Simple Machines

Step 1 Excite

When we think of a machine, we most often think of an electrical device such as a hair dryer or a dish washer. Not all machines are electrical, however. (Think about opening a can of paint with just your hands.)

You will be using machines, some of which date all the way back to Egypt in the year 2600 B.C., to help with your work in this lesson. Think of all the different kinds of machines that you see in use today. We have everything from Xerox copiers to bulldozers and hydraulics. But the machines you will explore today literally affect life in ways that are so common, you've probably never thought of them as being machines.

Are you still thinking of different kinds of machinery? Quick—time yourself. See how many different machines you can list in thirty seconds. Ready? Go!

How many did you get? No matter what sophisticated ideas you came up with, you probably could not beat the importance of the six simple machines we're going to discover today. So roll up your sleeves, and let's get to work!

Step 2 Examine

Simple machines are named as such because most of them only have one moving part—they are simple. However, some of them don't have one moving part—they have no moving parts! There are three simple machines: the lever, the pulley, and the inclined plane. The wheel and axle, the wedge, and the screw are modifications of the three simple machines. We will look at all six in detail, but there is one important concept to note: When you put simple machines together, you make up more complex machines. We mentioned the Xerox earlier. Modern, complicated machines like that one are made up of several or even numerous other simple machines.

The first simple machine we will look at is the inclined plane. It seems like everyone at one time or another complains about copy machines. They break down, paper gets jammed in them, and so on. You will never complain about the inclined plane breaking down or being out of toner because it has no moving parts. The only thing that is moving and producing work on an inclined plane is you! In the year 2600 B.C., when the Egyptians used...
ramps to build the pyramids, they were using inclined planes. But that same simple machine is still in use today. Have you ever noticed a handicapped entrance with a ramp? That's an inclined plane.

A lever in very simple terms is a handle (or a stick) that can move back and forth at a specified point. The word handle is used here to help you remember something. When you see a handle on anything, you'll almost always see a lever operating. The place where the lever is free to move up and down, or back and forth, is called the fulcrum. By moving the fulcrum to different points on the lever, you will be able to obtain extra power. One interesting point: The lever lock was invented in Great Britain in the year 1778.

There are three different classes of levers: class 1, class 2 and class 3. The type of lever depends on the arrangement of the force, the load, and the fulcrum. The class 1 lever has the fulcrum between the force and the load, like a seesaw. The class 2 lever has the fulcrum at one end, the force at the other end, and the load in the middle such as a wheelbarrow. A class 3 lever has the fulcrum at one end, the load at the other end, and the force in the middle. Your arm is a class 3 lever. The elbow is the fulcrum, and the muscles of the forearm apply the force between the elbow and the hand.

A pulley is made up of a wheel and an axle, which we will discuss later. To make the pulley work, you must also have something like a rope, a chain, or strong twine. A pulley helps you to work with the force of gravity rather than against it; that's why a pulley is so useful. For example, let's say your family is moving into a second-floor apartment and you are tired of lugging boxes up the stairs. You get the idea that you could just tie a rope around each box and lift it up to your second-floor balcony. Well, that's a good idea, depending on how you're going to lift those boxes. If you are planning to stand on the balcony and pull the box up to the second floor, you'll have a lot of work to
do. But if you devise a pulley and stand on the ground pulling the rope toward the ground (down) and yet lifting the box up to the balcony, you're working with gravity. That translates into an easier job.

The **screw** is probably the most recognizable of the six simple machines. We've all used screws to put something together. It would be safe to say that nearly every home has a screwdriver in the kitchen drawer or in Dad's toolbox. You cannot even put batteries in most new toys and games without a screwdriver and screws. A screw is really another form of an inclined plane. Think about how the ridge in a screw wraps itself around like a staircase. A staircase is an inclined plane! But there's more... the sharp end of the screw is a wedge. A **wedge**?

A **wedge** is the fifth of our six simple machines. A wedge is used to move or split things apart. A wedge can be round or flat, and it has been described as a type of inclined plane. A shovel is an example of a wedge.

The last of our six machines is the **wheel and axle**. Let's go back to your family's new apartment. How are you going to get heavy furniture from the rental truck to the front door? The hand dolly you might use is an example of the wheel and axle. The wheels—well, it's pretty obvious where the wheels are. The axle is what connects the wheels and the object(s) they're moving. On a hand dolly, that would be the little “shelf” that you put the objects on to move them. Wheels are also used in a very basic way, like turning a doorknob.

There are many aspects of machinery and how it works. A few miscellaneous terms of importance include **cogs and gears**, **force ratio**, **speed magnifiers**, and **force magnifiers**. Cogs and gears are often associated with clocks. They are little wheels with teeth protruding from them at equal distances from one another. The teeth on one cog will connect or “mesh” themselves with teeth on another as they spin round and round. Cogs make up gears. The bigger cogs and gears are, the more slowly they move. However, the bigger they are, the more power they exert.

**Force ratio** can be defined this way: The ratio of force (or power) that is exerted by any given mechanism to the force that is put in. Machines can normally be classified into two types: **Speed magnifiers** and **force magnifiers**. A speed magnifier is exactly what its name implies—it is a machine that magnifies or increases speed; it speeds things up. A whisk is an example of this kind of machine. Force magnifiers help us to exert more (or bigger) force on something than would be possible if we were using only our hands. A wrench is an example of a force magnifier.

Resources recommended in ● several lessons, ● several units, ● other HOW Units. ●—Key Resource (see beginning of unit).
Now that you have a basic understanding of machines and how they work, we are going to “put our hands to the plow.” You may want to work on today’s activities with a parent or friend.

Research simple machines. Use any resource (an encyclopedia, reference book, or the Internet). We recommend the following:

**Books**

- **The Usborne Internet-linked Science Encyclopedia**
  Read: “Simple Machines” 134-136.

- **The New Way Things Work**

- **Exploring Creation with General Science**

- **The Handy Physics Answer Book**
  Read: “Simple Machines” (85-98).

- **Playground Physics: Simple Machines** by Robert De Weese, Gary Shipman (Illustrator)
  Description: You can get your children interested in physics by using simple machines on your own playground. Getting youngsters started early with simple concepts can help to take away the mystery and even the fear of the physical sciences. Your purpose isn’t necessarily to make them into physicists. Understanding simple machines can make anyone a more effective user of everyday tools in solving common problems at home or in the car. Paperback - 16 pages (1994) Evan-Moor Educational Publishers; ISBN: 1557993017.

**Software**

- **Super Solvers Gizmos & Gadgets**
  Description: Morty and his mechanical monkeys want to control all of the scientific research that goes on at the Shady Glen Technology Center. You must outwit him by solving science puzzles and building machines that are faster and more efficient than his. This activity builds a basic understanding of physical science principles, encourages hands-on experimentation, creates awareness of science applications, and much more! Software Publisher - The Learning
Reading level: Ages 7 to 12.

Internet Sources

- **Brainpop: Inclined Plane**
  Description: Watch a movie on inclined planes and do an experiment with Bob the lab rat.
  http://www.brainpop.com/tech/simplemachines/inclinedplane/index.weml

- **What's So Simple about Simple Machines**
  Use this worksheet and old broken toys to examine the use of simple machines.
  http://worksheets.teach-nology.com/science/phy/lab5/

- **Brainpop: Levers**
  Description: Watch a movie on levers and do an experiment with Bob the lab rat.
  http://www.brainpop.com/tech/simplemachines/lever/index.weml

- **Machines**
  Description: This Web site provides information about machines: The four sources of power for machines; simple machines; larger machines; how machines help you; how machines work; and the history of machines.
  http://library.thinkquest.org/J001646F/

- **Coby's Science: Simple Machines**
  Description: A collection of ideas and resources that brings the topic of simple machines alive for students.
  http://ousdmail.ousd.k12.ca.us/~codypren/machines.html

- **Gadget Anatomy**
  Description: The hand-powered tools shown on this Web page all use combinations of the elements of machines to accomplish their functions.
  http://www.mos.org/sln/Leonardo/GadgetAnatomy.html

- **Inventors Toolbox**
  Description: An illustration of early common devices that make work easier to do by providing some trade-off between the force applied and the distance over which the force is applied.
  http://www.mos.org/sln/Leonardo/InventorsToolbox.html

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Resources recommended in several lessons, several units, other HOW Units. Key Resource (see beginning of unit).
Energy

**NASA Quest: Pulleys, Levers and Rigging**
Description: There's more to any ship than meets the eye. This activity allow students to conduct hands-on experiments exploring the basic principles of pulleys.
http://quest.arc.nasa.gov/antarctica2/main/t_guide/activity_122.html

**Dirtmeister: Simple Machines**
Description: Dirtmeister (director of Science Plus, Inc.) leads science reporters through the writing process, challenging them to learn about the six types of simple machines, then find an example of one and write about it.
http://teacher.scholastic.com/dirtrep/simple/index.htm

**Dirtmeister: Science Lab**
Description: Dirtmeister (director of Science Plus, Inc.) shows you how to lift four times your weight in this science lab about levers.
http://teacher.scholastic.com/dirt/lever/index.htm

**Lego Dacta: Simple Machines**
Description: An introductory exploratory presentation of simple machines using activities, bricks, and curriculum with elements such as large gears, wheels, and beams.
http://www.lego.com/dacta/machines/esm.asp

**Step 3 Expand**

Choose and complete one of the following activities:

**Activity 1: Write Summaries**
Write a summary paragraph of each of the six simple machines discussed in this lesson. (Younger students can copy paragraphs or narrate information). Older students should include purpose of a fulcrum, examples of a class 1, class 2 and class 3 lever in the summary of levers.

**Activity 2: Make a Functional Pulley**
Remember that a pulley has a wheel that turns on an axle. Make a pulley with items such as: A string, a pencil, and a sewing spool. Use a downward force to lift an object upward. Take a picture of your pulley (or sketch it) for your Portfolio.

*Underlined text refers to Internet link*
Activity 2:
Examine and sketch the following tools: wheelbarrow, crowbar, nutcracker, scissors, leg, and pliers. Identify and label the fulcrum, rod, effort, and load of each.

Activity 3: Create a Display Using Your Computer
Find an illustration of each simple machine (in a magazine or on the Internet). If you are using *The Usborne Internet-linked Science Book* you have access to illustrations on their Web site (see sample on page 122). Copy the diagrams and paste them into a graphics program. Label the illustrations using the text features in your graphics program (some word processing programs have these capabilities). Print out your work. If you don’t have a graphics program, print out the illustrations and cut and paste them onto paper. If your printout is not in color, use felt markers to color your project. Place this page in your Portfolio.

Activity 3: Do Research
How do you think the inclined planes in 2600 B.C. and the inclined planes of today might be different? Research the ancient Egyptians and find out as much as you can about their simple machines. Build an inclined plane that the Egyptians might have used while building their pyramids. Add an illustration of an Egyptian using a simple machine to your Time Line Book.

Activity 4: Make a Lever
Find at least three examples of levers in your home. (Hint: Most handles could be considered levers.) Now make your own lever using some sort of stick. What job can you do with your lever? If your job seems too difficult, remember that there is a simple way to increase your power with a lever. If you can’t remember how to do this, review the lesson.

Activity 5: Do Field Research
Disassemble a small broken toy or broken appliance, part by part. (Many thrift stores will give you broken things at a very inexpensive price.) As you take apart the item, record your progress on paper with written notations and/or drawings. Identify each part as to type of simple machine and function.

Activity 6: Make a List
Visit a playground. Ask yourself how playgrounds make use of the concept of simple machines. Make a list of the simple machines you find.

Activity 7: Make a Children’s Book
Put together a children’s book that illustrates the six simple machines in this lesson. Then, read the book aloud to teach a child about simple machines.

Resources recommended in ✪ several lessons, ✦ several units, ♦ other HOW Units. ➔ Key Resource (see beginning of unit).
Refer to The Big Book of Books and Activities or Pop Up Book Directions: http://projects.edtech.sandi.net/pershing/explorers/popup.htm, or Small Book Instructions: http://www.oktechmasters.org/andyb/small_book_instructions.htm

Activity 8: Define Words
Add the following to your Vocabulary Notebook.

axle
block and tackle
crane
cylinder
effort
elevator
friction
fulcrum
gear
invention
lever
load
machine
pulley
windmill

Step 4 Excel

Which of the activities in Step 3 did you do? Did you make a pulley, a lever, or an ancient Egyptian inclined plane? Did you and a parent do a building activity together? Share the product of the work. Did you encounter any frustrations or difficulties while doing this kind of hands-on building? Was anything especially fun for you? Share your findings with a friend.

Correct all written work to demonstrate correct punctuation and spelling, and effective use of grammar. Add corrected written work or any illustrations to your Portfolio.
We hope you enjoyed the sample pages from Heart of Wisdom.

Want to see more? Click on any book below to read more!

**Creation: An Internet Linked Unit Study**

“This is more than a study of Creation --This is a study of Christianity versus humanism” This new unit study is a multi-level (grades 4-12) Bible focused, study utilizing the Charlotte Mason approach (living books, narration, etc.), lifestyle of learning methods, and the Internet! All Biblical doctrines of theology, directly or indirectly, ultimately have their basis in the book of Genesis. Therefore, a believing understanding of the book of Genesis is a prerequisite to an understanding of God and His meaning to man. **Price includes password Internet access** to updates, and links to hundreds of sites that correlate with the study.

**A Family Guide to the Biblical Holidays**

This giant, 585-page telephone-size book gives an extensive look at the nine annual holidays: Passover, Unleavened Bread, Firstfruits, Pentecost, Trumpets, Day of Atonement, Tabernacles, Hanukkah, Purim and the weekly holiday--the Sabbath! This book explains the historical, agricultural, spiritual, and prophetic purposes of each holiday, showing how each points to Christ and creative ways to teach them to your children! Includes projects, crafts, recipes, games, and songs for celebrating each holiday. Also includes instructions for a weekly Bible study and instructions using the Special Home School Section to incorporate the teaching of the biblical holidays with the academic school subjects! Excellent, fascinating information about the true New Testament Church and our Hebrew roots also included! ISBN 0-9701816-0-4. Read Excerpts at BiblicalHolidays.com

**What Your Child Needs to Know When**

Revised 2001. This is long-time homeschool best seller. Concerned homeschooling parents are always asking, “Am I doing enough?” This book is the answer. It includes the checklist for academic evaluation for grades K-8 and explains why children need to obtain not just academic knowledge but, more important, the Godly wisdom to know how to use the knowledge! Includes chapters on true Biblical education methods (compared to classical Greek) and the Heart of Wisdom teaching approach! ISBN 0-9701816-1-2. 312 p.

**The Heart of Wisdom Teaching Approach: A Guide to Biblical Education**

This book provides you with the methods, program, and resources for a 12-year course of study where students spend half the school day studying God’s Word and the other half studying God’s world (academics). Students study history chronologically and science in the order of the days of creation. This book will instruct you, step by step, how to give your child an Bible focused, comprehensive education from preschool through high school; one that will train him or her to read, to study, to understand, to love to learn and most importantly to desire and seek true wisdom. The Heart of Wisdom teaching approach is a beautiful, exciting blending of Bible first philosophy, the Charlotte Mason approach, Hebraic education, Delight Directed learning, 4 Step Lessons, and more.

Heart of Wisdom Publishing ❖ E-mail Info@HeartofWisdom.com