

Force and Pressure SUMMARY SHEET

Pedagogical Approach: Student - led

Learner Previous Knowledge

Force, friction and work

Types of force

Understand types of force;

Target Knowledge for this Topic

Force & Pressure-Recap of force and its effects; The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion.

Different type force i.e. contact and non-contact forces.

Pressure and its effects

Find out what is pressure; Calculate pressure exerted by a body; Investigate about how pressure can be applicable in the daily life; Learn about how liquid and air exerts pressure; Find out how liquid pressure can be applied in the daily life; Measure the liquid and atmospheric pressure.

Learning Goals

More Complex Learning Goal- Students will be able explain the contact and non-contact forces and to predict the effect of force and pressure on an objects as well as fluids.

Target Learning Goal- Students will be able to describe contact and non-contact forces, pressure exerted by objects and fluids and explain how force and pressure are interrelated.

Simpler Learning Goal- Students will be able to list the contact and contact forces, define pressure and state how liquids and gases exert pressure.

Period No.

Lesson Objectives

Teaching Learning Materials Required

1

- Recapitulate force
- Explain effects of forces

- Board and markers
- Worksheet 1

2

- Explain contact forces and demonstrate force of friction through an activity

- Board and markers
- Worksheet 2

		Activity (for each group)- two pencil cells, wooden plank [if plank is not available, you may even use a thick cardboard register], a napkin, stop watch
3& 4	Explain non-contact forces and demonstrate how they work.	- Board and markers - Worksheet 3 - Reference sheet 2 - Activities: (per group)- 2 bar magnets and 4 pencils
5	Explain the concept of pressure.	- Board and markers - Worksheet 4
6 & 7	Demonstrate pressure exerted by liquids and gases	- Board and markers - Worksheet 5 - Reference sheet 3 - Activities (for each group)- empty plastic bottles, glass tube, clay, water, balloon, test tube, piece of cardboard
8	Analyze how pressure can be advantageous and disadvantageous to us.	- Board and markers - Worksheet 6

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Period 1

Lesson Objectives

At the end of this lesson students will be able to:

- Recapitulate force
- Explain effects of forces

Teaching Learning Materials required

- Board and markers
- Worksheet 1

Details of Teaching Learning Experience

Seating Arrangement: In groups of 4-5 each outdoor in school garden

Lesson Beginning <u>Time:</u> 10 min <u>Purpose:</u> • Activate prior knowledge	<u>Tug-of-War!</u> • Ask the students to take their pencil box and notebook and go out in the garden. • Let the students assemble in groups. • Ask them to recall the meaning of force. • Ask two groups to play tug of war game for 5 minutes. Ensure that there is same number of students on both sides. • Now ask students to work in pairs. Let each pair first push a rock or any heavy object first in same direction and then in opposite direction. • Instruct the students to observe how force is affected in these activities. Tell them to think when in which cases is the force more and in which cases it is less. • Distribute worksheet 1 to all students. • Let them fill it up in pairs.
Lesson Middle <u>Time:</u> 15 min. <u>Purpose:</u> • Develop conceptual understanding	<u>What can Force do? Find out!</u> • They must attempt the observation questions and make their deductions. • Let there be a whole class discussion now. The students may discuss all the answers of the questions of Annexure 1A. • Arrive at a common consensus.

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Lesson End <u>Time:</u> 10 min <u>Purpose:</u> • Finish Up • Homework Distribution	<u>Finish Up</u> • Wrap up the discussion by clearing doubts if the students have. <u>Homework Assignment</u> • Observe and find out examples at home where effect of force is visible.
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Worksheet 1

Skill: Drawing Inferences

What are effects of forces?

I. What difference will you observe when you and your friend push the object in the same direction?

2. What difference will you observe when you and your friend push the object in opposite direction?

3. In which direction will the rope move when you pull it equally from both ends?

4. Based on these examples, what can you say about nature of force? Select the correct answer from the given options.

- a) Forces applied on an object in the same direction add to one another.
- b) Forces applied on an object in the same direction cancel each other.

** Information: The strength of forces is usually called its magnitude [measured force]. It is measured in unit called Newton. More the magnitude more is the force and less the magnitude, less is the force.*

5. When is the magnitude of force more?

- a) When forces are applied on object in same direction
- b) When forces are applied on object in opposite direction

6. What effect do you see when equal and opposite force is applied on an object?

7. What will happen to the speed of the ball when you place a palm in front of moving ball?

8. Will the ball continue moving in same direction if a batsman hits it?

9. What happens when you apply force on a lump of clay dough?

10. Can you change the shape of soft material like a ball of wool or a rubber ball by applying force?

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11. What do you do when you have to break a piece of laddoo?

So, the effects of forces are:

- 1. _____
- 2. _____
- 3. _____
- 4. _____

Period 2**Lesson Objectives**

At the end of this lesson students will be able to:

- Explain contact forces and demonstrate force of friction through an activity

Teaching Learning Materials required

- Board and markers
- Worksheet 2
- Activity (for each group)- two pencil cells, wooden plank [if plank is not available, you may even use a thick cardboard register], a napkin, stop watch

Details of Teaching Learning Experience

Seating Arrangement: - In small groups of 4-5

Lesson Beginning <u>Time:</u> 10 min <u>Purpose:</u> Activate prior knowledge	<u>Whole Class Discussion</u> • Ask the students to first recapitulate the effects of force by asking a few students to do so. • Now pose the following questions: ○ How does a bullock pull the cart? ○ How can you shift a bucket of water from one place to another? ○ How do you shift a table from one place to another? ○ How does a magnet pull pins towards it? ○ How does a charged body such as a comb attract pieces of paper to it? • Collect all the answers. Ensure that the students come to the conclusion 'Muscular Force' for first 3 questions and now pose a question: 'What is the difference between the force exerted by a magnet and force exerted by you to pull a table?' • Collect responses to arrive at the answer that in one example there is contact while in the other there isn't. • Inform the students that they will study about contact forces now. • Distribute worksheet 2 to all students and ask them to quickly fill it.(First part only)
Lesson Middle <u>Time:</u> 15 min.	<u>Analyse!</u> • Ask the students to recall the meaning of friction.

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<u>Purpose:</u> • Develop conceptual understanding	• Collect response form a few students and ask them what can happen if friction does not exist? Inform the students that they will now do an activity to recall friction and its effects. • Let them follow the instructions and do the activity. • Ask them to attempt the question and answers. • Let there be a whole class discussion in which the students must arrive at a consensus.
Lesson End <u>Time:</u> 5 min <u>Purpose:</u> • Finish Up	<u>Finish Up</u> • Wrap up the class by clearing doubts. • Discuss the information given in reference sheet 1.

Worksheet 2

Skill: Comprehension

1. Write in your own words the meaning of muscular force.

2. Can you call muscular force as 'contact force'? Why?

3. Give three examples of muscular force.

II. Activity

Aim: To find out how object moves on smooth surface and rough surface

Material: two pencil cells, wooden plank [if plank is not available, you may even use a thick cardboard register], a napkin, stop watch

Instructions:

1. Create a "ramp" by placing a stack of books (about 1 foot high) under one end of the plank or register.
2. Let a pencil cell run on the ramp. Ask the students to time it with the stop watch.
3. Now spread the cloth on the 'ramp' and repeat the activity. Again, time it.

	Time taken by the cell to run on the ramp
Ramp without cloth	
Ramp with napkin	

Question:

- Did the cell move at the same speed or different speed?

4. Now cover half the ramp longitudinally with the napkin so that you have two 'tracks'; one normal and one smooth. You have to run the cell simultaneously on two different surfaces.

Predict!

Cell on the _____ track will move faster than cell on the _____ track.

- Why is there a difference in speed?

- Which force is responsible for the difference in speed here?

- Which surface will have more friction?

- Which surface will oppose motion less?

- Is your prediction about movement of cell correct?

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Reference sheet 1

Information

- A contact force as the name suggests acts on a point of an object by direct contact. Example: Playing with clay dough and pushing an object along the floor
- Muscular force is contact force. It is an applied force. An applied force is a force that is applied to an object by a person or another object.
- Friction is contact force too. It is the force exerted by a surface as an object moves across it or makes an effort to move across it. The friction force often opposes the motion of an object. For example, if a toy slides across the surface of a table, then the table exerts a friction force in the opposite direction of its motion. Friction results from the two surfaces being in contact together closely.
- Smoother the surface, less is the friction and vice versa.
- Irregularities on a surface increases friction. We need more force to overcome the interlocking of the two surfaces which are in contact. Hence rough surfaces have more friction.

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Period 3 & 4

Lesson Objectives

At the end of this lesson students will be able to:

- Explain non-contact forces and demonstrate how they work.

Teaching Learning Materials required

- Board and markers
- Worksheet 3
- Reference sheet 2
- Activities: (per group)- 2 bar magnets and 4 pencils

Details of Teaching Learning Experience

Seating Arrangement: - In groups of 4 or 5

Lesson Beginning <u>Time:</u> 10 min <u>Purpose:</u> Activate prior knowledge	<u>Whole Class Discussion</u> • Begin the class by asking groups to state the types of contact forces that they studied. Now pose following questions: ○ Can you think of forces acting on each other where there is no contact between objects? ○ Is magnetism contact or non-contact force? Why? ○ Why does an object fall back to earth and not remain suspended in air? Which force is at play? ○ Can we call gravity as non-contact force? ○ You have learnt about static charges. They too attract and repel each other. Can we call them as force? • Let the whole class participate in the discussion and ensure that all agree with the answers. • Now ask the students to write the meaning of non-contact force in their own words in their notebook. Ask them to give examples based on the question answer session that they have had.
Lesson Middle <u>Time:</u> 50 min. <u>Purpose:</u>	<u>Experiment</u> • Distribute worksheet 3 to each group. • Ask the groups to follow instructions and do the given activities. • They must attempt the questions.

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Develop conceptual understanding	- There can be a whole class discussion in which the groups can exchange their observations of the activities as well as answers. - Ensure that all the students are on the same page.
Lesson End <u>Time:</u> 10 min <u>Purpose:</u> Finish Up	<u>Finish Up</u> - Wrap up the class by clearing doubts. - Discuss reference sheet 3 with all students.

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Worksheet 3

Skill: Observation and Investigation

Experiment: To test magnetic force [non-contact]

Material: two bar magnets, 3-4 pencils

Instructions:

1. Put one bar magnet on the pencils perpendicular to them so that the pencils act as rollers.
2. Take another bar magnet and bring one end of it near the magnet on the pencils but do not touch it.
What happens?
3. Now change the pole of the magnet in your hand and repeat the activity. What happens?

I. Questions:

1. What happens when you bring a magnet near the magnet on the pencils for the first time?

2. Does the magnet on the pencil rolls every time another magnet is brought near it?

3. What do these observations tell you?

4. Can we say that a force exists between the two magnets? _____
5. Can we call it a contact force or non-contact force? Why?

6. As you have studied in previous class, like poles repel and unlike poles attract. In which case in the above activity, will there be like poles coming together? _____

Let's Recall

Recall the activity of bringing a comb/scale (rubbed with cloth or hairs) near pieces of paper.

I. Questions:

- a) What happens when you bring a scale near the pieces of paper?

- b) The force exerted by a charged body on another charged or uncharged body is called electrostatic force.
Which of the objects is charged with electrostatic charge?

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c) Can we say that a force exists between the scale and the pieces of paper? _____

d) Can we call it a contact force or non-contact force? Why?

Think and write

1. Why do you think objects fall down and not remain suspended in air?

2. You must have seen in movies that an object in space tends to float. Why then do objects not float on Earth?

3. Does it mean some force is acting on the objects which pulls them to the Earth?

4. Can you call this force contact or non-contact force?

The force, because of which Earth pulls objects towards itself, is called **force of gravity**. This force of attraction is present in all objects and all objects exert a force on each other. This force is called **gravitational force**.

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Reference sheet 2

- Non-contact forces are forces which act on objects without any physical interaction. Example: Gravity, electrostatic force and magnetism.
- Gravity is an imaginary force pulling everything towards the earth surface. All the objects are pulled towards the earth without any physical contact with the objects and bodies. Gravity is a force due to which bodies are attracted towards earth surface. They are attracted by a force which is proportional to their weight. Gravitation is responsible for keeping all the planets in their respective orbit around the sun.
- Magnetism is a special force which exerts on other magnets or substances made up of iron. The force is called magnetic force which is a non-contact force. The magnetic fields surrounding all magnets are said to have two poles, called North and South.
- The force exerted by a charged body on another charged or uncharged body is called electrostatic force. Like charges repel and unlike charges attract. More the distance between charges less will be the force.

Lesson Plan 5

Lesson Objectives

At the end of this lesson students will be able to:

- Explain the concept of pressure.

Teaching Learning Materials required

- Board and markers
- Worksheet 4

Details of Teaching Learning Experience

Seating Arrangement: - In groups of 4 or 5

Lesson Beginning <u>Time:</u> 5 min <u>Purpose:</u> Introduce the topic	<u>Whole class Discussion</u> • Begin the class by asking groups to the following questions: ○ Is it easier to cut with blunt knife or sharp knife? ○ Which end of nail is easy to drive in a block of wood? ○ If your friend pokes you with a sharp pencil point and with a chalk, which one will hurt more? ○ In all above examples, what makes task easier; when force is applied over larger area or smaller area? ○ Have you heard the term pressure? What do you think it means? • Gather responses and arrive at a common consensus. • Inform the students that they will now find out what is pressure and how it is related to force.
Lesson Middle <u>Time:</u> 25 min. <u>Purpose:</u> • Develop conceptual understanding	• Discuss about pressure by taking various daily life examples. • Distribute worksheet 4 to each group. • Let the group attempt the questions. • There can be a whole class discussion in which the groups can exchange their answers. • Ensure that all the students are on the same page.

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Lesson End <u>Time:</u> 5 min <u>Purpose:</u> Finish Up	<u>Finish Up</u> Wrap up the class by clearing any doubts that the student may be having.
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Worksheet 4

Skill: Comprehension

Questions

1. What is pressure? Write it in the form of mathematical equation.

2. Why is the pressure high when a knife is sharp?

3. Can you now say why a sharp knife is easier to use for cutting vegetables?

4. If you want more pressure, should the force be more or less? _____

5. How are area and pressure related? Should area be more or less for pressure to be more?

6. What happens to pressure of atmosphere as we go higher in altitude?

7. How can we use pressure for our advantage? What are its applications?

8. Why is oxygen mask provided in airplane?

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Lesson Plan 6 & 7

Lesson Objectives

At the end of this lesson students will be able to:

- Demonstrate pressure exerted by liquids and gases

Teaching Learning Materials required

- Board and markers
- Worksheet 5
- Reference sheet 3
- Activities (for each group)- empty plastic bottles, glass tube, clay, water, balloon, test tube, piece of cardboard

Details of Teaching Learning Experience

Seating Arrangement: - In groups of 4-5 students

Lesson Beginning <u>Time:</u> 5 min <u>Purpose:</u> Activate prior knowledge	<u>Group Discussion</u> • Ask a student to write mathematical equation of pressure on board. ○ Based on the above observation, what will be more comfortable, broad shoulder straps on your school bag or thin ones? ○ Do you think only solids exert pressure? ○ Does all gases exert pressure? • Gather responses and arrive at a common consensus. • Inform the students that they will now do the experiments and demonstrate that fluids exert pressure.
Lesson Middle <u>Time:</u> 60 min. <u>Purpose:</u> • Develop conceptual understanding	<u>Experiments</u> • Distribute worksheet 5 to the students of all groups. • Ask the groups to discuss how to do the experiment first. • Extend help only if really needed. • After they have done the activities, there can be a whole class discussion in which the groups can exchange their answers. • Ensure that all the students are on the same page.

Lesson EndTime: 5 minPurpose:

- Finish Up
- Homework Assignment

Finish Up

- Wrap up the class by clearing any doubts.
- Discuss reference sheet 3 with students.

Homework Distribution

- Use the internet or your textbook and find out how pressure exerted by liquids and gases is used for our benefits. Write them down in your notebook.

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Worksheet 5

Skill: Spirit of Inquiry

Do liquids exert pressure? Let us find out!!

Experiment 1

Material: Glass tube, rubber sheet or balloon, water

Instructions

1. Fix the rubber balloon at one end of the tube.
2. Fill the glass tube One-third with water. Observe what happens.
3. Now fill the tube half and observe again.
4. Now fill more water till two-thirds and observe again.

Questions

- a. What happens when you put water in the tube?

- b. When does the balloon enlarge more?

- c. What is the relation between increasing height of column of water in the tube and the balloon expansion?

- d. What can you conclude from this observation with respect to liquids and pressure?

- e. Which statement is correct?

- i. Pressure exerted by water at the bottom of the container depends on the height of its column.
- ii. Pressure exerted by water at the bottom of the container remains constant irrespective of the height of its column.

Does liquid exert pressure only at the bottom of a container? Let us find out.

Experiment 2

Material: empty, soft drink bottle, glass tube, clay, rubber balloon, water

Instructions

1. Slightly heat one end of the glass tube and quickly insert it at a lower end of the bottle.
2. Put clay around the joint to prevent leakage.
3. Fix a balloon at the end of the glass tube.
4. Now fill the bottle gradually just as you did in experiment 1.
5. Observe what happens.

Questions

a) What happens when you put water in the tube?

b) When does the balloon enlarge more?

c) What is the relation between increasing height of column of water in the tube and balloon expansion?

d) What can you conclude from this observation with respect to liquids and pressure?

e) _____

f) Which statement is correct?

- i. Liquids exert pressure on sides of the container.
- ii. Pressure exerted by water at the side of the container remains constant irrespective of the height of its column.

Do gases exert pressure?

Blow a balloon. Why does it bulge? Close its mouth. What happens when you keep the mouth of the balloon open? Does it mean that the air in it exerts pressure on the walls of the balloon?

Write your conclusion here.

We can conclude that gases _____.

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Reference sheet 3

- Liquids and gases exert pressure.
- Liquids exert pressure equally on all sides of the container.
- Liquids exert equal pressure at the same depth.
- The pressure exerted on bottom of the container depends on height of water column.
- Gases exert pressure too. They too exert pressure equally on the sides of the container.

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Lesson Plan 8

Lesson Objectives

At the end of this lesson students will be able to:

- Analyze how pressure can be advantageous and disadvantageous to us.

Teaching Learning Materials required

- Board and markers
- Worksheet 6

Details of Teaching Learning Experience

Seating Arrangement: - In small groups of 4-5

Lesson Beginning <u>Time:</u> 5 min <u>Purpose:</u> Activate prior knowledge	- Ask the students to recall about the pressure. - Inform the students that they will now use their knowledge of pressure and atmospheric pressure to analyze cases.
Lesson Middle <u>Time:</u> 25 min. <u>Purpose:</u> Develop conceptual understanding	<u>Case Studies</u> - Distribute worksheet 6 to each group. - Ask the groups to analyze the cases. - Extend help if required. - Let there be a whole class discussion in which the groups can exchange their answers. - Ensure that all the students are on the same page.
Lesson End <u>Time:</u> 5 min <u>Purpose:</u> Finish Up	<u>Finish Up</u> Wrap up the class by clearing any doubts that the students may have.

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Worksheet 6
Skill: Analytical Thinking

Case Studies

- Sunita wore very pointed high heels. The heels were pencil point and she loved wearing them. However she soon developed pain in the heel and her doctor asked her to stop wearing them. Imagine you are the doctor. What will be your diagnoses? Think as a physicist and not a medical doctor!

- Anil takes off his shoes and stands on the floor. Now he spread some gravel on a sheet of newspaper on the floor and stood on the gravel. He wants to know why it hurts to stand on gravel. How will you explain him in terms of force and pressure?

- There was a burglary in the neighborhood. Luckily, it had rained the previous night and the police found a footprint. One detective was observing it closely. Anita asked him what he was looking for and he replied that he was trying to figure out how heavy the burglar was, from the foot print. How can he do that?

- Sheila's uncle was fascinated to see her uncle get ready for deep sea diving. He wore a heavy, specialized suit for the purpose. Sheila wondered why he could not wear the normal swimsuit that he wore for swimming. Her uncle explained the reason clearly by using concept of force and pressure. Guess the explanation given to Sheila by her uncle.
