

Grade 1

Science Docent Grade 1 Forces & Motion

1st Grade – Forces & Motion & Engineering

Objective:

Students will observe how wind forces affect a building. They will gain an understanding by designing a structure and testing it against wind forces. They will also have an opportunity to think like an engineer: solving a design problem, coming up with potential solutions and testing their results.

PS2.A: Forces and Motion

Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)

Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2)

If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3)

PS2.B: Types of Interactions

Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)

Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)

Docent Lab Guidelines:

Docent(s) should plan to arrive early to set up before the class arrives.

Reserve the science room on the Science Lab Master Schedule. Please make sure you add 30 minutes of set up time and about 30 minutes of clean up time to

the overall class time. Allow at least 1 hour if not more for this lab. It would be better to have 90 minutes of class time for this lab.

This lab would work best with at least 3 docents.

Safety glasses and aprons are not required.

Give a brief 10 minute overview of what force and motion are and how they relate to our daily lives. You can also opt to play a short video instead of speaking. These are listed below.

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There is one experiments. Provide a time limit for the students to complete their work. Allow enough time for the “testing” portion of the experiment. This is where the houses will be test to see if they stand up to a wind force.

The last 5-10 minutes of class review the student’s observation as a group. Encourage students to share the pros and cons of their design,

Forces & Motion Facts from *Science Trek* (For Docent’s Reference Only)

Motion makes the world go 'round. Motion makes the moon go 'round too. In fact, motion makes lots of things go. When we think of motion we often think of cars, bicycles, kids running, basketballs bouncing and airplanes flying. But motion is so much more. Motion is important to our lives and impacts so many things that we do. Motion is the changing of position or location. But motion requires a force to cause that change. Let's learn about force and motion and the effects of these physical laws in our world.

What is Force?

Force is just a fancy word for pushing or pulling. If I push on something or pull on it, then I am applying a force to it. Force makes things move or, more accurately, makes things change their motion. Two natural forces that we have experienced are the force of gravity and magnetic forces.

These two forces act at a distance and do not require direct contact between the objects to function. Gravity produces a force that pulls objects towards each other, like a person towards

the ground. It is the force that keeps the Earth revolving around the sun and it's what pulls you toward the ground when you trip.

Types of Contact Forces

There are 6 kinds of forces which act on objects when they come into contact with one another. Remember, a force is either a push or pull. The 6 are:

normal force

applied force

frictional force

tension force

spring force

resisting force

Let's investigate how these forces can be seen in our lives.

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Normal Force

A book resting on a table has the force of gravity pulling it toward the Earth. But the book is not moving or accelerating, so there must be opposing forces acting on the book. This force is caused by the table and is known as the normal force.

Applied Force

Applied force refers to a force that is applied to an object such as when a person moves a piece of furniture across the room or pushes a button on the remote control. A force is applied.

Frictional Force

Frictional force is the force caused by two surfaces that come into contact with each other. Friction can be helpful as in the friction that allows a person to walk across the ground without

sliding or it can be destructive such as the friction of moving parts in a motor that rub together over long periods of time.

Tension Force

Tension force is the force applied to a cable or wire that is anchored on opposite ends to opposing walls or other objects. This causes a force that pulls equally in both directions.

Spring Force

The spring force is the force created by a compressed or stretched spring. Depending upon how the spring is attached, it can pull or push in order to create a force.

Resisting Forces

Resisting force, like air resistance or friction, change motion. Whether the forces actually stop or slow something depends upon your point of view. Air friction makes a leaf travel along in the wind. When you pick up a pencil, it's friction with your fingers that gets the pencil in motion. In each case, the friction makes the two things (like the air and the leaf) move together.

Newton's First Law

Newton's first law of motion states: A body in motion tends to remain in motion, a body at rest tends to remain at rest unless acted on by an outside force.

So, if an object is moving – its inertia (mass) will tend to keep it in motion, and if something is at rest, its inertia will tend to keep it at rest.

Newton's Second Law Newton's second law of motion states that a force, acting on an object, will change its velocity by changing either its speed or its direction or both.

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If your basketball goes rolling into the street and is hit by a bike, either the ball will change direction or its speed or both. It will also be true for the bike.

Newton's Third Law

The third law is probably the best known of Newton's laws. It states that for every force and action, there is an equal and opposite reaction.

This is what causes a cannon to recoil when it fires. The 'kick' from the firing of the ammunition is what makes the cannon jump backwards.

Videos on Forces & Motion:

Forces and Motion (Kids educational video. This video explains Newton's Laws of Motion (Run time 3 min. 1 sec.)

<http://ca.pbslearningmedia.org/resource/idptv11.sci.phys.maf.d4kfom/force-and-motion/>

Forces & Motion by Bill Nye the Science Guy (run time 3 min. 53 sec.)

<https://www.youtube.com/watch?v=8iKhLGK7HGk>

Forces & Motion by Study Jams

<http://studyjams.scholastic.com/studyjams/jams/science/forces-and-motion/force-and-motion.htm/>

Good Thinking! Falling 101 from the Smithsonian Science Education Center (Information for docents only on gravity, inertia and air resistance)

<https://www.youtube.com/watch?v=ly9T46UouGk>

Experiment #1: The Three Little Pigs Experiment

Estimated hands-on time: 45-55 minutes

Work in groups

Overview:

In this experiment based on *The Three Little Pigs* story. Students are to imagine that there are no bricks available and they have to help the third little pig by using engineering design to build a house for the third little pig. They will be provided with materials to use and can only use the materials provided. Each house will be tested to see if it is wolf proof, by using a small fan or hairdryer.

Discussion:

As a class brainstorm several ideas for making a strong house, for example which shapes are the strongest. <https://www.youtube.com/watch?v=pCI6LMWk2ik>

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Predict which materials will be better for building

Discuss how wind is a force we cannot see

Various Building Materials Such as:

Straws or sticks from outside (if available) – can use drinking straws

Tooth picks

Wood Skewers

Craft sticks

Linguini

Plastic cups

Paper clips

Marshmallows (large and mini size)

Clay (1 stick per group - optional)

Used pieces of cardboard

Paper towel or toilet paper rolls

Pipe cleaners

Masking tape or small rubber bands to bundle straws

About 8-1/2" x 11" sheets of used flat cardboard to use as a base. This will allow groups to move their house to the testing area. Students can elect to tape their house to the base.
(one sheet per group)

Fan or hair dryer

Small toy pigs

Scissors

Extension cord for fan

Preparation:

Set out all the materials. Docents can choose to set out materials at each table group or have a material station where the students come over and choose their own materials. Set up a “testing” area in the classroom. Preferable in a spot where all the students can observe the results.

Instructions:

Start by asking the children to recall *The Three Little Pigs* story. Ask if they recall what happened to the first two little pigs houses. What was the “force” that destroyed the first

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two houses? Ask the students to think about what type of house they would build that would be able to with stand the force of the wolfs breath.

Ask the students if they know what an engineer does? Explain that engineers design things that help people and they figure out how to solve problems. Today all the students are going to be engineers. They will design a house to help protect their “little pig” from a wind force.

Explain not all design solutions are successfully and that is perfectly fine. This is all part of science. Some house will fall and others will stand.

Teacher and docent to decide the size of each team. Preferable no larger than 4 in a group.

Explain the rules (design constraints):

Can only use the materials provided

There must be room for their little pig to stand inside the house

There must be an entrance to the house

Their design doesn't have to necessarily look like a traditional house

They must work in a team and share their ideas

There is a limited time. Give the time limit. And maybe set a visual timer on the white board, counting down the time in 5 to 10 minute increments

All the houses will be tested after the timer goes off

Evaluation of Designs:

Test each design by using a fan or blow dryer on a low setting to simulate the huffing and puffing of the wolf. If time allows, students can work on improving their designs.

If time allows have the students assemble on the floor to discuss their designs. Ask a few students to describe their design telling what worked and what didn't work. Possible discussion questions:

Why did you select these building materials?

How could the designs be improved?

What do you think made the houses strong or weak?

Did the shape of the house made a difference?

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Clean up tips:

Please return all the toy pigs for use in other classes.

Vacuum up the room if needed.

Students are welcome to take their designs back to class but we would really love it if some student left their house in the lab so they can be displayed at Open House in May.

Suggested Reading:

Celsi, Teresa; Cushman, Doug. The Fourth Little Pig. Steck-Vaughn:1999

Peet, Bill. Chester the Worldly Pig. Houghton Mifflin: 1978

Scieska, Jon; Smith, Lane. The True Story of the Three Little Pigs by A. Wolf. Viking Books: 1989.

Beaty, Andrea. Iggly Peck, Architect. Abrams Books, 2007.

Laden, Nina. Roberto the Insect Architect. Chronicle Books, 2000.