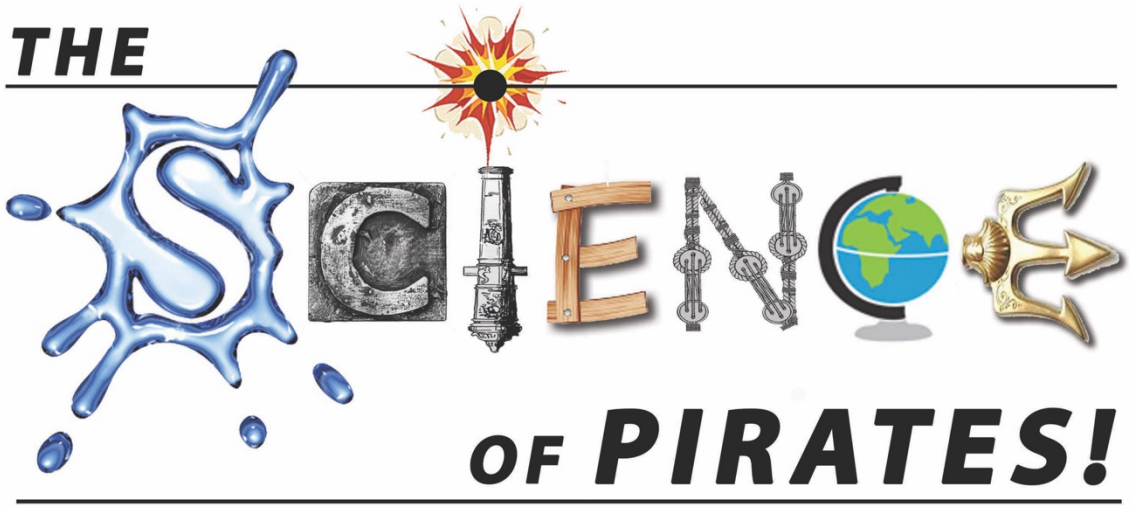
TEACHER GUIDE



Four "Learning Pods" of S.T.E.A.M curricula with a nautical twist.
Teacher Guide and Follow-Up

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David Engel's "Pirate School: The SCIENCE of Pirates!"

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Teacher Guide and Follow-Up

Welcome aboard Educators!

"Pirate School: The Science of Pirates!" is, at first glance, an entertaining comedy. We designed this series specifically as a humorous diversion but knew it was essential it be steeped in mandated S.T.E.A.M curricula. We believe these challenging times call for content presented in an innovative manner, and with your generous guidance we know creative-dramatic play may co-exist with valuable educational content *(We also hope this format helps ease your burden and puts a smile on your face too).*

We hope you will find as much value in "Pirate School: The Science of Pirates!" as we put into the making of it. Prepare to hoist your anchor and set sail!

Learning Pod #1
SCIENCE
"How did sailors move those giant ships?"

Main points: While investigating this question students will understand how wind is generated, and the following concepts: that air has weight, air rises when warmed, falls when cooled: air may be compressed and how air pressure effects and generates weather. All culminating with how a sailboat sail acts like a bird's wing generating Lift and propelling a sailboat forward.

Discuss and define the word: **Science.**

Experiments & Activities:

Investigate Air Pressure: What is air pressure? Discuss and define.
Balloon pop demonstration: Each student blows up a balloon to illustrate compressing air molecules and observe the difference in air pressure inside and outside a balloon. When balloons invariably fly across the room, this opens up the discussion of "Jet Propulsion"

Investigate the Bernoulli Effect and Lift: Observe birds, draw the wing of a bird and an airplane.
Demonstrate the Bernoulli Effect: Paper Lift.
Each student holds the short end of a piece of printer paper. Placing short edge mouth-height, students blow a stream of air over the paper. Observe what occurs. Discuss why.

Continued…

Extra Credit- Buoyancy:

Investigate Buoyancy**.**

Discuss why ships float. Discuss the words “Displacement,” “Density” and “Hollow”

Activity: Measuring cup filled with one cup of water. Drop a pebble in, observe what happens. Place a lemon or lime into measuring cup. Observe the result. How much water was displaced? Discuss why a piece of fruit floats but a pebble doesn’t.

Materials for Learning Pod #1:

One Balloon (or two if first pops!).
A measuring cup filed with 1 1/2 cups water.
A lemon or lime.
A pebble or a penny (something small that doesn’t float).
Several sheets of paper (regular printer paper will do!)

Alternate Activity: Build a Sailboat

Students build a buoyant boat that will be propelled my wind. Using two toothpicks, connect two corks in the fashion of a catamaran: Corks are pushed onto the toothpicks, so the corks and toothpicks are parallel.
Cut a small square of paper to act as a sail. Bend the sail slightly and skewer bottom with the third toothpick, proceed to skewer the top of the ‘sail’ paper. You will have a curved sail on a ‘mast.’ Push the opposite end of ‘mast’ toothpick into one of the cork ‘hulls” and place in a large shallow tub or cookie sheet of with about 1/2” of water. Student take turns blowing on boat to propel it to the other side of the body of water. Discuss why the boat floats. Why it moves.

A Note from the artist:

Dear Educators, please be aware that Learning Pod #1 is longer than the others due to additional introduction and theatrical exposition. Approximate run times:

Act 1: 28min
Act 2: 11 min
Act 3: 10min
Act 4: 12 min

Continued…

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Teacher Guide and Follow-Up Worksheets

Learning Pod #2:
TECHNOLOGY
"How does a cannon work and how does a cannon-ball find its target?"

Main point: Learners will explore the dynamics of a cannon ball, or sphere in flight, "The Magnus Effect." Students will be introduced to the concepts of Force, Momentum, and Energy. Adaptations to the Marshmallow cannon will be made to improve the accuracy of a cannon's technology.

Discuss and define the word: TECHNOLOGY.
Brief discussion of the question, sharing of theories (Kids Ideas: How does a cannon work?")
Discuss Force, the energy that pushes or pulls something.

Investigate Force
Roll a ball. Force started it in motion. Stop a rolling ball. A Force stopped that balls motion. Let a ball slow down and stop, another Force stopped that ball (Friction, Gravity).

Experiments & Activities: Observe Force and Propulsion in action
Hold and flex a flexible ruler. Discuss how energy is stored within. Placing either marshmallows or crumpled balls of paper as the 'cannon balls' allow students to transfer the energy from the ruler to the 'cannonball.' Discuss the results. Can you hit a target?

Make a marshmallow cannon and knock down paper cups.
Tie a balloon closed and cut off ¼ or the body of the balloon, leaving the tied-nib end. Open the cut end and slide over a toilet-paper roll about 1/3 of the way covered. Tape the balloon to the cardboard, allowing the tied-nib end to remain over the closed-end of the toilet-paper core. Hold the tube or "Cannon" in one hand, load with a marshmallow into the open end of the cannon. Pull the tied nib back (building Force) and release. Observe projectile. Discuss strategies to topple target of paper-cups, distance.

Materials List:
Toilet paper tube (whole) or paper towel cardboard tube (cut in half)
Large balloon (tied and top 1/4 inch cut off)
Three-four mini-marshmallows
Several paper cups, stacked as targets
A ruler, yardstick or paint stirrer

Continued…

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Teacher Guide and Follow-Up Worksheets

Learning Pod #3
ENGINEERING
"How did sailors move such heavy things like anchors, cargo and cannon?"

Main Point: Learners will investigate Simple Machines: The Pulley, The Wedge, An Inclined Plane, The Wheel & Axle, The Screw, The Lever. They will discover the power of mechanical advantage. Whether on the playground, on the bike path or on a sailing ship, Simple Machines make our lives better. Participants will identify the many engineering marvels all around them and experience their power firsthand.

Discuss and define the word: Engineering.
Brief discussion of the question: How did sailors MOVE such heavy things like anchors, cargo and cannon? Sharing of theories (Ideas)

SIMPLE MACHINE VIDEO: Here's a nice option for viewing https://youtu.be/fvOmaf2GfCY

MATERIALS LIST FOR ENTIRE SECTION:
Simple Machines:
Empty jar or water bottle with screw-on lid
Modeling clay/Playdough
A Book
Three sharp pencils
Ruler or Yard Stick

Popsicle-stick Catapult:
Eight wooden popsicle sticks
Multiple rubber bands
Plastic Spoon
Modeling clay (for projectiles)

Force:
Yard stick or Ruler (12")
Several sheets of paper, balled up as projectiles

Continued…

Pulley System:
Large box or sheet of cardboard.
Tin cans of two different sizes from the recycle bin
Yarn or rope
A bottle of water
Small bucket
Weights. Various tiles, rocks or cutlery. Modeling clay.
Hot glue/Hot Glue Gun

Experiments & Activities:
LEVER
Make a Fulcrum out of clay. Balance a ruler on the fulcrum. Lift a book with the Lever. Discuss.

WHEEL/AXEL
Make two balls of clay and fashion wheels of equal size. Push a pencil through each wheel to make a wheel and axel. Roll them down the face of a book, or across their desk. Discuss.

INCLINED PLANE
Position a book to create a ramp. Roll your wheel and axle up and down. Discuss.

WEDGE
Use a pencil to push through a block of clay. The point of the pencil is a wedge and easily splits the clay. Discuss.

SCREW
Open and close a cap to a water bottle or jar. Observe the power of the Screw. Discuss.

THE PULLEY
The pulley allows an object to be lifted with less force. Every extra pulley added shares the load, again decreasing the amount of force needed. Of course, all this decrease in force comes at a cost. Each pulley also increases the distance over which the force will need to be applied. Make your own pulley system.

Make a Pulley System

Students will discover the difference between a simple (Single) pulley and multiple pulleys (Block and Tackle). By affixing cans to a backing, the cans will serve as the pulleys. If you are working with older students, allow them to set up their own pulley experiment by gluing the cans in what they think may be optimal positions.
If you are working with younger students. Glue the small cans in a couple of rows so that they can experiment by hooking up their pulley in various ways.
Place the larger cans over the smaller cans to make a pulley that turns easily.

Continued…

Activate the Pulley System!
Attach one end of the string to the bucket, and the other to the bottle of water.
Tell your students to draw a picture of your pulleys. In two different colors draw two different ways that the string could be looped around the pulleys. Write a paragraph explaining which set up will move more easily and why. Loop the string over the pulleys.
Add weights until the bottle of water moves. (Hint: Only fill the bottle half-way for easier lifting.)
Try a different configuration and repeat.
After your students has experimented with a few different set ups, ask them to write an explanation how using more or less pulleys changes the force needed to lift something.

Materials for making your own Pulley System
Large box or sheet of cardboard.
Cans of two different sizes from the recycle bin
Yarn or rope
A bottle of water
Small bucket
Weights. I used our Picasso Tiles, but any object would work. Rocks or Cutlery are good solutions.
Hot glue

Experiments & Activities:
LEVER
Make a popsicle stick Catapult
The Lever can store and deliver an awesome amount of Force. Students will make a catapult that bends an arm over a central fulcrum that propels an object.

Stack six popsicle sticks one on the other and loop rubber bands over the two ends, fixing them as a bunch. This is your fulcrum. Using more rubber bands, affix a plastic spoon about ½ way up a single popsicle stick. Place another popsicle stick under and perpendicular to the fulcrum. This will be the base of the catapult. Now lay the Spoon-Popsicle stick perpendicular to the fulcrum, with its lower end touching the end of the base-popsicle stick. Attach them looping rubber bands to secure. Your catapult is ready for action.

Materials List:
Empty jar with screw-on lid
Modeling clay/Playdough (to make rolling logs and pellets)
Book
Eight wooden popsicle sticks
Multiple rubber bands
Yard stick
Ruler (12”)

Continued…

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Learning Pod #4

MATH

"How did sailors upon the sea know where they were? How did they know how to get there and get home again without electricity and computers!?"

Sailors used math to navigate. They also used the stars, the moon, the sun and clocks. Learners will discover why maps have all those lines on them, and how a compass works. Students will make a compass and use simple fractions to divide the globe into little manageable pieces. Learners will also figure out how to tell how fast a ship is going by counting knots on a string while a sandglass ticks off time.

Discuss and define the word: Math Where do we find math in everyday life? In cooking? Shopping? Counting money? Dividing equal shares of food?

Experiments & Activities:

Make a Compass:

Students will make a rudimentary compass that will react to the pull of the Earth's magnetic Poles. Discuss which direction the sun rises and sets in relation to the school and the classroom. Identify North and South in the classroom.

Make the float: Cut discs of cork from a bottle-cork (@1/4" thick) or use a small piece of construction paper (@ the size of a quarter).

Magnetize the needle: with a sewing needle or a small paperclip, rub one end of a magnet for the count of 30.

Fill the Liquid: in a shallow plastic bowl or jar lid (Do not use metal), pour about ½ to 1" of water. Place float in middle of water, balance magnetized needle on float. Observe what happens.

Materials List:

Large plastic lid, small sewing needle (or paperclip), a magnet, a cork (or piece of construction paper) a scissor, ½ cup of water.

Continued…

Investigate a Compass Rose:

Look at a map, either contemporary of from another Era. Observe the Compass Rose. Draw a Compass Rose by making a cross in a circle. Note the primary directions (N, S, E, W). Add NW, W, SW, S, SE, E, NE, N to illustrate fractions of the Compass.

Make Fractions of the Globe:

Students draw a circle to represent the Globe. They draw the Equator and cut globe in half from side to side creating the Northern and the Southern hemispheres.

Students draw another line, bisecting the globe up and down, or North to South creating two equal halves, or hemispheres. They have made the Western and Eastern hemispheres.

Draw eight lines side to side and up and down to represent the Meridians of Longitude and Latitude (four above the Equator and four below, etc.)

Tell Time on water: KNOTS

Break class up into groups of three. Tie simple overhand knots 6 inches apart along a length of rope/twine 4' long. One rope per group of students. One student embodies the Ship, another is the Navigator, and the third is the navigator's mate. The "Ship" gently pulls end of rope. The Navigator counts how many knots slip thorough their hand, whilst the navigators mate watches a second hand on a clock. When hand reaches 10 seconds the mate calls "Stop!" and we determine how fast, or how many knots, the Ship is moving.

PLOT A COURSE (Next Page)

Follow the commands to survive the voyage. Using primary and secondary points on a compass rose, match the Letters and the Numbers to navigate safely to the Treasure.

Continued…

PLOT A COURSE FROM YOUR HOME-PORT TO TREASURE ISLAND USING THE FOLLOWING COORDINATES. AVOID DANGER AT ALL COSTS!

A1, EAST A2, EAST A3, SOUTH B3, SOUTH-EAST C4, SOUTH-WEST D2, SOUTH-EAST E3, EAST D4, EAST E5, NORTH-EAST D6, SOUTH E6