

My Machine World (Class 8)

Introduction	In this project, learners will explore how force, pressure, and friction work in the real world and will use their creativity by making simple and compound machines. In Nagaland, learners see machines in daily life: the dao used for cutting, carrying firewood with a headband, hand pumps in villages, bicycles on hilly roads, and pulleys for lifting loads. These everyday actions involve force, pressure, and friction. Learners will connect these familiar experiences to the science behind them, design and build their own compound machine, and present it to an audience. Remember to upload a photo of your class completing this project to the project completion form.
Leading Question	Can you build a machine that solves a real problem?
Lesson	Chapter 5: Exploring Forces
Total Time Required	In Class: 40 minutes a day for 5 days At Home: 20 minutes a day for 4 days
Materials Needed	Pencil, Notebook, Cardboard pieces, Thread or jute string, Old cloth or tissue scraps, Round rolling objects, Balloon, Needle or sharp stick, Plastic bottle or bamboo tube, Water, Tape or gum, Magnet, Small pieces of paper, Plastic scale or plastic straw, Piece of polythene or plastic bag
Learning Outcomes	By the end of this project, learners will be able to: Knowledge-based Outcomes: ● Classify and differentiate between contact and non-contact forces with examples. ● Demonstrate the effects of force on objects through hands-on activities. ● Identify and compare types of friction (static, sliding, rolling) and explain their role. ● Describe ways to increase and decrease friction with real-life examples. ● Explain the relationship between pressure and force using examples from daily life. ● Construct a simple manometer and use it to demonstrate pressure in liquids. ● Describe the importance of atmospheric pressure. ● Build a compound machine using at least three types of simple machines. 21st Century Skill Outcomes: ● Design and build a functional machine using locally available materials. ● Collaborate in groups to plan, build, and revise the machine. ● Present the machine's purpose and working to an audience. ● Analyse force, friction, and pressure acting in their machine.
Suggestions for Teachers	1. Review each day's plan and materials the evening before class. 2. Inform learners one day in advance about any materials they need to bring from home. 3. Divide learners into mixed, inclusive groups of 5 (gender and ability balanced) before Day 1. Assign roles: Leader, Recorder, Materials Manager, Reporter, Observer. 4. Scan QR codes or links given in the plan before class (if applicable). 5. Ask curiosity-building questions and encourage learners to think independently before giving explanations..

Day 1 Learners will activate prior knowledge about machines from Nagaland daily life, classify simple and compound machines, explore what force means through hands-on activity, and are introduced to the leading question and the final product.

Materials	Pencil, cardboard pieces, thread or jute string, old cloth, round rolling object (stone, bottle, pen), tape or gum, notebook
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Time	Activity and Description												
10 minutes	<u>Introduction to the Project and Leading Question (Whole Class)</u> Teacher says: <i>Think about the tools in your home. Does your mother use a dao to cut vegetables? Have you seen a hand pump in your village? Have you ridden a bicycle on a hilly road near your home? All of these use machines. Today, we begin a project to find out: can YOU build a machine that solves a real problem?</i> Write the leading question on the board: <i>Can you build a machine that solves a real problem?</i> Teacher says: <i>Over 5 days, you will investigate this question. On Day 5, each group will present a compound machine they have built. Today, we begin by understanding what machines and forces are.</i> Write the product criteria on the board and keep them there for all 5 days: ● A working compound machine that includes at least 3 types of simple machines. ● The machine must have at least 10 parts. ● The machine must solve one clear problem. ● A group presentation explaining the machine's purpose, forces acting in it, types of friction, and where pressure is applied. Note: Divide learners into groups of 5 before this class. Assign group roles: Leader, Recorder, Materials Manager, Reporter, and Observer. These roles rotate on Day 3. Note: Teachers revisit these criteria explicitly on Day 3 and day 5(before presentation)												
10 minutes	<u>Simple and Compound Machines (Whole Class + Group Observation)</u> Teacher says: <i>A machine is a device that makes work easier. Simple machines have very few moving parts. Compound machines are made of two or more simple machines joined together.</i> Write on the board and explain each with a Nagaland example: ● Lever: A dao handle is a lever. A bamboo see-saw at Hornbill Festival. Force changes direction at the fulcrum. ● Pulley: A rope-and-log system used to carry loads up hilly terrain. ● Wheel and Axle: Bicycle wheels on Nagaland's hilly roads. ● Inclined Plane: A sloped path to push goods uphill is easier than lifting straight up. ● Wedge: The blade of a dao. Used to split wood or bamboo. ● Screw: Screws used in wooden furniture or construction. Teacher says: <i>Compound machines combine these. A bicycle uses wheels, levers (handlebars), and screws. A scissors uses a lever and two wedges.</i> Groups observe the classroom and school compound. Each group finds and records 2 simple machines and 2 compound machines in this table in their notebook: <table><tr><th>Object</th><th>Number of Parts</th><th>Type of Machine</th></tr><tr><td>Dao / knife</td><td>2 (blade + handle)</td><td>Simple (wedge + lever)</td></tr><tr><td>Door handle</td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></table> Teacher asks: How does each machine make work easier? Which ones use force to change direction?	Object	Number of Parts	Type of Machine	Dao / knife	2 (blade + handle)	Simple (wedge + lever)	Door handle					
Object	Number of Parts	Type of Machine											
Dao / knife	2 (blade + handle)	Simple (wedge + lever)											
Door handle													
20 minutes	<u>What Is Force? Making a Wheel (Group Activity)</u>												

	Teacher says: <i>Now, let us explore what force is by making something. Take two round pieces of cardboard and one pencil. In your groups, what do you think we can make with these? Try it for 5 minutes.</i> Groups work to assemble the cardboard wheel on the pencil axle. After 5 minutes, teacher guides discussion: • Is the wheel moving on its own? (No. It is stationary.) • What will you do to move it? (Push or pull it. Tie thread around the pencil and pull.) • Can anything move completely by itself without any force? (No, a force is always needed.) Teacher says: <i>When we push or pull an object to change its state of motion, that is called force. When force acts by touching two objects, it is called contact force. Muscular force (your muscles pushing the wheel) is a type of contact force. We will learn about other types soon.</i> Groups then use their wheel to build a mini compound machine that drops a small stone or paper ball into a target (e.g., a drawn circle or a box). Instructions: • Stack 2-3 books to create a height. • Tape a piece of cardboard at the edge as a slope (inclined plane). • Place the object you want to drop at the top of the slope. • Roll the cardboard wheel down the slope so it nudges the object into the target. • This is a chain-reaction compound machine: you apply one force that triggers the next action. Teacher says: <i>Think about our leading question: Can you build a machine that solves a real problem? This mini machine is your first attempt. Over the next 3 days, you will build something bigger and better.</i> What problem did your mini machine solve today? Write one sentence in your notebook. Note: Teacher asks the groups to state one thing they now know about force before moving further.
Homework	Make a list of simple and compound machines used around your home or village. Write at least 5 examples. For each, write: what type of machine it is, and what problem it solves. Bring materials from home for your group's compound machine on Day 2 (coordinate with your group's Materials Manager).

Day 2 -Learners will investigate friction through a rolling experiment, design their compound machine in groups, and identify types of forces and friction acting within their design.

Materials	Notebook, pencil, cardboard , round rolling object, sketch pen or colour pencil
Time	Activity and Description
5 minutes	<u>Recap of Day 1 (Whole Class)</u> Teacher says: <i>Yesterday you built a mini compound machine. Who wants to share: what problem did your machine solve? And what type of force did you use to start it?</i> Take 3 quick responses. Then ask: "What machines did you notice at home for your homework?" We asked: Can you build a machine that solves a real problem? Today, we will learn about friction, which will help you design a better machine.
15 minutes	<u>Friction Experiment (Group Activity)</u> Teacher says: <i>Have you noticed that a bicycle slows down on a muddy path near Kohima more than on a flat cemented road? Or that your rubber sandals grip the floor better when dry than when wet? This is because of friction.</i>

	Each group takes two pieces of cardboard of the same length. One has a smooth surface (e.g., plain cardboard). The other has a rough surface (e.g., cardboard with cloth or rough paper stuck on it). Lean both pieces against a wall to make two slopes of the same angle. Groups do the following and record results: ● Release the rolling object from the top of the smooth surface. Observe how far it travels after reaching the bottom. ● Release the same object from the top of the rough surface. Observe how far it travels. Teacher says: <i>On which surface did the object travel farther? Why? The surface that creates more resistance to motion produces more friction.</i> Discuss as a class: ● Static friction: The force needed to start moving an object at rest. This is why a heavy log is hard to push initially. ● Sliding friction: Friction when one surface slides over another. A dao sliding across a stone. ● Rolling friction: Friction when an object rolls. A bicycle wheel on a dirt road. This is the smallest type of friction. Note: Friction always acts opposite to the direction of motion. If you push an object to the right, friction pulls it to the left. Before an object starts moving, static friction acts to prevent motion. Once motion begins, kinetic friction (sliding or rolling) takes over.												
20 minutes	Designing the Compound Machine (Group Work) Teacher says: <i>Now you will design your own compound machine. Look at the product criteria on the board. Your machine must include at least 3 types of simple machines, have at least 10 parts, and solve one real problem.</i> Machine problem ideas connected to Nagaland daily life (groups choose one or think of their own): ● A machine to drop seeds into a planting hole (paddy farming context). ● A machine to ring a bell when someone enters the room. ● A machine to tip a cup of water to fill a smaller cup. ● A machine to pick up a stone and drop it into a basket. Groups discuss and draw a picture of their machine in their notebooks. They must label: ● Each simple machine component and which type it is. ● Where contact force is applied. ● Where muscular force is used. ● Where friction (type) is present. ● If any non-contact force is involved. After 5 minutes, teacher asks each group: ● What problem does your machine solve? ● What materials will you need? Note: If drawing is difficult for some learners, they can describe the machine verbally to their Recorder, who writes down the steps. Each group divides responsibility: Materials Manager lists all objects needed and assigns each member to bring one item from home.												
Homework	Based on your machine design, complete this table in your notebook for at least 3 events in your machine: <table><tr><th>Event in Machine</th><th>Force Type</th><th>Force (High/Low)</th><th>Friction Type</th></tr><tr><td>Ball rolls down slope</td><td>Contact force</td><td>Low</td><td>Rolling friction</td></tr><tr><td></td><td></td><td></td><td></td></tr></table>	Event in Machine	Force Type	Force (High/Low)	Friction Type	Ball rolls down slope	Contact force	Low	Rolling friction				
Event in Machine	Force Type	Force (High/Low)	Friction Type										
Ball rolls down slope	Contact force	Low	Rolling friction										

Bring all materials needed for your machine to Day 3.			

Day 3 - Learners will assemble their compound machines using locally gathered materials, present the working machine to peers, give and receive structured feedback, and begin revisions.

Materials	Tape or gum, cardboard scraps, thread, notebook, pencil. Optional: toy car, bottle caps, bamboo sticks, pebbles, stones																	
Time	Activity and Description																	
5 minutes	Recap of Day 2 (Whole Class) Teacher says: <i>Yesterday you designed your machine and learned about friction. Today is building day. Before we start, rotate your group roles: the Leader becomes Recorder, Recorder becomes Materials Manager, and so on.</i> Ask 2 groups quickly: What problem does your machine solve? What simple machines does it include? Revisit Main Question: <i>Today you will try to actually build the machine from your design. Let us see if your design works as planned, or if you need to adjust it.</i>																	
15 minutes	Assembling the Machine (Group Work) Groups take out all materials and list them in this table in their notebooks: <table><tr><th>Object</th><th>Type of Simple Machine</th><th>Role in the Machine</th></tr><tr><td>Cardboard slope</td><td>Inclined plane</td><td>Rolls the ball forward</td></tr><tr><td>Pencil + cardboard disc</td><td>Wheel and axle</td><td>Carries motion to next step</td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></table> Groups work together to build the machine step by step. Each member assembles at least one part. Note: Teacher moves from group to group. If a group is stuck, ask: What is the first step in your machine? What needs to move first? Guide, do not build it for them.			Object	Type of Simple Machine	Role in the Machine	Cardboard slope	Inclined plane	Rolls the ball forward	Pencil + cardboard disc	Wheel and axle	Carries motion to next step						
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Cardboard slope	Inclined plane	Rolls the ball forward																
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15 minutes	<u>Group Presentations and Peer Feedback (Whole Class)</u> Each group demonstrates their machine to the class (1-2 minutes per group). They show: • What problem the machine is supposed to solve. • How to start the machine (the first force applied). • What happens step by step. After each demonstration, the watching groups write feedback on a spare page in their notebooks: • Did the machine work as described? (Yes / No / Partly) • Was the purpose of the machine clear? (Yes / No) • Which part of the machine was the most creative or clever? • One specific suggestion to make the machine work better or more clearly. After all groups present, return feedback to each group. Note: Feedback must focus on the design quality and clarity of the machine, not just on whether it worked the first time. Remind learners: first designs rarely work perfectly. That is the point of testing. Refer appendix-1 for the feedback																	

5 minutes	<u>Non-Contact Force Introduction (Whole Class)</u> Teacher says: <i>Your machine uses contact forces to move. But some forces act even without touching. If I drop this stone, it falls without me pushing it down. What force is that? (Gravity.) If I hold a magnet near a pin without touching it, the pin moves. What force is that? (Magnetic force.) Tomorrow we will explore these non-contact forces and add one to your machine.</i>
Homework	Read the feedback your group received. Write one change you will make to your machine and why. Reflection Prompt: "Write: What is one thing you would change or improve in your machine design? What was the hardest part of building today?"

Day 4 -

Learners will investigate non-contact forces through magnet and static electricity experiments, explore pressure through a manometer activity, and finalise their revised compound machine for the Day 5 presentation.

Materials	Magnet, wooden stick, two ring magnets if available (otherwise use one bar magnet and metal pin), plastic scale or straw, polythene piece, small paper pieces, water bottle, plastic tube or bamboo pipe, balloon, needle (adult supervision), tape, revised machine materials
Time	Activity and Description
5 minutes	<u>Recap of Day 3 (Whole Class)</u> Teacher says: <i>Yesterday you built and tested your machine and got peer feedback. Today you will improve it and add a non-contact force to it. But first, let us investigate what non-contact forces are.</i> Ask: Has anyone seen a magnet being used in Nagaland for fixing something? What about static electricity from dry hair on a comb in winter? Take 2-3 quick responses.
20 minutes	<u>Non-Contact Force Experiments (Group Work, then Whole Class Share-out)</u> Divide the class into two groups. Each group writes a hypothesis before doing the experiment, then records observations. Group 1: Magnet Experiment ● Stand a wooden stick vertically on the table (or hold it upright). ● Place one ring magnet on the stick resting on the table. ● Place the second ring magnet on the stick above the first, with LIKE poles facing each other. ● Observe: does the upper magnet float without touching the lower one? ● Try rotating the upper magnet so OPPOSITE poles face each other. What happens now? Write observation: Which arrangement shows repulsion? Which shows attraction? Group 2: Static Electricity Experiment ● Tear 10-12 tiny pieces of paper and place them on the table. ● Rub the plastic scale or straw well with the polythene piece for 20 seconds. ● Bring the rubbed part near the paper pieces WITHOUT touching them. ● Observe what happens. Write observation: Did the paper pieces move? In which direction? Teacher says: <i>These forces acted without any physical contact. The force applied by a magnet from a distance is magnetic force. When rubbing creates static charges on an object, that object attracts uncharged objects. Both are non-contact forces.</i> Sustained Inquiry: Each group presents its experiment findings to the class.
10 minutes	<u>Pressure: Manometer Activity (Group Work)</u>

	Teacher says: <i>Have you used a hand pump in your village? When you press the handle, water rises. That is because of pressure. Pressure is the force applied on a surface per unit area. More force or less area means more pressure.</i> Simple manometer demonstration: ● Fill a plastic bottle halfway with water. ● Fit a plastic tube or bamboo pipe through a hole in the cap. Seal around the tube with tape so it is airtight. ● Squeeze the bottle gently. Observe what happens to the water in the tube. ● Press harder. What happens? Teacher says: <i>The water rises in the tube when you press. This shows that pressure in a liquid increases when force increases. The tube is acting as a simple manometer. Atmospheric pressure works the same way: the air around us has weight and pushes on all surfaces.</i> Groups record: What happened when you pressed the bottle gently? When you pressed hard? What does this show about pressure?
5 minutes	<u>Final Revisions to Machine (Group Work)</u> Teacher says: <i>Use the feedback from Day 3 and what you have learned about non-contact forces and pressure. Add or improve at least one part of your machine. You can include a magnet or a static-electricity effect as a new step in your chain.</i> Groups revise the machine design and test it once. Recorder notes what changed and why. Groups decide which non-contact force to include and how. They also decide the order of presentation on Day 5.
Homework	Practise your group presentation. Each member must know: the machine's purpose, the forces acting in it, the types of friction, and where pressure is applied. Invite a guest (a parent, a teacher from another class, or a senior learner) to attend your presentation tomorrow if possible.

Day 5 -Learners will present their compound machines to an audience, explain the science behind them, and reflect individually on their learning across the project.

Materials	Completed compound machines, notebooks, pencil, any props needed for the presentation
Time	Activity and Description
5 minutes	<u>Set-Up and Reminders (Whole Class)</u> Teacher says: <i>Today you will present the machine you designed and built over 4 days. This is your answer to the leading question: Can you build a machine that solves a real problem? Let us find out!</i> Assign presentation order (each group 5-6 minutes). Remind learners what each presentation must include: ● Name of the group and each member's role. ● What problem the machine solves. ● How the machine works, step by step. ● Which simple machines are included. ● How force is applied at each step (type and magnitude: high or low). ● Where friction acts and what type. ● Where pressure acts in the machine. Note: If guests (parents, teachers, senior learners) are present, welcome them. If any learner is nervous, give a hint: 'What is the name of your machine? How do you start it?'
25 minutes	<u>Machine Presentations (Group Work + Whole Class)</u>

	Groups present one by one. The audience (classmates, teacher, guests) watches and listens. After each presentation, the audience asks one question from this list: • What problem does this machine solve? • Which part of the machine uses the most force? • Where is friction most useful in this machine? • Could this machine be used in daily life in our village? Teacher says: <i>Every group has built something real. Even if the machine did not work perfectly, you learned from the process. That is exactly what engineers and scientists do.</i> Leading Question Moment Teacher says: <i>Before we reflect, let us revisit our leading question. Can you build a machine that solves a real problem? What is your answer now? Raise your hand if you feel you can.</i> Collect the responses and teacher asks What changed in your thinking from Day 1 to today?
10 minutes	<u>Reflection (Individual Work)</u> Learners write answers to the following 5 questions individually in their notebooks: • What is the purpose of the machine your group built? Does it solve the problem it was designed for? • Name 2 types of force that act in your machine and explain where each acts. • What is one thing you would change or improve in your machine if you had more time? • What was the most difficult part of this project? How did your group handle it? • How would you now answer the leading question: Can you build a machine that solves a real problem? Note: Collect reflection notebooks. Use learner responses to inform your teaching of the chapter. Take a photo of the machines and the class for the project completion form.

ASSESSMENT CRITERIA

A majority of my learners were able to:

- ☐ Classify at least 3 types of simple machines and give a local Nagaland example for each.
- ☐ Differentiate between contact and non-contact force with one example of each.
- ☐ Identify at least 2 types of friction in their machine and explain where each acts.
- ☐ Build a compound machine with at least 3 simple machine components using locally available materials.
- ☐ Present the purpose and working of their machine to peers in a structured group presentation.

PUBLIC PRODUCT CRITERIA

Product	A working compound machine presented to the class and invited guests
Audience	Classmates, teacher, and optionally parents, other teachers, or senior learners
Criteria	• The machine includes at least 3 types of simple machines. • The machine has at least 10 identifiable parts. • The machine solves one clearly stated problem. • The presentation correctly names at least 2 types of force and 1 type of friction acting in the machine. • Every group member participates in the presentation in some way. • The machine is built using low-cost, locally available materials.

ADDITIONAL ENRICHMENT ACTIVITIES

- **Nagaland Machine Audit:** Learners walk around the school or their village and identify 10 machines. For each, they classify all simple machine components it contains, identify the forces at work, and note where friction is useful or a problem. They present findings as a short report.
- **Improve the Machine:** Groups that finish early redesign one component of their machine to reduce friction or increase the force output. They explain the change and why it works better.
- **Pressure Investigation:** Learners make a simple pressure demonstration using two sharp pencils. They press one finger on one pencil tip (high pressure) and the same force spread across a flat palm (low pressure). They write: same force, different pressure. Where do you feel more pain? Why? Connect this to why dao blades are sharp but handles are wide.

MODIFICATIONS FOR SIMPLIFICATION

- **Short on time (Day 3 and 4 can be merged):** Skip the manometer activity and replace it with a discussion of pressure examples (dao blade, wide handle). Machine assembly and peer feedback are combined into one 40-minute session. Core learning outcomes on forces and machine design are retained.
- **Limited materials:** If magnets are not available, skip the magnet experiment. Replace it with the static electricity experiment only, which uses a plastic scale and polythene, both freely available. If no cardboard is available, use stiff dried banana leaves or folded newspaper as structural materials.
- **Mixed ability (lower-level learners):** Learners who struggle with identifying forces in the machine are given a simpler task: draw the machine and put an arrow showing where you push or pull. Stronger learners label the force type. All learners contribute at least one part to the physical build.

APPENDIX

Appendix 1: Peer Feedback Form for Machine Presentation

Reviewer Group: _____ Machine Reviewed: _____

Question	Your Response
1. Was the purpose of the machine clearly explained?	Yes / No / Somewhat
2. Did the machine include at least 3 types of simple machines?	Yes / No (write which ones you saw)
3. Was at least one type of friction mentioned and explained?	Yes / No
4. Was the machine well-organised and easy to follow?	Yes / Partly / No
5. One specific suggestion to improve the machine or the presentation:	

Appendix 2: Experiment Hypothesis and Observation Template (Day 4)

Hypothesis	What I think will happen: _____
Required Materials	
Procedure	
Observation	What I actually saw: _____
Conclusion	

CHAPTER-PROJECT MAPPING

Corresponding Chapter: Lesson 5 - Know about Forces (Class 8 Science, Nagaland SCERT)

Chapter Topic	Chapter Sub-Topic	Coverage	Day
Types of Forces	Contact and non-contact forces with examples	Yes	Day 1, 4
Effects of Force	Push, pull, change in direction or shape	Yes	Day 1, 2
Friction	Types: static, sliding, rolling; factors affecting friction	Yes	Day 2, 3
Increasing and Decreasing Friction	Importance and real-life applications	Yes	Day 2, 4
Simple and Compound Machines	Six types of simple machines; compound machines	Yes	Day 1, 2, 3, 5
Non-Contact Forces	Magnetic force, static electric force, gravitational force	Yes	Day 3, 4
Pressure	Pressure = Force / Area; pressure in liquids and gases; manometer	Yes	Day 4
Atmospheric Pressure	Importance and effects	Partial	Day 4
Pressure Gauge (Manometer) Calculations	Numerical problems using $P = F/A$	No	Not covered