition of friction:
Friction occurs when two surfaces rub against each other.

Purpose: *To see how friction affects movement.*

Materials:
1) a wooden rectangular prism
2) a wooden plank
3) polar fleece wrapped around poster board (similar length to the wooden plank)
4) cellophane wrapped around poster board (similar length to the wooden plank)
5) tissue paper wrapped around poster board (similar length to the wooden plank)
6) construction paper wrapped around poster board (similar length to the wooden plank)
7) poster board (similar length to the wooden plank)
8) metre stick
9) text books

Method:
1) Stack the text books and lay one end of the wooden plank on top (this makes the plank slant down hill).
2) Place the metre stick down the ramp with the zero at the top.
3) Place the wooden rectangular prism on the top of the plank.
4) Push the wooden rectangular prism and measure how far it goes down the plank. Record the results in the chart below.
5) Repeat steps 3 to 4 for all the other materials.
** Remember always use the same force when pushing the wooden rectangular prism.

Surface	Distance Travelled
Wooden Plank	
Polar Fleece	
Cellophane	
Tissue paper	
Construction paper	
Poster board	

Answer these questions in full sentences:

1) What surface had the least amount of friction with the wooden rectangular prism?

_____

2) What kind of texture was this material (rough, smooth, ridged, bumpy)?

_____

3) What surface had the most amount of friction with the wooden rectangular prism?

_____

4) What kind of texture was this material (rough, smooth, ridged, bumpy)?

_____

5) If you wanted to create a surface with very little friction what kind of texture would you pick?_____

6) If you wanted to create a surface with lots of friction what kind of texture would you pick?_____

Grade 3 ECactivity006 covers:
EC14:identify surfaces that affect the movement of objects by increasing or reducing friction (eg. dry roads, icy roads)

Forces and Movement
Let's Make a Plane

Materials:
1) ONE sheet of paper
2) junk from the junk box
3) paper clips
4) glue
5) scissors
6) tape

Method:
1) Using the materials available (you don't need to use all of them), design and make an aeroplane.
2) Write down the steps you took to make your aeroplane.

How to make my aeroplane, by:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Flight Contest

Rules:
1) Come to the carpet in your group and stand at the starting line.
2) When the flight starter says go, release your air plane.
3) Count the number of squares your aeroplane travelled.
4) Go back to your group and create a graph showing the distance travelled by each air plane.

Plane	1	2	3	4	5	6	7	8	9	10	11

Improvements

In the box below draw any improvements you would make to your plane the next time you build it.

Presentation

Share your creation with the rest of the class. You will be evaluated on the following:

	Level 1	Level 2	Level 3	Level 4
Understanding of concepts	- describes basic steps in the building of the aeroplane	- describes the design features - describes simple changes in the design	- describes the design features used - describes how the design will change next time and why	- describes the design features and the positive and negative aspects of those features and how they could be improved for next time
Communication of knowledge	-methodology difficult to understand - describes the performance	- methodology can be replicated with effort - describes the performance	- methodology is clear and can be replicated - describes performance and how design features added or detracted to that performance	- methodology is concise with helpful hints for replication - describes performance and relates the performance to the design and future changes
Inquiry and design skills	- required assistance designing and building aeroplane - a flying aeroplane was built	- some assistance was needed in either the design or building phase of the aeroplane - a flying aeroplane was built	- used appropriate tools for aeroplane design - some creative design features were added to the aeroplane	- creatively used tools in new ways to build aeroplane - a risk was taken to try a different design for paper aeroplanes

Grade 3 ECactivity007 covers:
EC10:record relevant observations, findings, and measurements, using written language, drawings, charts, and graphs (eg. track a toy boat moving on water at various speeds, record the distances travelled, and present their findings on a chart)
EC11:communicate the procedures and results of investigations for specific purposes and to specific audiences, using drawings, demonstrations, simple media works, and oral and written descriptions (eg. give a demonstration showing how a device has been constructed and how it performs; make a drawing showing what alterations would be made to its design in the future; describe in writing the steps they used to build a device)
EC12:design and construct a device that uses a specific form of energy in order to move (eg. a paper airplane propelled by hand).

Forces and Movement
Magnets and Movement

Materials:
1) paper clip
2) desk
3) magnet

Method:
1) Put the paper clip on the right side of your desk.
2) Without touching it with your fingers, move the paper clip to the left side of your desk.

How did you do it? *Used the magnet*

At a junk yard, they have to move cars from the right side of the yard to the left side of the yard. How do you think they move cars that weigh thousands of kilograms from one side to the other?
They use a crane with a magnet attached.

_____

Draw a picture:

At a recycling plant they have to separate cans made out of aluminum and cans made out of iron.
What is the difference between the two metals? *Iron is magnetic, aluminum is not.*
How do you think they do it at the recycling plant?
They use a magnet to separate the cans.

_____

Draw a picture:

Grade 3 ECactivity008 covers:
EC15:demonstrate how a magnet works and identify ways in which magnets are useful (eg. as metal detectors, as a car wrecker's hoist, as a power source for magnetic trains)

Forces and Movement
Down the Toilet

When you push the handle on a toilet, the flush occurs automatically. The handle is attached to a lever, when you press down on the handle the lever raises. The lever is attached to a chain, which is attached to a plug. When the lever raises it pulls the chain and lifts the plug, which lets water through and flushes away the contents of the toilet. As a class, let's make a list of things that work automatically in our homes. Write the list on your special notepad below.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Grade 3 ECactivity009 covers:
EC16:recognize devices that are controlled automatically (eg. timers, washing machines), at a distance (eg. a remote-control toy), or by hand (eg. the flushing mechanism of a toilet)

Forces Certificate

This certificate hereby certifies

_____

as a Grade 3 Forces expert.

_____ _____

Principal Teacher

Share your science booklet with at least one family member at home. After you have shared complete the following:

1) Cut out your Forces Certificate.
2) Get the person you shared your science booklet with to fill out the form below, detach it and bring it back to school.

C .....

_____ shared their science booklet with the following family members:

_____

Parent's Signature

Forces and Movement Homework

Due:_____

Name:_____

Activity ONE: testing the strength of your refrigerator magnets

Materials:
1) three refrigerator magnets
2) a refrigerator
3) several pieces of paper

Method:
1) Place one sheet of paper under each of the refrigerator magnets on the fridge.
2) Continue to place more sheets under the magnets until they cannot hold the sheets any more.
3) Record the results in the chart below.

Magnet	Tally	Final Score

Which magnet was the strongest?_____

Activity TWO: Getting rid of static cling

On your special notepad below make a list of ways you can prevent static cling from your laundry.

_____

_____

_____

_____

_____

_____

_____

Grade 3 EChomework covers:
EC7:ask questions about and identify needs and problems related to the behaviour of different forces in their immediate environment, and explore possible answers and solutions (eg. identify everyday situations that produce static electricity and describe ways of removing static electricity from clothes; compare the strength of two magnets in holding layers of paper on a refrigerator door, or in picking up paper clips)