PREFACE

"Study the science of art. Study the art of science."

Leonardo Da Vinci

STEAM is an educational discipline that aims to spark an interest and lifelong love of the arts and sciences in children from an early age. Science, Technology, Engineering, the Arts and Math are similar fields of study in that they all involve creative processes and none uses just one method for inquiry and investigation. Teaching relevant, in-demand skills that will prepare students to become innovators in an ever-evolving world is paramount, not only for the future of the students themselves but for the future of the world.

STEAM empowers teachers to employ project-based learning that crosses each of the five disciplines and fosters an inclusive learning environment in which all students are able to engage and contribute. As opposed to traditional models of teaching, educators using the STEAM framework bring the disciplines together, leveraging the synergy between the modeling process and math and science content, for example, in order to blur the boundaries between modeling techniques and scientific/mathematical thinking. Through this holistic approach, students are able to exercise both sides of their brain at once.

An important part of this educational approach is that students who are taught under a STEAM framework are not just taught the subject matter but they are taught how to learn, how to ask questions, how to experiment and how to create.

The goal of this guide is to provide instructional tools in line with the National Curriculum of Pakistan, and it will be useful for teachers of students in all grades. It presents a teaching approach that encourages the active participation and involvement of students in the learning process, with an appropriate balance between thinking and hands-on activities. Sometimes students will be engaged in discussion, and if teachers use questioning effectively, it can improve their students' thinking and communication skills.

To make the guide user-friendly, simple step by step instructions are provided.

A total number of periods is also suggested for each unit, but the amount of time needed to complete each unit or activity may vary according to its degree of difficulty and the abilities and skills of the students. Teachers can adjust the times to suit their particular needs and context. Advanced preparation and clear instructions by teachers will help to minimize classroom management problems.

All materials suggested for the activities should be easily available at low/no cost: alternative materials can be substituted if necessary.

HOW TO USE THIS GUIDE

Following the simple guidelines can help you get most out of these lesson plans. However, as all teachers know, in order to deliver the best lessons, you should be thoroughly familiar with the subject matter before you plan your lessons.

1. Always read the lesson plans thoroughly before the class to maximize confidence and command over your teaching. It will also enable you to modify in advance the plans to suit the needs of your particular students.
2. Collect and test all the materials listed in the plan before the lesson in order to obtain the required results. This will also minimize classroom management problems.
3. Instead of giving your input directly, introduce the key vocabulary using the glossary or dictionary. Involve the students in exploring the meanings of the key vocabulary using the glossary and if any meaning is not there, ask them to look up the meanings in a dictionary. You can also prepare flash cards for the new terms and display them on the walls. Before starting your lesson, ask the students to read these words aloud and share their meanings. This will help your students improve the pronunciation of the new scientific terms and their fluency in using these terms in discussion of the topics.
4. Before any activity, give clear instructions about what, how, and why they are going to do it.
5. Each additional worksheet has been coded according to the following criteria.

STE.	7.	1.	4
Subject	Grade	Term	Numb

6. The concept of STEAM education is new for everyone. If a child takes longer time than you had anticipated, adjust accordingly. Always be appreciative of the work done in class.

We hope that this guide will prove useful in making the learning and teaching something to be looked forward to and enjoyed by teachers and students alike.

IQRA ZAHID

DEPARTMENT OF ACADEMICS

THE NEXT SCHOOL

THE NEXT SCHOOL

DAILY LESSON PLAN

Class: 7 Term 2 Lesson 1 and 2

Project: Students are introduced to the pulley using a demonstration: **Build a Cabin Car**	Duration 80 min

Learning Objectives: At the end of the lesson, students will be able to

- Learn how a pulley can be used to change the direction of applied forces and move/lift extremely heavy objects.
- Explore different mechanisms of using single and multiple pulleys at the same time.

Teaching Objectives: Teacher will

- Demonstrate how pulleys are used.
- Explain how pulleys could have been used by engineers in ancient times to do work.
- Identify modern applications in which engineers use pulleys.

Skills involved:

Systems thinking ❏ Problem-finding ❏ Visualizing ❏ Improving ❏ Creative problem-solving ❏ Adapting

Resources required:

Powered and simple machine kit

Instructions:

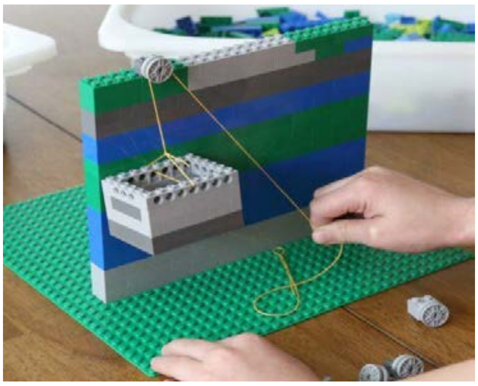
Warm up: Instruct a student to lift a milk jug filled with water using only his or her hand. Next, have two additional students hold a broom handle at shoulder level between them. Now, tie a thin rope to the handle of the jug and let it rest on the floor. Instruct the student who earlier lifted the jug to pull the rope over the broomstick and pull down on the end of the rope to lift the jug.

Ask the student to describe the difference between the two experiences.

Now, untie the rope from the jug and tie one end of the rope to the broomstick. Have the two students continue to hold the broomstick at shoulder level while the other volunteer slips the free end of the rope through the handle of the jug and then back over the broomstick. Have the same student pull the end of the rope to lift the jug.

Ask the student to describe the differences in the three experiences.

Activity: Build a cable car by using a pulley system!



Step 1: Build a LEGO basket to hold your load, have two holes in the top for attaching the string, and it's best if the holes are centered.

Step 2: Then find some wheels (with the tires removed) to use as pulleys. You will need bricks with axles to attach them to. Some of ours are also attached to a connector pin and a 1 x 2 Technic brick (with a hole).

Step 3: Attach the string, and fill up your basket with pennies.

Step 4: First lifting the basket of pennies to see how heavy it felt. It was heavy!

Step 5: Challenge the students to use different pulleys at a time to see how it works?

Evaluation/Reflection:

____________________ ____________________

Signature of the teacher Signature of the Head/Coordinator

THE NEXT SCHOOL

DAILY LESSON PLAN

Class: 7 **Term 2** **Lesson 3 and 4**

Project: Different arrangements of gears and wheels: **Power Car**	Duration
	40 min

Learning Objectives: At the end of the lesson, students will be able to

- Explore the concept of scientific investigation
- Explore the mechanism of gears, gearing up and gearing down.

Teaching Objectives: Teacher will

- Help them in measuring the angles of slope
- Tell them how to measure the distance and circumference

Skills involved:

Systems thinking ❑ Problem-finding ❑ Visualizing ❑ Improving ❑ Creative problem-solving ❑ Adapting

Resources required:

Powered & simple machine kit

Instructions:

Warm up: Ask a student, did you observe or investigate the speed and pulling power of a powered car as the car is moving up on a hill?

Take different observations from the students and ask them to build a powered car that climbs up a hill and ask them to investigate the speed and write it down on a paper.

Activity: Build a power car that climbs a hill!

Build Your Test Hill

Mark a start and finish line on the plank, 2 m (≈ 2 yds) apart. Place the plank on an object so the finish line is 20 in (≈ 50 cm) higher than the floor.

Tip

The power car can travel very fast, even up hills, so it might be a good idea to put the ramp against the wall in a corner to prevent it going over the edge.

Contemplate

Which is the fastest uphill power car?

The power car needs to be as fast as possible when driving uphill.

First predict how fast power car A will travel 2m (≈ 2 yd) uphill.

Then test your prediction. Next, follow the same procedure for power cars B, C and D.

Test several times to make sure your results are consistent.

Test results may vary depending on the surface of the hill.

Tip

Use the weight element as a counterbalance.

Try different combinations of wheels and gearing to achieve the best pulling power.

How heavy a load can your best power car pull?

Evaluation/Reflection:

____________________________ ____________________________

Signature of the teacher Signature of the Head/Coordinator

THE NEXT SCHOOL

DAILY LESSON PLAN

Class: 7 **Term 2** **Lesson 5 and 6**

Project: Explore the scientific concepts of levers, cams, inclined plane, mechanical programming, data recording, friction, force and momentum: **The Hammer**	Duration 80 min

Learning Objectives: At the end of the lesson, students will be able to

- Learn about the mechanisms of using the lever, Cam and inclined plane
- Explore how mechanism works into action

Teaching Objectives: Teacher will

- Help them in scientific investigation force, momentum, and friction.
- Enable the students to acquire the knowledge about the topic

Skills involved:

Systems thinking ❑ Problem-finding ❑ Visualizing ❑ Improving ❑ Creative problem-solving ❑ Adapting

Resources required:

Powered simple machine kit

Instructions:

Warm up: Imagine you are trying to build a little shed for the Dog, but the wood that you are using is very hard and you need to use a lot of nails to make it hold after many attempts to be exhausted and try to think of simpler ways to hammer the nails into the wood.

Say: Now think and work better than this, make them think in a group and ask them to try to solve the problem.

Now tell them we can help you to test a solution that will work and make the hammering much easier for you?

Activity: How can you make a hammer machine that will efficiently hammer nails into different surfaces?

Let's find out!

Construct: Build the Hammer

Testing

Turn the handle of the hammer by hand. Does it rise and fall smoothly?

If it feels stiff to turn, check that the axle bushings are not rubbing on the bricks and creating too much friction.

Did you know?

The LEGO research labs make sure every element has exactly the right amount of grip for the job it does and for safe handling by children. We call it 'clutch power' and it is measured very carefully!

Contemplate

Can you measure grip forces by hand?

Push the axle into each gear in turn – and pull it all the way through. Can you arrange them in order from most grip (most friction) to least grip?

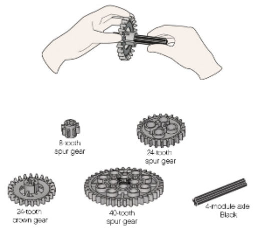
How can we measure the clutch power more accurately?

Use the same size axle to test each gear.

Turn the handle to hammer the axle down.

Count how many hits until the axle touches the tabletop for each gear.

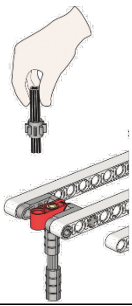
In our tests, the 8-tooth gear has the least amount of friction. It is so small it is hard for fingers to grip. The crown gear is next. Even though it is big enough to grip, it also has pointy teeth. The 24- and 40-tooth spur gears have the most friction as they have blunt teeth, are easy to grip, and transmit the most power in a model.



Is the hammer a better test of axle friction than testing by feel?
If you hammer each gear several times, you will find very similar results each time. This hammer is a real scientific instrument and much better than guessing. The LEGO® labs have huge machines that do the same job, but much more accurately.

What else can the cam do?
On page 14, step 18, the modification makes it so that the hammer hits twice for each turn of the handle. Also change the axle position through the cam to make different actions and timings. Try making a slow rise and a fast drop, or a fast rise and a slow drop.

Optional: Using a heavier hammer
It will drive the axles through more quickly. You need to put in more energy to lift the hammer, but it drops with more force. It has more momentum. The smooth cam edge is an inclined plane, which makes it easier to lift heavier weights.



Evaluation/Reflection:

_____________________________ ___________________________________

Signature of the teacher Signature of the Head/Coordinator

THE NEXT SCHOOL

DAILY LESSON PLAN

Class: 7 Term 2 Lesson 7 and 8

Project: Explore sail shape, area and angle to the wind needed for a wind powered vehicle to effectively capture wind energy: **Land yatch**	Duration 80 min

Learning Objectives: At the end of the lesson, students will be able to

- Explore different concepts of scientific investigation like air resistance, area, gears, force and friction.
- Do teamwork encourages joint focus, sharing, reinforces positive behavior and social contact.

Teaching Objectives: Teacher will

- Help students in measuring formal and informal measuring of time and distance.
- Check the degree to which the students are meeting the learning objectives.

Skills involved:

Systems thinking ❑ Problem-finding ❑ Visualizing ❑ Improving ❑ Creative problem-solving ❑ Adapting

Resources required:

Powered and simple machine kit

Instructions:

Warm up: Ask the students to imagine It is a windy weekend at the beach and you are out to have a bit of fun and you have the old cart which you normally use, but today the weather is really windy, which makes it very hard work for the cart. Imagine after many attempts you give up in the end and understand why it is so. Now you are trying different options to help and suddenly you see an old towel half buried in the sand. How is this going to be helpful for us? (Take different ideas from students)

Say: Now at this time how we use the towel, the wind power, and a few other things, it may be possible to make a kind of land yacht that will safely take them all for a fun ride.

So, day we are going to build a safe cart powered by wind.

Activity: How can you make a safe cart that is powered by the wind ... and carries at least one person? Let's find out!

Build the Land Yacht

Build it with the small sail first.

Contemplate

What difference does sail size make?

Predict and test: what difference could there be between the 40 cm2 (≈ 15 in2) (small), 80 cm2 (≈ 31.5 in2) (medium), and 160 cm2 (≈ 63 in2) (large) sails on the yacht. How far will each roll ... and (optional) how fast?

Test at least three times with each sail attached to obtain a scientifically valid answer.

In our tests, the small sail rolled about 1.5 m, the medium about 2 m and the large about 2.5 m. Double the area gathers more wind energy but does not double the distance.

Why? The further from the fan, the weaker the wind! Larger sails moved faster at first. But all the sail sizes stopped rolling after about 10 seconds. None of them sail faster than the wind!

Tip

Choose ONE speed setting to do all the tests. Any speed will do. We used high speed.

Note

Your 'serious' scientists might also suggest testing the land yacht with just the bare mast, i.e., with no sail at all, so you might wish to try that as well.

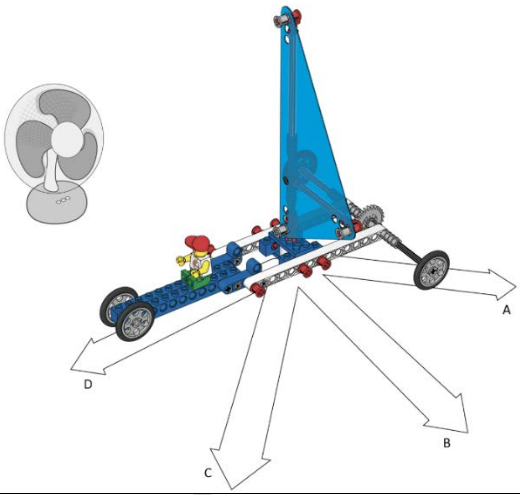
What if the wind is blowing from an angle?
Launch your land yacht at different angles across the wind stream. Can you explain what happens?
At most angles except D the yacht still moves forward! One part of the wind's force is deflected off the sail, propelling it forward.
The other part of the force tries to blow it sideways. In fact, a land yacht sailing across the wind at angles B and C can go very fast – but could also flip over.

Did you know?

The LEGO figure weighs 3 g (≈ 0.1 oz).
The yacht weighs about 55 g (≈ 1.94 oz).
The weight of the brick is 53 g (≈ 1.9 oz).
Predict and test how the yacht would perform with a weight brick load.

Does sail shape matter?

Try making card or paper sails with the same area but a different shape. Find out about Square Riggers, Kon-Tiki, Chinese Junks, and Arab Dhows from books or by searching the internet.



Evaluation/Reflection:

______________________________ ______________________________

Signature of the teacher Signature of the Head/Coordinator

Week 25 & 26

Project: What float your boat by using engineering design models: Making a Simple DIY Motor Boat	**Duration** 40 min

Learning Objectives: At the end of the lesson, students will be able to

- Incorporate the scientific principles of force and motion with engineering design and mathematics
- Design a watercraft that will support a given amount of weigh

Teaching Objectives: Teacher will

- Define a buoyant object as one whose density is less than that of water.
- Describe how water pressure acts in opposition to gravity in order to make buoyant objects float.

Skills involved:

Thinking skills · Problem Solving · Communication · Self-management

Resources required:

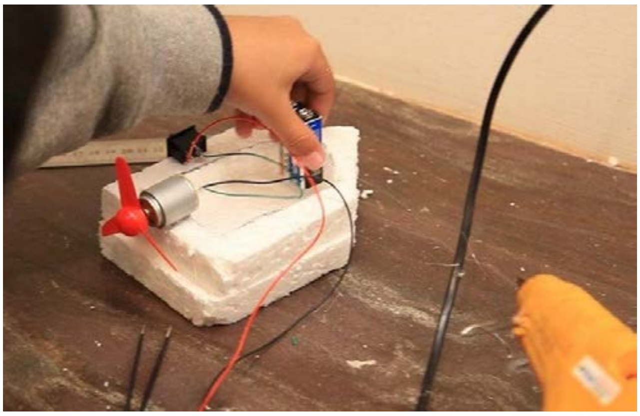
Small DC Motor, Battery Connector, Electric Wire, Propeller,9v Battery, On / Off Switch, Styrofoam Pieces
https://www.youtube.com/watch?v=30_hWot2unA&ab_channel=A2CArtsAndCrafts

Instructions:

Warm up: Use the first of the associated activities, Clay Boats, to get students involved and interested in the subject. This activity provides students with an opportunity to use model-building as a way to help understand the forces and phenomena at work in the world around them. Allow students to make inferences, refine hypotheses, and draw conclusions about the behavior of materials and structures.
After students have completed the Clay Boats activity and discussed their observations

Activity: Building a simple DIY Motor Boat!

Step 1: In three simple steps we can cut the Styrofoam pieces to make them look like a boat. The second piece of Styrofoam will also need to be cut in the same proportion.



Step 2: Use a paper cutter to make the cuts, but please make sure to do this with the students so they can use it carefully.
Step 3: The first piece needs to be cut from the center to make a border. This border will sit on the second piece. Once done, glue the two pieces together one on top of another.
Step 4: Once done make a circuit which is completed in series. This series circuit diagram shows these connections visually.
Step 5: Finally, all pieces need to be glued to the Styrofoam to make our boat ready to go in the water. Make sure to be very careful while splashing too much water.

Evaluation/Reflection:

_________________________ __________________________________

Signature of the teacher Signature of the Head/Coordinator