6th Grade: MAKING WORK EASIER

(Motion and Force)

Rational of this unit

For work, pupils have already learned in 1st and 2nd grade about using wheels and rollers to make work easier, and also in 4th grade about how to safely use and store tools in daily life such as hammers and saws. In 5th grade they studied scales, and also learned that force is related to using tools.

In this unit, pupils will learn that a force is needed when causing an object to move or to stop, and that an object moving is said “to be in motion”. Additionally, they will understand that force is connected to motion, the amount of force can be measured using a spring balance, and about the newton (N) unit of measurement in learning about work as it is used in science.

Objectives: what pupils are expected to achieve in this unit

- To understand that force is needed to cause an object to move.
- To understand that gravity and magnetism are some of the forces which cause an object to move.
- To understand that force is needed to cause an object to stop moving.
- To learn the property that unless a force is applied, objects at rest will stay at rest.
- To learn about force and units of force, and to understand that the amount of force can be measured with a spring balance.

Interrelation of contents of each grade

** The order below is as shown in the syllabus.*

Grade	Description (Making Work Easier)
1st Grade	• Making wheels • Using wheels
2nd Grade	• Making different shaped wheels • The best shape for wheels • Rollers (pencils, corn stalks, corncobs, round sticks)
3rd Grade	–
4th Grade	• Safe use of simple tools (hammers, saws, jembes, pangas, knifes, bottle openers) • Maintenance of simple tools (cleaning after use, sharpening of cutting tools, oiling, proper use, and proper storage methods)
5th Grade	• How to balance on a see-saw • Making a simple beam balance and balancing different materials on it to compare their masses.
6th Grade (This unit)	• Motion (Moving objects, stopping moving objects) • Force (meaning of force, units of force (N))
7th Grade	• Meaning of friction • Advantages and disadvantages of the work of friction • Ways to increase and decrease friction • The fulcrum, load and effort of levers (claw hammers, crowbars, hand-pushed wheelbarrows and plows)
8th Grade	• Inclined slopes (ladders, stair case landings, spiralling roads climbing hills) • One fixed pulley (Items using one pulley, such as on a flagpole)

Before starting this unit

Current learning status of the pupils

6th grade children are not aware of the various forces working around them in the course of everyday life. In particular, gravity is so taken for granted that many do not realize that it is a force at work. Forces like magnetism which cannot be seen and work without touching things are hard to visualize.

In this unit, we will first define force for such children and then explain the phenomena around them in terms of force.

Preparatory Notes

- There are no expensive materials or hard to find experimental tools for studying of this unit. In order to quantitatively measure large invisible forces as definite things, the goal is to have the pupils actually experience and as a consequence understand the fact that pulling strongly on a spring and hanging many weights from a spring are indeed one and the same thing. You should therefore prepare a sufficient number of springs for such exercises.

Objectives to be achieved by competency

Interest, motivation, and attitude

1. Taking an interest in the motion of objects and voluntarily try to examine the state of objects moved in daily life.
2. Taking an interest in force, and thinking about the functions of force.

Scientific thinking and communication activities

1. Ability to make and perceive the correlation between the state of an object's motion and size of force.
2. Ability to explain an example of gravity working and make a connection between it and gravity.
3. Ability to notice that the weight of a weight (force added) is proportional to the stretching of a spring.

Knowledge, understanding, and skills in observation and experimentation

1. Ability to explain that force must be applied in order to cause an object to move.
2. Ability to explain that objects fall because on earth gravity applies force to objects.
3. Ability to explain that magnets provide force to move objects as well.
4. Ability to explain that force must be applied in order to cause an object to stop moving.
5. Ability to explain that force changes the state of motion of an object.
6. Ability to explain that an object at rest will remain at rest unless an external force acts upon it.
7. Ability to explain that transforming objects, holding up objects and changing motion are all functions of force.
8. Ability to explain that force is expressed in units called newtons.
9. Ability to explain that force magnitude can be measured using a spring balance.

Ideas behind the structuring the unit

First, pupils need to know that force is needed in order to move and stop objects.
Next they will learn that when objects change position this is called ***motion***, and that force is needed to change the state of motion of an object. Pupils will also learn that ***newtons*** are units of force, and that forces can be measured with spring balances.

Unit teaching plan

6 periods + 1 period for the Final Unit Evaluation Test

* The numeric value in parentheses represents the corresponding period (e.g. 1) means the first period).

* *(Evaluation: Knowledge and Skills 1), (Evaluation: Interest 1)*, etc. indicate the points at which teachers can check whether the pupils have attained the goals specified in the section *Objectives based on the viewpoint*.

Sub-Unit	Description
1. Various forces and motion (4 periods)	1) Search for examples of objects being moved in daily life, and understand that a force must be at work to make an object move. *(Evaluation: Interest 1, Thinking and Representation 1, Knowledge and Skills 1)* 2) Have pupils understand that all objects on earth are acted upon in the same way by downward force (gravity), and will fall. *(Evaluation: Interest 1, Thinking and Representation 2, Knowledge and Skills 2)* 3) Understand that the working force in magnets is called magnetism, and that it is its own force that will attract iron and like substances even when separated from it. (*Evaluation: Knowledge and Skills 3)* 4) Understand that a force must be applied in the opposite direction an object is travelling in order to make an object in motion stop. Also understand that unless an external force acts upon an object, if it is at rest it will remain at rest. *(Evaluation: Knowledge and Skills 4, Knowledge and Skills 5, Knowledge and Skills 6)*
Intermediate Review (No time allotted)	Give the "1st **Sub-Unit Review Test**." (Homework can be given depending on the progress of the class.)
2. Force Magnitude and Spring Extension (2 periods)	5) Understand that not only acting on moving objects, but also transforming objects, holding up objects and changing motion are all functions of force. (*Evaluation: Interest 2, Knowledge and Skills)* 6) Understand that spring extension is proportionate to weight of the weights, and that the force (gravity) of a 100g weight pulling on a spring is the standard unit of force, called 1 ***newton*** (1N). *(Evaluation: Thinking and Representation 3, Knowledge and Skills 2, Knowledge and Skills 9)*
Intermediate Review (No time allotted)	Give the "2nd **Sub-Unit Review Test.**" (Homework can be given depending on the progress of the class.)
Unit End Review (2 periods)	7) Teacher gives the "**Final Unit Evaluation Test**."

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Lesson Plan

1. Various Forces and Motion (4 periods: 1st – 4th period)

Goals of this sub-unit

- Taking an interest in the motion of objects and voluntarily try to think about the state of objects moved in daily life.
- To understand that force must be applied in order to cause an object to move.
- Ability to understand the gravity that acts upon objects.
- To understand that objects fall because on earth gravity applies force to objects.
- To understand that magnets have the power to move objects as well.
- To understand that force must be applied in order to cause an object to stop moving.

Material Preparations

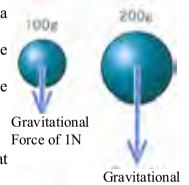
- Stones, paper, large stones, some metal, objects lying around
- Magnets, iron nail or paper clip, string, tape, objects lying around (pencils, rubbers, etc.)
- Board (something to make an incline), books (or something to slide down the incline)
- Coin, card, cup, ring (made of cardboard), pen, glass bottle

Period 1: The Force that Moves Objects

	Learning flow and activity	Teaching Hints and Advice
Introduction 10 minutes	• Give an example of an object being moved in daily life. → Carrying water. → Pulling something. → Riding a bicycle. → Throwing a ball. Give more examples like those above.	• Make pupils realize that there are many different ways to move an object, such as pushing, pulling, throwing, etc. *(Evaluation: Interest 1)* Taking an interest in the motion of objects and voluntarily try to examine the state of objects moved in daily life.
Questions	How can we make objects move? Think of examples of motion around us.	
Experiment 20 minutes	• Prepare a large stone and move it. • Prepare a small stone and move it. • Roll an object. • Move an object using something as a tool.	• Make pupils realize that whether the stone is small or big, moving an object always requires a force. • Also show them that the movement of the object differs based on the amount of force applied. *(Evaluation: Thinking and Representation 1)* Ability to make and perceive the correlation between the state of

		an object's motion and size of force.
Presentation 5 minutes	• Understand that a force must be at work to make an object move.	• Make pupils realize that when a force is applied, the object and the person applying the force come in contact with each other. (*Evaluation: Knowledge and Skills 1)* Ability to explain that force must be applied in order to cause an object to move.

Period 2: Gravity

	Learning flow and activity	Teaching Hints and Advice
Introduction 10 minutes	• Predict what will happen if you take an object in hand and let go. 	• Make pupils realize that the object gets faster and faster. *(Evaluation: Interest 1)* Taking an interest in the motion of objects and voluntarily try to examine the state of objects moved in daily life.
Questions	Why do objects fall? And why does the falling object go faster and faster?	
Experiment 20 minutes	*(items to prepare)* Stone, paper, large stone, some metal, and some object lying around. • Conduct the experiments. →**Experiment 1:** Drop a small stone and large stone at the same time. Observe which falls faster.  → **Experiment 2:** Drop a flat piece of paper and a stone. → **Experiment 3:** Ball up the paper to the same size as the stone. Drop the balled up paper and the stone at the same time. • Check that the speed may differ, but all items always fall in a downward direction.	• Have the pupils predict the results when conducting the experiment. • Always drop from an elevated position. • Explain that in the world there is a force pulling all objects to the centre of the earth (gravity). • Because the difference cannot be seen with the eye, place a tray or something underneath and have them judge by the sound made when the objects hit. • Point out that the small and large stones hit at the same time. • Point out that the flat paper falls slower. • Point out that the balled paper and the stone hit at the same time. • Explain that gravity acts on all objects the same way.
Presentation 5 minutes	• Understand gravity.	• Make pupils understand that all objects on earth are acted upon in the same way by gravity, and will fall.

		• Explain that gravity is a force that works even without touching an object. *(Evaluation: Thinking and Representation 2)* Ability to explain an example of gravity working and make a connection between it and gravity. *(Evaluation: Knowledge and Skills 2)* Ability to explain that objects fall because on earth gravity applies force to objects.

Period 3: Magnetism

	Learning flow and activity	Teaching Hints and Advice
Introduction 5 minutes	• Tape one end of a string to a desk, then attach a paper clip to the other end and bring a magnet close to it. The clip will float in the air. → Why is this?	• Ask the pupils for opinions on why the paper clip is floating. • Point out that magnets have the power to pull objects.
Questions	Examine what kind of force magnets possess.	
Experiment 20 minutes	*(items to prepare)* Magnets, iron nail or paper clip, string, tape, objects lying around (pencils, rubbers, etc.) → **Experiment 1:** Investigate whether magnets will stick to a paper clip, nail, pencil, and other various objects. → **Experiment 2:** Examine the difference in the magnet's power in close objects and those far away.	• Have pupils bring items they would like to check themselves. • Have them predict whether the magnet will stick or not before experimenting. Also have them explain why they think so if possible. • Point out that objects the magnet sticks to have iron in them. • Explain that the force working in magnets is called magnetism. • Make them understand that magnetism is stronger the closer an object is to a magnet, and confirm by experiment that there is a limit to how far magnetism can reach. • Explain that magnetism is a force that works without touching an object.
Presentation 10 minutes	• Understand the force possessed by magnets.	• Explain that magnets have the power to attract iron. *(Evaluation: Knowledge and Skills 3)* Ability to explain that magnets provide force to move objects as well.

Period 4: Balancing Two Forces

	Learning flow and activity	Teaching Hints and Advice
Introduction 5 minutes	• Give an example of an object being stopped in daily life.	• Make pupils realize that a force is needed not only when moving an object, but also when stopping an object's motion.
Questions	Examine what kind of force is necessary to stop an object in motion.	
Experiment 10 minutes	*(items to prepare)* • Board (something to make an incline), books (or something to slide down the incline) → **Experiment:** Watch an experiment in which a book is slid along an incline and stops moving at the bottom. Think about what kind of force must be applied to stop motion.	• Point out that a force must be applied in the direction opposing that in which an object is moving in order to stop its motion. • Explain that a force must be added in order to make an object move or to stop.
Questions	Examine what happens to an object when no force is acting upon it.	
Experiment 15 minutes	*(items to prepare)* • Coins, cards, cups, rings (made of cardboard), pens, glass bottles → **Experiment:** 1) Place a coin on top of a card on a cup, then pull the card out quickly. 2) Place a ring vertically on the mouth of a bottle, and then place a pen on top of the ring. Quickly pull the ring out from above the bottle. 3) Strike the bottom of a stack of coins with force.	• Prepare enough materials so that pupils can conduct the experiments one by one. • The coin will fall into the cup. • The pen will fall into the bottle. • The bottom coins will fly away and the other coins will stay in the same position.
Presentation 5 minutes	• Understand the property of objects at rest to stay at rest unless an external force acts upon it.	• Make pupils imagine and think about objects not being acted upon by a force. • Have them understand that objects in motion will move in a linear uniform motion. *(Evaluation: Knowledge and Skills 4)* Ability to explain that force must be applied in order to cause an object to stop moving. *(Evaluation: Knowledge and Skills 5)* Ability to explain that force changes the state of motion of an object. *(Evaluation: Knowledge and Skills 6)* Ability to explain that unless an external force acts upon an object, if it is at rest it will remain at rest.

Lesson Plan

2. Magnitude of Force and Spring Extension (2 Periods: 5th – 6th period)

Goals of this sub-unit

- Taking an interest in force, and thinking about the functions of force.
- To understand that force changes the state of motion of an object.
- To notice that the weight of a weight (force added) is proportional to the stretching of a spring.
- To understand that force is expressed in units called newtons.
- To understand that force magnitude can be measured using a spring balance.

Material Preparations

- Spring, weights, spring balance
- Worksheet

Period 5: Force and State of Motion

	Learning flow and activity	Teaching Hints and Advice
Introduction 5 minutes	• Think about when forces are at work other than when they are moving objects.	• Have pupils think of scenes in which forces are at work in everyday life. *(Evaluation: Interest 2)* Taking an interest in force, and thinking about the functions of force.
Questions	Search for settings in which forces are at work and think about what forces are working.	
Experiment 20 minutes	• Look at the drawing on the worksheet and find settings in which forces are at work. • Explain what forces are at work.	*(Refer to pg. 171 regarding worksheet)* • Show pupils that in any force there is a point acted upon, direction and size.
Presentation 10 minutes	• Present scenes in which force is at work.	*(Evaluation: Knowledge and Skills 7)* Ability to explain that transforming objects, holding up objects and changing motion are all functions of force.

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Period 6: Magnitude of Force and Spring Extension

	Learning flow and activity	Teaching Hints and Advice
Introduction 5 minutes	• Think about the difference in the extension of a spring when smaller and larger forces pull it.	• Have the pupils discover that magnitude of a force and how it transforms an object are related.
Questions	Investigate what happens to a stretched spring when you increase the weight hung from it.	
Experiment 20 minutes	*(items to prepare)* • spring, weights → **Experiment:** Add weights to the spring one at a time and check the extension of the spring each time.	• If you do not have a spring, replacing with a rubber band is acceptable. • Make the pupils understand that by altering the extension of the spring, adding more weights and strongly pulling on the spring serve the same role. • Make pupils understand that extension of the spring is proportional to the weight hung from it. • Explain that the force (gravity) of a 100g weight pulling on a spring is the standard unit of force, called 1 newton. • Make them understand that magnitude of force is shown in newtons (N). • Make them understand units in newtons. *(Evaluation: Thinking and Representation 3)* Ability to notice that the weight of a weight (force added) is proportional to the stretching of a spring.
Presentation 10 minutes	• The newton is the unit of size for force. • Be able to imagine magnitude of force from the extension of a spring.	*(Evaluation: Knowledge and Skills 8)* Ability to explain that force is expressed in units called newtons. *(Evaluation: Knowledge and Skills 9)* Ability to explain that force magnitude can be measured using a spring balance.

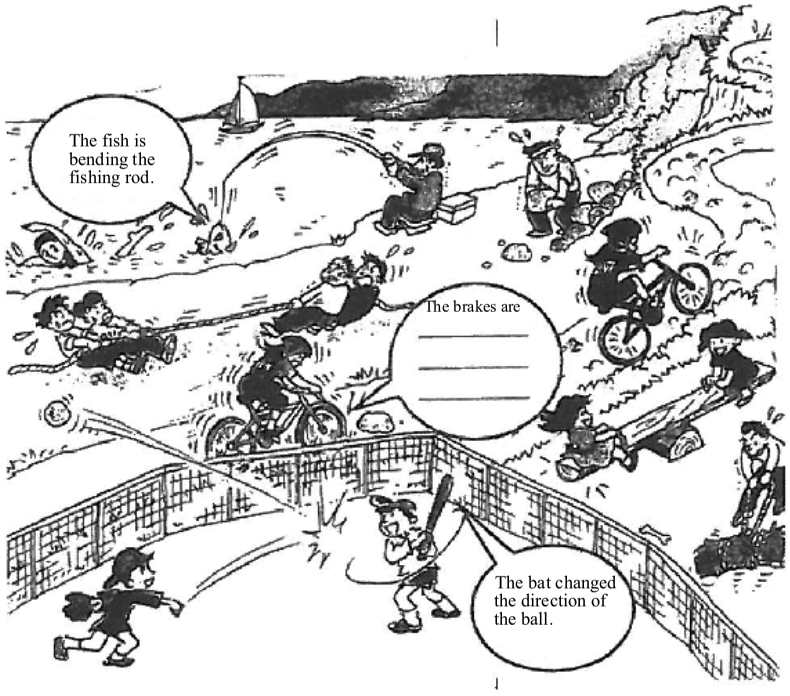
[Worksheet] ---------- * To be used in 5th Period

The Search for Settings in which Forces are at Work

Date: **Class:** **Name:**

Where are forces at work?

Draw a circle around every case of force at work in the drawing.



Write down your thoughts on what forces are at work.

* *Keep this worksheet for the next class.*

1st Sub-Unit Review Test

* given after the end of 4th Period

Class: Name:

1. You are holding an apple in your hand. Answer the following questions.

1) If you release the hand holding the apple, in which direction will the apple move?

(**It will fall down vertically (towards the center of the earth)**)

2) What force is acting upon the apple here?

(**Gravity**)

2. Which of the following dropped at almost the exactly same time as the 200g stone when it was dropped from a height of 2m?

(**A**)

A. a 100g battery B. a bird's feather C. a flat sheet of paper

3. Which of the following does the force of a magnet act upon?

(**A, D**)

A. an iron nail B. a rubber C. a pencil D. a razor blade

4. What should you do to make a moving toy car stop? Choose the correct answer below.

(**B**)

A. Acting with a force in the same direction as the toy car is moving will make it stop.

B. Acting with a force in the opposite direction as the toy car is moving will make it stop.

C. Acting with a force from the side of the direction the toy car is moving will make it stop.

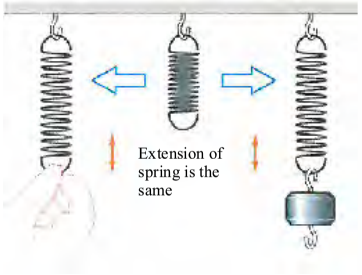
D. Acting with a force from below in the direction the toy car is moving will make it stop.

2nd Sub-Unit Review Test

* given after the end of 6th Period

Class: Name:

1. Refer to the figure on the right. What is the relationship between the force applied to a spring when pulled by a hand and that applied by hanging weights when length of the two springs is equal? Put one of the symbols =, <, or > in the blank below.



Force applied to spring by the hand (=) Force applied to spring by the weights

2. If more weights were added to the figure on the right, what would happen to the spring?

(**B**)

A. no change **B.** will get longer **C.** will get shorter

3. What is the unit that shows magnitude of force called? Give the symbol and the name.

Symbol: (**N**) **Name:** (**newton**)

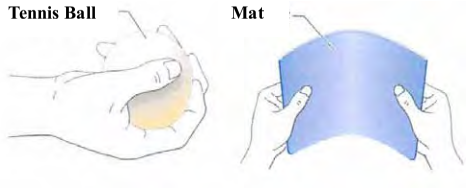
Final Unit Evaluation Test

* Done at Unit End

Class: Name:

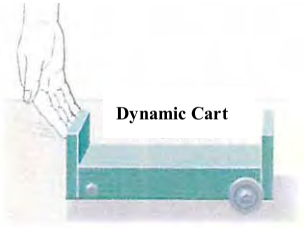
1. What happens when a force is exerted upon an object? Answer **questions 1 – 4** below.

1) Clench a tennis ball tightly. Exert force from both sides of a writing pad.



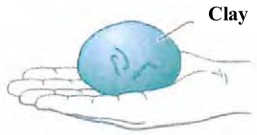
(**The shape changes (it bends)**)

2) Push the cart.



(**It moves in the direction pushed**)

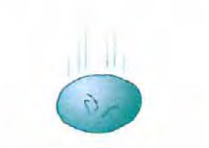
3) Set the clay on your hand.



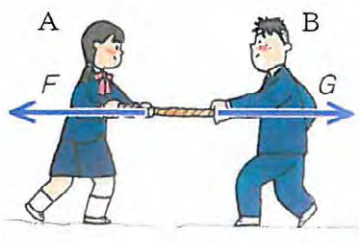
(**It is held up (stays in place)**)

4) The hand holding the object in **3)** above is taken away.

(**It moves, it falls**)

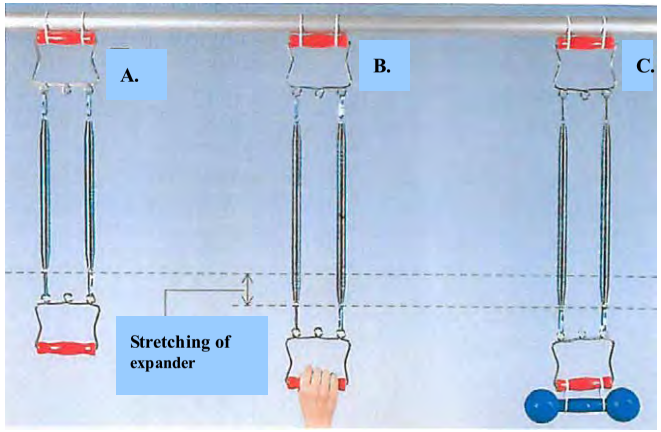


2. **A** and **B** are playing tug-of-war. If the force of **A** pulling is stronger, in which direction will the rope move, **F or G**? (F)



3. In **B** a force is being exerted pulling the expander, and in **C** a weight array has been suspended from the expander as shown in the picture below. The expanders in **B** and **C** have extended the same distance in comparison to **A**. Which of the following is the correct explanation for what's happening?

(C)



(Tokyo Shoseki, Field No. 1, p.24)

A. Even though the expander stretches the same amount, they are two different forces and cannot be treated as the same.

B. The length stretched by the expander is the same, so the hand and the weight array are the same size.

C. The length stretched by the expander is the same, so the force of the hand and the weight array are the same size.

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Student Questionnaires

1. What kinds of studying have you done in the past for the above test problems?

0.	None at all	This was done 10% of the time for all problems.
1.	No	This was done 30% of the time for all problems.
2.	Average	This was done 50% of the time for all problems.
3.	Yes	This was done 70% of the time for all problems.
4.	Absolutely yes	This was done over 90% of the time for all problems.

Answering Questions using Pictures and Diagrams in the Textbook or Illustrations Drawn on the Blackboard

1. The Students answered the questions by walking up to the board and drawing diagrams or writing words.
   0. 1. 2. 3. 4.
2. The teacher asked and answered the questions by drawing diagrams or writing words on the board.
   0. 1. 2. 3. 4.
3. Questions were answered using pictures and diagrams in the textbook.
   0. 1. 2. 3. 4.

Experiments

1. Did the students conduct any experiments or observations?
   0. 1. 2. 3. 4.
2. The teacher conducted the experiments.
   0. 1. 2. 3. 4.
3. The students conducted the experiments by following the teacher's instructions.
   0. 1. 2. 3. 4.

Discussion and Thinking

4. We talked with friends in the class and thought about the problems.
   0. 1. 2. 3. 4.
5. We thought about the problems carefully with friends and stated our ideas logically.
   0. 1. 2. 3. 4.

6. We thought about the problems carefully when coming up with a hypothesis and after the experiment.

0. 1. 2. 3. 4.

Understanding Ideas

7. I was able to understand new ideas.

0. 1. 2. 3. 4.

8. I was able to see new viewpoint of looking at and thinking about science.

0. 1. 2. 3. 4.

9. I was able to grasp the principles hidden beneath the facts.

0. 1. 2. 3. 4.

Application of Knowledge

10. I was able to apply the new knowledge that I learned in school in my daily life.

0. 1. 2. 3. 4.

11. The teacher has explained that the new knowledge things the students are learning in school are connected with actual life.

0. 1. 2. 3. 4.

12. I was able to learn that the new principles and viewpoints toward science can be applied to a variety of different phenomena.

0. 1. 2. 3. 4.

Pursuing Knowledge through Problem Solving

13. We were first given a problem and then were to solve that problem.

0. 1. 2. 3. 4.

14. We made predictions, put then to the test, formulate scientific explanations, and put them to practical use.

0. 1. 2. 3. 4.

15. The students were asked to verify through the experiment that they had created a hypothesis as well as a plan for the observation.

0. 1. 2. 3. 4.

2. When you learned each unit for the above test problems, did you become interested in the material?

0.	None at all	This was true 10% of the time for all problems.
1.	No	This was true 30% of the time for all problems.
2.	Average	This was true 50% of the time for all problems.
3.	Yes	This was true 70% of the time for all problems.
4.	Absolutely yes	This was true over 90% of the time for all problems.

Interest and Motivation

1. I was very interested in science lessons.

0. 1. 2. 3. 4.

2. I became more motivated to learn.

0. 1. 2. 3. 4.

3. I was interested in what we were learning from start to finish.

0. 1. 2. 3. 4.

Concentration and Involvement

4. I was actively engaged in learning the topic.

0. 1. 2. 3. 4.

5. I enjoyed learning the topic so much I lost track of time.

0. 1. 2. 3. 4.

6. I was very focused on learning topic material but at the same time, I was also very excited and enjoyed myself.

0. 1. 2. 3. 4.

Cooperation and Collaboration

7. I enjoyed the learning process while collaborating with friends.

0. 1. 2. 3. 4.

8. I was able to learn through cooperation and mutual support with my friends.

0. 1. 2. 3. 4.

9. I shared my experiments and ideas with my friends and we all had a fun time learning together.

0. 1. 2. 3. 4.

Level of Earnestness and Enjoyment during Experiments

10. The experiments were very enjoyable.

0. 1. 2. 3. 4.

11. Since experiments need five senses, I carefully moved my hands and eyes when collecting the data.

0. 1. 2. 3. 4.

12. During the experiments, I recorded my observations accurately and carefully.

0. 1. 2. 3. 4.

Spirit of Inquiry

13. I began to have more an inquiring mind toward new discoveries.

0. 1. 2. 3. 4.

14. I became very excited and curious about challenging the unknown.

0. 1. 2. 3. 4.

15. I made a strong effort to learn what is known by trying to find examples, drawing illustrations, and through discussions and experiments.

0. 1. 2. 3. 4.

Logic and Objectivity

16. I attempted to find plenty of evidence and facts to check whether my hypothesis held true.

0. 1. 2. 3. 4.

17. I was able to confirm that the principles and concepts were true by applying them to actual life.

0. 1. 2. 3. 4.

18. The explanations were very convincing and easy to understand for the entire class. I was very satisfied with the interpretations which were logical and accorded with the truth.

0. 1. 2. 3. 4.

Appendix

Examples of assessment questions which is used in Kenyan text books

1. When an object is moving, we say it is:
   A. Still
   B. Stagnant
   C. In motion
   D. At rest
2. Which one of the following is **not** a force?
   A. Effort
   B. Movement
   C. Push
   D. Pull
3. An object is pulled towards the ground by the:
   A. Weight
   B. Force of gravity
   C. Inertia
   D. Force of a magnet
4. When you jerk an object at rest using a paper, the object:
   A. Moves with the paper
   B. Rests with the paper
   C. Remains at rest
   D. Ascends

(KLB; Primary Science Pupils' Book for Standard Six P.98)

5. Force is measured in:
   A. Kilograms
   B. Metres
   C. Newtons
   D. Grammes
6. When two objects of different masses are dropped:
   A. The heavier one falls first
   B. The lighter one falls first
   C. They fall at the same time
   D. They collide

(KLB; Primary Science Pupils' Book for Standard Six P.99)

2. How can you stop a moving ball?

3. What is force?

4. Force is measured in _____.

(JKF; Primary Science Education Foundation Science 6 P.92)

2 Which one of these objects would be difficult for a person to move?
A a stationary lorry B a book
C an empty carton D a bottle of soda

3 What are the units of force?

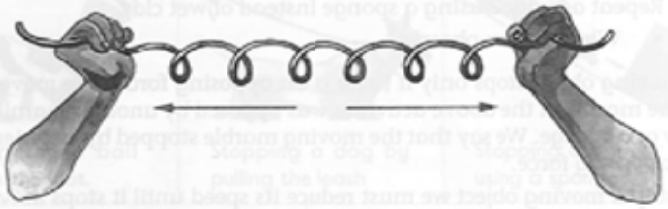
4 1 kilogram is the same as _____ newtons.

(Macmillan; Macmillan Primary Science, Pupil's book 6 P.131)

1. Movement is the change of
   A. direction. B. position.
   C. force. D. surface.
2. The unit of force is the
   A. Newton. B. newton.
   C. Newtonian. D. one tonne.
3. To stop a moving object we
   A. apply force in the opposite direction.
   B. make the ground more smooth.
   C. remove all obstacles from its way.
   D. stand directly in front of it.
4. Things fall towards the ground because of
   A. motion. B. gravity.
   C. density. D. inertia.

(Oxford; Science in Action 6 P.84)

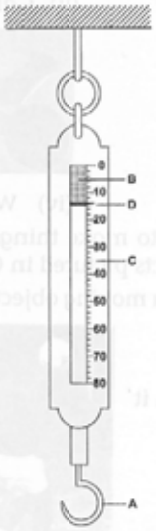
5. Karisa pulled a spring as shown. Which of the following statements are true?



(i) The spring pulls on his hands.
(ii) The spring becomes shorter when Karisa stops pulling.
(iii) Karisa feels a push on his hands.
(iv) Karisa feels a pull on his hands.
A. (i), (ii) only.
B. (i), (iv) only.
C. (i), (ii), (iv) only.
D. (i), (ii), (iii) and (iv).

(Oxford; Science in Action 6 P.84)

7. The instrument for measuring force is called a
   A. spring.　　B. weight.
   C. spring balance.　　D. string balance.
8. The diagram below shows an instrument used for measuring force.



Which part is not correctly labelled?
A. Hook　　B. Spring　　C. Balance　　D. Pointer

9. Which of the following is true about moving objects?
   (i) A moving object changes position.
   (ii) A moving object pulls things by gravity.
   (iii) Force causes things to move.
   A. (i) and (iii) only.
   B. only (i).
   C. only (ii) and (iii).
   D. (i), (ii) and (iii).

(Oxford; Science in Action 6　P.85)

7. In which of the following cases is the force required greatest?
   A. To lift an object straight up.
   B. To lift an object along a rough slope.
   C. To pull an object along a flat smooth table.
   D. To pull an object along a smooth slope.

(Longhorn; Understanding Science, Pupil's Book 6　P.100)

2. Which of the following is the word used to describe the force that occurs between two surfaces that are sliding against each other?
   A. Pull
   B. Push
   C. Gravity
   D. Friction

3. What force makes a mango to drop from a tree to the ground?

4. To _____ is to move faster and faster.

5. In order for a force to be able to stop a moving object,
   A. the force must be less than the force of the moving object.
   B. the force must be in the same direction to that of the moving object.
   C. the force must be in the opposite direction as that of the moving object.
   D. The force must be a half of that of the moving object.

(Longhorn; Understanding Science, Pupil's Book 6 P.99)

14. The force of _____ helps to slow down and stop objects from moving.

15. Why is a bicycle with worn out tyres difficult to stop?

(Longhorn; Understanding Science, Pupil's Book 6 P.100)

Appendix

Examples of materials which is used in Kenyan text books

Force and movement

Force and movement

Objects such as stones, tables and desks will always stay in one particular place unless they are moved. To move these things, a force is needed.

What is a force?

A force is a push or a pull. There are many things in nature that can produce a force. Examples are: moving water, wind, people, animals and engines.

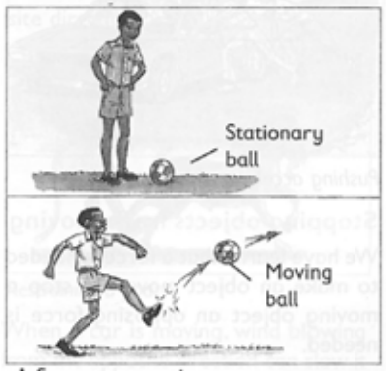
What a force can do

A force can do the following things:-

- Start motion
- Speed up motion
- Slow down motion
- Stop motion

(a) Start motion

A force can make a stationary object start moving. Look at these pictures.



A force starts motion

The force from the boy's leg sets the ball in motion.
What force has started the motion in each of the following pictures?

Sailing boat

A girl riding a bicycle

A moving car

(Longhorn; Understanding Science, Pupil's Book 6 P.95)

The meaning of force

Activity 1: Pulling and pushing springs

1. Hold each end of a spring and try to stretch it.

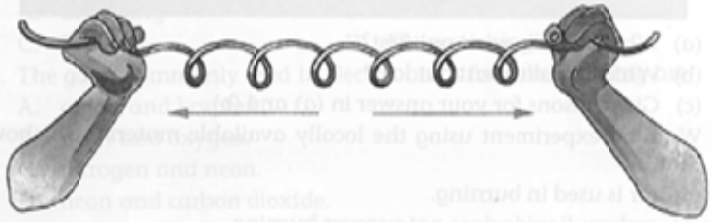


Figure 11.1: Pulling a spring

- What do you feel?

2. Try to push the spring between your hands so that the spring becomes shorter.

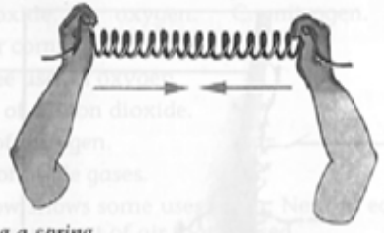


Figure 11.2: Pushing a spring

- What do you feel as you push the spring?

When a spring is stretched, the hands feel the pull of the spring. This pull is called **force.**

When a spring is pressed between the hands, the hands feel the push of the spring. This push is also called force.

Force is a **push** or a **pull**. When you use force to pull or push an object, the object **moves**. It changes its position. The change of position of an object is called **motion.**

(Oxford; Science in Action 6 P.80)

Note that for the objects to move, they have to be **pushed, pulled** or **lifted**; that is, a **force** has to be applied.

Activity: Investigating the force of gravity

(i) Hold a small object such as a ball as shown in figure 11.2.

(ii) Release it. What happens?

Observation

You observe that the ball falls downwards. As it falls, its speed increases. The fall is caused by the **pull of gravity.** Gravity is a force that pulls objects towards the earth. The force of gravity is as a result of the earth's rotation.

(KLB; Primary Science Pupil's Book for Standard Six P.90)

Fig. 11.2: The force of gravity causes motion

(iii) Take two objects of different sizes and masses.

(iv) Release the two objects at the same time as shown in figure 11.3.

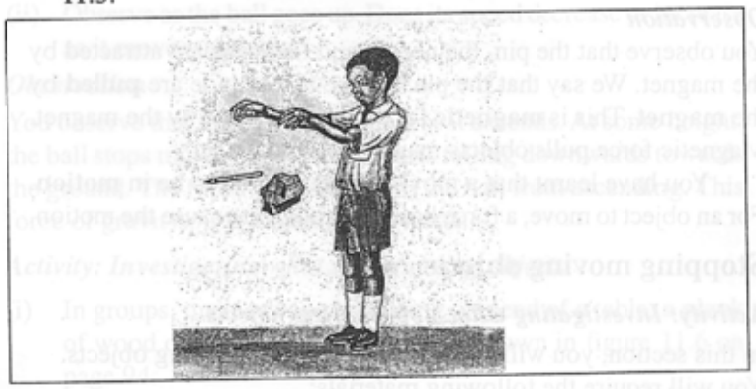


Fig. 11.3: The force of gravity causes motion

What happens?

Observation

You observe that the two objects hit the ground at the same time. Use other objects to do similar activities.

(KLB; Primary Science Pupils' Book for Standard Six P.91)

Put an empty box. Is it harder to push than the box with stone?

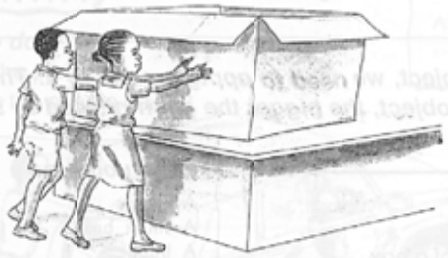


Figure 11.1 *Pushing and pulling light and heavy objects*

- ***For something to move from one place to another you need to push or pull it.***
  The heavier the object, the more you need to push or pull.
  The more we push or pull things, the greater the distance they move.

(Macmillan; Macmillan Primary Science, Pupil's book 6 P.127)

Units of force

Activity: Measuring force in Newtons

(i) Look for different objects that can be suspended or pulled on a table using a spring balance as shown in figures 11.10 (a) and (b).

(ii) Measure the force used to pull each object. Record your results in a table in your exercise book.

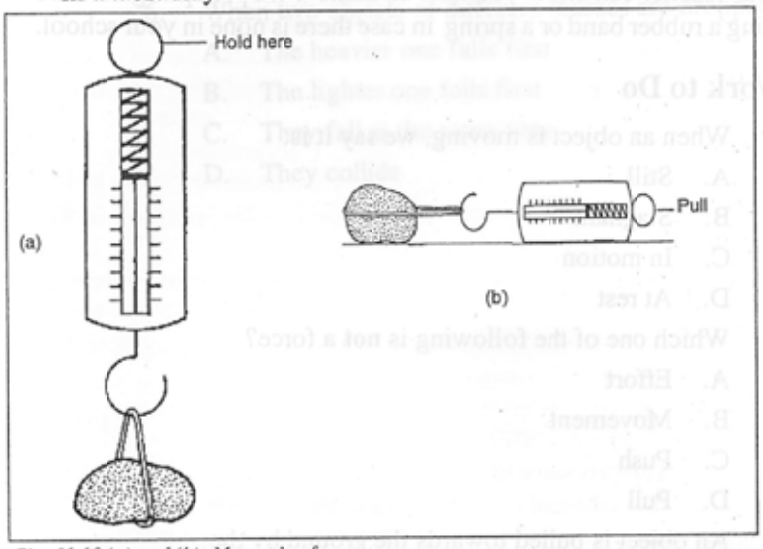


Fig. 11.10 (a) and (b): Measuring force

Table 11.1: Measuring force

Object	***Amount of force applied (N)***
Wooden block	
Stone	
Book	
Chalkbox	

(KLB; Primary Science Pupils' Book for Standard Six P.97)

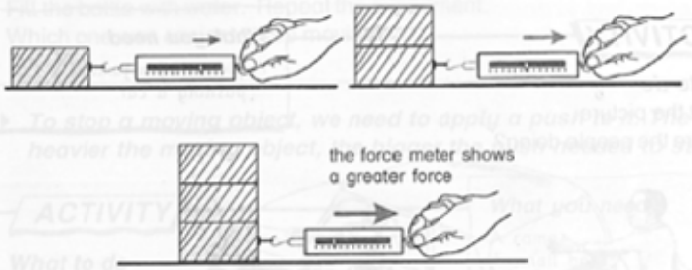


Figure 11.5 *Using and reading a spring balance*

Double the weight of the block by putting another block of wood on top of the first one. Measure again and record the reading on the spring balance.

You could repeat this with a third block, and so on, measuring and recording the reading each time.
What happens to the spring balance reading when you increase the number of blocks?

Did you notice that the spring balance reading increases as you increase the number of blocks to be pulled?
We can measure push or pull using a spring balance. Since force is a push or a pull, a spring balance is used to measure force.
So, the more blocks to be pulled, the greater the force needed.
Force is measured in units called newtons.
1 kilogram (kg) = approximately 10 newtons (N)

(Macmillan; Macmillan Primary Science, Pupil's book 6 P.130)

Stopping objects from moving

Stopping objects from moving
Objects that are moving can be made to stop moving. Sometimes it is not easy to stop them.

ACTIVITY

What you need
Empty plastic bottle with a top
Water

What to do
Make the empty bottle roll by pushing it.
Stop the bottle rolling with your hand.

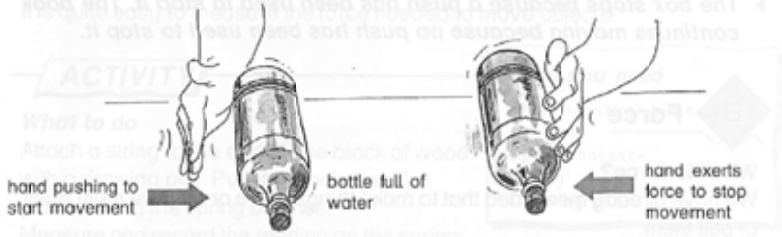


Figure 11.2 *Stopping a moving bottle*

(Macmillan; Macmillan Primary Science, Pupil's book 6 P.127)

Demonstrating how to stop moving objects

What does your friend need to do to stop the moving ball?
Let your friend stop the ball.
Did you realise that to stop the moving ball, your friend had to push the ball in the opposite direction?

(JKF; Primary Science Education Foundation Science 6 P.89)

The girl is trying to prevent a goat from moving by pulling it in the opposite direction.

Restraining a goat

(Longhorn, Understanding Science, Pupil's Book 6　P.97)

- Tie a stone like the boy below. Pull the stone and ask you friends how they can stop the moving stone

Your friend can stop the moving stone by pulling it back.
Move other things and have your friends stop them.
The path of a moving object can be blocked. The object used to block pushes back the moving object. This stops movement.

(JKF; Primary Science Education Foundation Science 6　P.90)

Activity 4: Stopping moving objects

1. Put 10 marbles in a row on a flat table. Take one marble and roll it in the direction of the ten marbles.

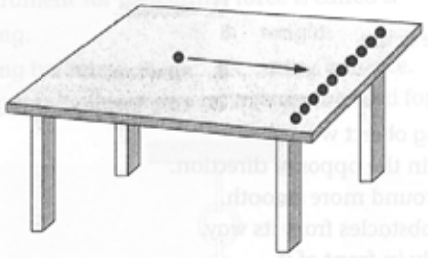


Figure 11.6: Stopping rolling objects

When the rolling marble hits one of the other ten, it stops.

- Why does it stop?

2. Put a piece of wet clay on a flat table. Roll one marble in the direction of the clay.
   - What happens when the marble hits the clay?
3. Repeat activity 2 using a sponge instead of wet clay.
   - What do you observe?

A moving object stops only if there is an **opposing force.** The movement of the marble in the above activities was opposed by another marble, wet clay or a sponge. We say that the moving marble stopped by experiencing an opposing force.

To stop a moving object we must reduce its speed until it stops moving.

- State how each of the objects in the table below can be stopped.

Object	How the object can be stopped
Wheelbarrow	
Handcart	
Bicycle	
Car	
Rolling tins	

(Oxford; Science in Action 6 P.83)

Magnetic force

Activity: Investigating magnetic force

(i) Place a pin, a needle or a razor blade on a desk. Bring a magnet close to the objects as shown in figure 11.4.

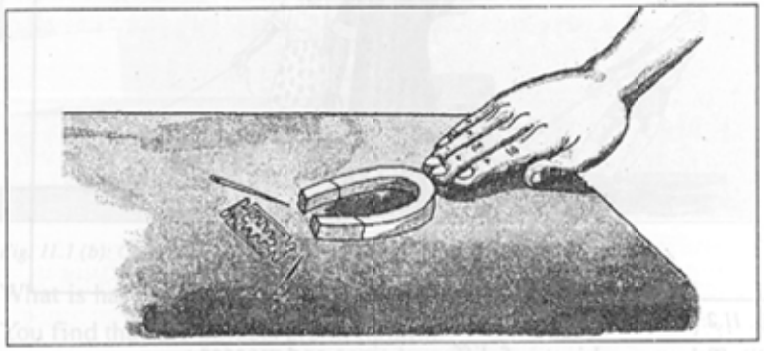


Fig. 11.4: Magnetic force causes motion

(ii) What happens?

Observation

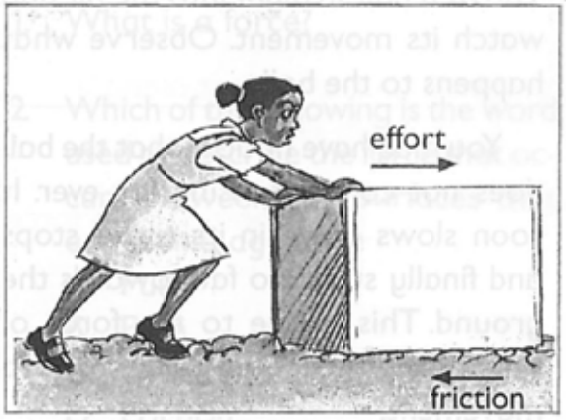
You observe that the pin, the needle and the razor are attracted by the magnet. We say that the pin and the razor blade are **pulled** by the **magnet**. This is **magnetic force**. It is produced by the magnet. Magnetic force pulls objects made of iron and steel.

You have learnt that a moving object is said to be in **motion**. For an object to move, a force has to be applied to cause the motion.

(KLB; Primary Science Pupils' Book for Standard Six P.92)

Friction stops sliding movement

If you tried to push a box or any other heavy load over a rough ground, you will notice that it is not easy. This is because of a force that opposes the sliding movement between the bottom surface of the box and the ground. This opposing force is called **friction**.



Friction opposes sliding movement

For the box to move or slide forwards, the girl must apply an effort which is greater than the force of the friction. However, if the floor was cemented smooth and polished, the box would slide over easily with just a little effort. Rough surfaces cause more friction than smooth surfaces.

(Longhorn; Understanding Science, Pupil's Book 6 P.97)

Stationary and moving objects

Let us carry out some activities that will help us learn more about stationary and moving objects.

Activity: Investigating the relationship between stationary and moving objects

For this activity, you will need to collect the following materials: coins, cardboards, a glass, a block of wood, a bottle top, a stone and a plank of wood to make a sloping surface.

Notice that the coin does not move along with the cardboard.

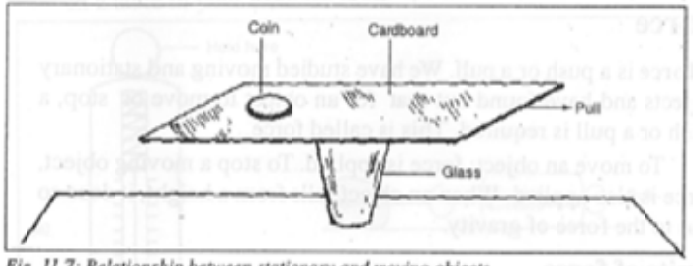


Fig. 11.7: Relationship between stationary and moving objects

(ii) Now arrange the block of wood, the stone and the bottle top on the sloping surface as shown below.

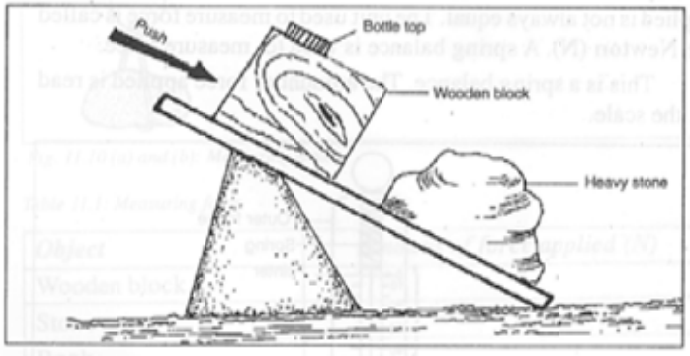


Fig. 11.8: Changing motion

(iii) Push the block of wood to slide down the slope until it knocks the stone.

- What happens to the block of wood?
- What happens to the bottle top?

When an object is stationary, it tends to remain stationary unless it is moved by a force. This tendency to remain in the same state (moving or stationary) is called **inertia**.

(KLB; Primary Science Pupils' Book for Standard Six　PP.95-96)