

SIMPLE MACHINES

Introduction

Here is an outline of a simple machine/ early elementary physics science unit. We did these classes over the course of a semester with a homeschool group of about 5 boys. The basic outline of the course and resources are below then I'll break down the individual classes into more detailed outlines after that. I hope this inspires a fun and interactive unit of your own! This text as copied directly from my blog and put in this file for a more printable format. Discover more resources and ideas at hatchingcuriosity.com.

Overview outline (Class outlines to follow):

Physics Classes as prep for the Simple Machines Classes:

1. Matter
2. Energy
3. Forces
4. Speed and Motion
5. Issac Newton and his laws of motion
6. Physics Review Lesson

Simple Machine Classes:

1. Inclined Plane
2. Wedge
3. Lever
4. Wheel & Axel
5. Pulley
6. Screw
7. Gears
8. Simple Machines Review Lesson

Putting it all together:

8. What is an Engineer?
9. Rube Goldberg machines and Marble Runs
10. Make a snack Mixing machine

Some Resources I recommend (affiliate links to purchase are found on my blog post):

Books

- Explore Simple Machines (Explore your World series) Anita Yasuda
- Simple Machines (Let's Read and Find Out Science series) by D.J. Ward and Mike Lowery
- Forces Make things move (Let's Read and Find Out Science series)
- Newton's Rainbow by Katherine Lasky and Kevin Hawkes

Manipulatives

- Thames & Kosmos Simple Machines Science Experiment & Model Building Kit
- Learning Resources STEM Simple Machines Activity Set
- Newtons Cradle Balance Balls

Media

- The Magic School Bus Complete Series
- The Magic School Bus Rides Again on Netflix
- Sci Show Kis Channel on YouTube
- Fun Science Demos Channel on YouTube



SIMPLE MACHINES

Physics Lesson #1: Matter

1. What is the world made of (Matter -Solids, Liquids, and Gas review and Energy)
2. **What is Matter?** (Matter has mass and volume.)
3. Mass. (Measure mass of an oddly shaped rock on a scale record all observations and a drawing to their rock in their science journal)
4. Volume (Measure box LXWXH then propose the problem of measuring the volume of their oddly shaped rock. Retell story of Arcemidies Eureka! and measure volume in a cylinder with water)
5. Density (Take the mass/volume of their rocks and compare them to each other to find relative densities)
6. Do a float/sink experiment (explain that objects with a higher density than water will sink while items with a lower density will float)
7. The more spread out matter is the less density it has. Review Density with the states of matter demo linked above (or on my Youtube Channel Hatching Curiosity)

Physics Lesson #2: Energy Review from Energy Unit

What is energy? (The ability to do work)

Types of Energy: chemical, electrical, radiant, mechanical, thermal, nuclear, magnetic, electromagnetic (Have the kids find example of each type of energy in the house)

Law of Conservation of Energy: "Energy cannot be created or destroyed. Only transferred or transformed" (Have the kids recite this definition from memory)

We will learn more about how energy and matter interact in chemistry class but will learn how we can use energy to efficiently move matter in this class.

What are Physics? Physics study matter and its motion and behavior through space and time. In this class we are going to learn about simple machines and core principles of physics. (Have the kids copy or write this definition in their science journals)

SIMPLE MACHINES

Physics Lesson #3: Forces

1. **What are Forces?** Forces push or pull an object resulting from its interactions with another object. (Have the kids copy or write this definition in their science journals, then play Tug-o-war)
2. **Friction:** The resistance of one object moving against another. It slows it down. (Roll a marble across the carpet, then roll it across a tile or wood floor. Which one displayed more friction?)
3. **Gravity:** When an object with a smaller mass is drawn to an object with a larger mass. Like us being pulled toward the earth. (Hold a bean back up then move your hand from under it and watch it fall. What happened? Why did it not stay in the air where you left it? Refer back to density and gravity)
4. Read Gravity is a Mystery
5. Explain that weight is one way to measure mass but how much something weighs depends on how much gravity is pulling against that object. Measure each child's weight then have them discover how much they would weigh on other planets.
6. **Electromagnetic forces:** is the attraction between charged particles that we will explore more in chemistry. Some examples of electromagnetic forces are light from the sun and the magnetic field around the earth that protects us from harmful radiation. (Use a magnet under a sheet of paper with metal dust on top to demonstrate a magnetic field let the kids play with magnets attracting to each other)
7. In this class, we are going to learn how to leverage forces to help us do work.
8. Observe forces around the home and record those observations in your science journal.

Physics Lesson #4: Speed and Motion

1. **What is speed?** The distance over time (measure how long it takes them to go down a long slide vs how long the slide is or how long it takes them to run 10 feet then record the definition of speed and their observations in their science journal)
2. **What is Velocity?** The rate at which an object changes its position. Distance and direction over time. (Have them run in a specific direction measuring how long it took them to go a certain distance. Then record their observations and write this definition in their science journal)
3. **What is Acceleration?** A change in velocity. (Have them go on a car ride with curves and turns and tell you every time there is a change in acceleration (speed or direction) then write the definition in their science journal.

SIMPLE MACHINES

Physics Lesson #5: Isaac Newton and his laws of Motion

1. Review speed, velocity, and acceleration
2. Read Newton's Rainbow Biography of Issac Newton (link above)
3. Have the kids try to move a ball without any force. (It can't be done)
4. **The Law of Inertia:** An object will not change its motion unless a force acts on it or a body at rest remains at rest unless acted on by an outside force. A body in motion at a constant velocity will remain in motion in a straight line unless acted upon by outside forces. (Have the kids write one of the two definitions in their science journal)
5. Have the kids play soccer a little bit then talk about forces they experienced in the game (push, pull, and gravity) and changing acceleration they experienced.
6. If something is moving it is because a force sets it in motion.
7. **Law of Acceleration:** The net force= MassX Acceleration. (Have the kids record the definition in their science journals)
8. Have the kids push a toy truck across the floor. Then have them try to push your truck outside. Which one took more force? An object with more mass takes more force to move.
9. Jump on a trampoline and have them observe the bend from a side angle. Then have your smallest child jump on the trampoline. Explain that mass plays a role in velocity. The more mass an object has the more forces it takes to get it moving but the more potential energy it has for acceleration.
10. **Newton's 3rd Law of Motion:** For every action, there is an equal and opposite reaction. (Have the kids push on the truck outside with all their strength. What happened? (The kid moved backward) explain that the same amount of force that they were exerting on the truck was being exerted on themselves. Then have them record their definition in their science journals)

Physics Lesson #6: Physics Review Lesson

1. Observe Newton's Cradle (linked above) Which of Newton's laws of motion do you see at work?
2. When I drive 50 MPH what is that measuring? (speed)
3. When I am driving 50MPH SW on HWY90 what is that measuring? (Velocity)
4. What is a change in velocity called? (Acceleration)
5. Read Forces Make Things Move Book for review
6. Watch Magic School Bus Season 1 Episode 3 Magic School Bus Plays Ball

SIMPLE MACHINES

Simple Machines Lessons

At the beginning of each lesson read about the simple machine from the Simple Machines: with 25 science projects for kids book linked above and watch the videos on the subject from Sci show Kids and Fun Science Demos on YouTube (also linked above).

At the end of each lesson have the kids draw a picture of the simple machine in their science notebook labeling necessary parts and then write their OWN definition of the simple machine below it.

Have the kids look for examples of the simple machine around the home and report back at the beginning of the following lesson.

Simple Machine Lesson #1: Inclined Planes

1. Create an inclined plane from blocks and cardboard boxes. Attach a string to the back of a toy truck and the other end of a string to a toy bucket. Measure how many marbles it takes to move the toy truck off the table. Then repeat the experiment with the inclined plane at a different angle. What did you notice? (They will need more or fewer marbles to move their truck depending on the angle of the plane).
2. Show them a video or a picture of the great pyramids and explain that the pyramids were made using long ramps to haul the stones up the structure.

Simple Machine Lesson #2: Wedge

1. Have the kids use a door stop to hold open a door. Then have them use an axe to cut wood or a knife to cut an apple. Explain that they have been using a simple machine called a wedge.

We used a log splitter and had grandpa explain wedges to the kids. They loved it!

Simple Machine Lesson #3: Lever

1. Get a rock or something else you can use for a fulcrum, a 2x4, and something to move with the lever (we just used a 2nd rock)

Yes you can use smaller things to demonstrate this concept but the kid will LOVE using the larger objects in this lesson.

2. Have the kids try to lift their object several times with the fulcrum at different points on the lever. What happened? (The closer the fulcrum was to the load the easier it was to lift the object)
3. Have the kids cut out a circle with scissors. Explain that scissors are levers too.
4. Optional: Go into the classes of levers as described in the simple machines book or take the kids to a see-saw at a park.

SIMPLE MACHINES

Simple Machine Lesson #4: Wheel & Axel

1. Have the kids play with toy trucks and cards and observe the wheel and axel.
2. Have the kids push a wheelbarrow. Explain that the wheelbarrow is an example of a complex machine composed of three simple machines. Then have them guess which three simple machines are being used (wheel & axel, lever, and inclined plane).
3. The wheel and axel are also used in another simple machine we will learn about tomorrow.

Simple Machine Lesson #5: Pulley

1. Hook up a pulley to a wood frame or find one already in use. Have the kids lift a heavy load with one pulley. Explain that the pulley helped change the acceleration by changing direction but didn't help lift the load.
2. Add another pulley. Have the kids lift the load again. Which one was lighter? The 2nd pulley cut the load in half so you should have felt half the weight.
3. Add one more pulley. This will cut the load in half again.
4. Have the kids string up the pulleys themselves and repeat the experiment explaining to you what they've learned.

Simple Machine Lesson #6: Screw

1. A screw is an inclined plane wrapped around a rod. It helps decrease the resistance when being screwed into wood and locks it in place once it is there. Have the kids hammer a nail into some wood then pull it out with a hammer explaining what simple machine they are using to pull it out with. Then have them screw a nail into the wood and try to pull it out.

I would just include this lesson with the next one if you are going to do the gear lesson

Simple Machine Lesson #7: Optional Lesson: Gears

1. Gears are wheels and axels with groove or teeth that interlock. As one turns it turns the other so using the same concept as pulleys to split the load as it goes.
2. Optional: Go into gear ratios with different size gears.

Simple Machine Lesson #8: Simple Machines Review Lesson

1. Read the Let's Read and Find Out Science: Simple Machines Book for review (link above)
2. Have the kids play with one of the two simple machines sets linked above following the activity card prompts.
3. Watch the Magic School Bus Rides Again Season 2 Episode 7 The Magic School Bus: The good the bad and the gnocchi

SIMPLE MACHINES

Pulling it All Together Lesson #1: What is an Engineer?

An Engineer designs, builds, and tests systems and machines.

Discuss different types of engineers (mechanical engineers, civil engineers, structural engineers, etc. many suggestions can be found in the simple machine spine we have been using throughout these lessons)

If you were to be an engineer what type would you want to be?

Engineers and inventors use physics and simple machines every day.

Have the kids learn more about a type of engineering that is interesting to them and record their findings in their science journals.

Pulling it All Together Lesson #2: Rube Goldberg and Marble Runs

Machines make work easier but Rube Goldberg found creative ways to make work harder using simple machines. They sure are fun to watch though. (Watch Rube Goldberg Machines)

Make a Marble run in your house using a simple marble run set, paper towel tubes cut in half, or get creative and create your own smaller version of a Rube Goldberg machine. Name every simple machine you use and any of the physics terms you can remember.

Record your marble run and share it with friends and family.

Pulling it All Together Lesson #3: Snack Mixing Machine

Optional: Have the kids play with the simple machine sets again one more time for review or look through their notes in their notebook to review simple machines.

Have the kids design, build and test a snack mixing machine (Like an engineer!) that mixes 3 snacks (I did graham cracker cereal, marshmallows, and chocolate chips) using at least 2 different simple machines. First, they will draw it in their notebooks, then they will build it using household items, then they will test and adjust their machine to make sure it works.

Present their machine using all the terms they can remember throughout the course.

Thank you!

Check out pictures, links, and a video review of the resources used at:
hatchingcuriosity.com/blog/simple-machines

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