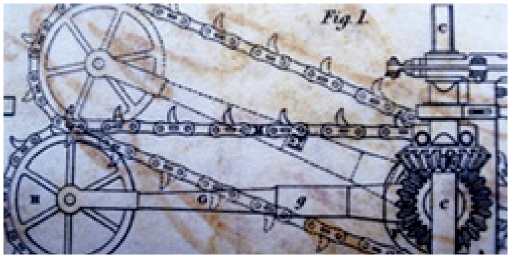


Go-Go Gadget: Invent a Machine

Unit Summary

Students study the concepts of force, motion, and work as they analyze simple machines. They study the simple machines in complex machines, and track the transfer of force from input (effort) to output (work). Students collect, organize, represent, and analyze data from a human automation investigation using spreadsheet software. In a design challenge, students become inventors and identify work they want to perform, and then they invent labor-saving machines to do the jobs. The design steps of planning, drafting, construction, troubleshooting, and reliability testing are followed before students unveil their wonderful inventions to an awed crowd.

At a Glance
Grade Level: 3-5
Subject: Science, Math
Topics: Work, Force, Motion, Data Analysis
Higher-Order Thinking Skills: Creativity, Analysis, Data Analysis
Key Learnings: Simple machines, Compound machines, Mechanical design
Time Needed: 4-5 weeks, 45-minute lessons, 3 times per week
Background: Texas, United States

Curriculum-Framing Questions

- **Essential Question**
  How can we make life easier?
- **Unit Questions**
  How do I invent a machine to do my work?
  What changes when human work is automated?
- **Content Questions**
  What are the definitions of force, motion, and work?
  What are the three basic simple machines and their uses?
  What is the difference between a simple and compound machine? How can I collect, represent, and analyze data to help me understand?

Things You Need
Assessment
Standards
Resources

Assessment Processes

View how a variety of student-centered assessments are used in the Go-Go Gadget: Invent a Machine Unit Plan. These assessments help students and teachers set goals; monitor student progress; provide feedback; assess thinking, processes, performances, and products; and reflect on learning throughout the learning cycle.

Instructional Procedures

Preparing for the Unit

Read the teacher background information document to get a basic introduction to simple machines. Collect books on machines to have them available for student use.

Introducing Simple Machines

Pose the questions, *What are machines*? and *Do we need them in our everyday lives?* Have students brainstorm different types of machines, how the machines are used, and if they think the machines are needed in everyday life. Record student responses on chart paper. Ask students to write their thoughts about machines in their science journals. Have students begin to think about the Content Question, *What are the definitions of force, motion, and work?*

Begin instruction with the definition of work and proceed to the use of machines as labor-saving devices. Introduce the six basic simple machines—the lever, pulley, and the inclined plane—and their modified cousins—the wedge, wheel and axle, and screw to answer the Content Question, *What are the six basic simple machines and their uses?* Show students a variety of simple machines (these can be collected readily or found in kits, such as the Great Explorations in Math and Science (GEMS) Simple Machines kit). Divide students into two groups, and have one group investigate the simple machines while the other studies the following simple machine Web sites: Understanding Simple Machines* and Edheads*. Encourage the hands-on group to experiment with the machines and show each other how force is applied to a machine to move a load over a distance (accomplishing work). Take anecdotal observational notes as students work to make sure students understand the difference between effort and work. After a specified time, have groups switch, so all students receive hands-on experimentation and investigation. Ask students to record their findings and what they have learned in a science journal, and then have students share what they have learned with the rest of the class. Write questions on the board for students to use as a guide while they are working.

Following the introduction of simple machines and how they function, challenge students to use digital cameras to take pictures of as many examples of simple machines as they can around the school. Have students use graphics software to label and explain their photos and use the labeled photos for a wall display. Ask students to investigate machines further by completing activities found at the following Web sites: Work Is Simple with Simple Machines* and Marvelous Machines*.

Conducting Independent Study on Composite Machines
Set students to work in pairs, studying from bookmarked Internet sites. Have them describe the six simple machines and give examples of each on a research worksheet. Student-friendly sites, such as Franklin Institute's Simple Machines* and Inventor's Toolbox*, are good starting points.

Introduce students to the concept of composite, or compound, machines. Choose an example compound machine (such as an old-fashioned egg beater) to show how simple machines are combined to create a more complicated machine. Show how the force is transferred from simple machine to simple machine within the compound machine. On a projected computer image, show students this Lawn Mower Site*, and encourage them to find all six simple machines that work in concert to make a lawn mower mow. Edheads* could be explored again for more simple and compound machine review.

As a homework assignment, ask students to find fairly simple compound machines they can bring to school. When the class has a large assortment, rotate the machines through small groups, and challenge students to describe the simple machines in each. Take digital photos, import the photos into a drawing program, and then have students analyze the machines, label the component machines, and identify the mechanics through which force turns into work. At this point, have students begin to think about the Essential Question, *How can we make life easier?* As students brainstorm, log their responses on chart paper. Students could record their own thoughts in a science journal.

Asking Thought-Provoking Questions
Post the Unit Question on the board, *What changes when human work is automated?* Organize students into small groups of three or four to discuss the question in a round-robin, allowing each student to give an answer. Take observational anecdotal notes to assess students' level of understanding and to help develop thought-provoking questions for a follow-up discussion. After students have had the opportunity to share their answers to the question, have individuals share with the whole group. Record students' thoughts on chart paper. Next, have students begin to think about machines that automate human work, including ATM machines, self-checkout stations at supermarkets, dishwashers, washing machines, and so forth. After students have had an opportunity to share their ideas, bring the discussion back to the whole group. Have students share their ideas and discuss the changes that have occurred when work is automated. To facilitate the discussion, ask the following questions:

- *How have machines changed the way people do work at home and at their jobs?*
- *How have machines affected the time and effort people spend doing different kinds of work? Are these changes positive or negative?*

After the discussion, ask students to record their responses in their science journals.

Conducting a Human Automation Investigation
For homework, ask students to choose a machine that they use at home and time how long it takes to complete a certain task. They then time themselves doing the same job to see how much more or less time it takes. For example, students could run the dishwasher, first counting the number of dishes, cups, and silverware. Then they could wash one of each and multiply or do repeated addition to figure out how long it would take them to do the entire load. Tell students to bring the information to class.

Creating a Spreadsheet
Using the students' homework assignment information, spreadsheet software, and a projector, show students how to create a spreadsheet from scratch to display and analyze the class data. Use the instructions for creating a spreadsheet and the sample human automation data spreadsheet to help guide the process.

Analyzing the Data
Distribute the class human automation data spreadsheet and ask students to compare the time it takes them to do the job on their own against how long it takes them to do the job with a machine. Have students analyze their findings and record their thoughts in their science journals.

Creating, Troubleshooting, and Testing Inventions
Set aside a period or more for groups to construct and troubleshoot their devices. Have the groups use spreadsheets to evaluate their machines and determine their laborsaving qualities in some quantifiable way. For example, students may want to record speed or load trial data, or set up machine-aided versus human-powered contests. Circulate among students as they work to conduct informal conferences to ascertain understanding of concepts and processes, and to provide guidance, if necessary, to correct misunderstandings.

Ask students to take photographs or video of the machines in action. (If photographs are imported into a drawing program, labels can be added showing how the work is accomplished.) Products and tests are saved and incorporated into a presentation.

When the projects are completed, ask students to self-assess their creativity during the process using the creativity checklist.

Creating Student Multimedia Presentations
Show students how to create a slideshow presentation using the presentation rubric as a guide so students are aware of what quality work looks like. Have students use the student checklist to help guide them as they develop their presentations to ensure they have included all of the required components.

After students create their multimedia presentations, have them present their machines to the class and demonstrate how they perform work, supporting their talk with their gadget slideshow.

Concluding Activities
Have students revisit the Essential Question, *How can we make life easier?* in small- and large-group discussions. Students can participate in a mock debate as they begin to discuss the pros and cons of using machines to make life easier using their inventions as evidence. Ask students to record their thoughts in their science journals as a final activity.

Prerequisite Skills

- Students may need mini-lessons on spreadsheet and multimedia use.
- Prior experience with word processing and file management is helpful.
- Previous cooperative learning and scientific method/process investigations would be beneficial.

Differentiated Instruction

Resource Student

- Make modifications as dictated in the student's Individual Education Plan (IEP)
- Use cooperative grouping
- Present instructions in a variety of ways
- Break down tasks into component parts
- Allow extra time for completing assignments
- Use assistance from a parent, volunteer, or teacher's aide
- Provide teacher-created templates and graphic organizers
- Provide positive reinforcement for each accomplished benchmark

Gifted Student

- Provide individual research projects
- Have the student plan and organize a simple machines display
- Provide extension activities, such as visiting Leonardo's Mystery Machines* where the student can observe a diagram of a machine and identify its purpose
- Have the student visit Rube Goldberg's Gallery* and describe the sequence of the diagram and then invent a Rube Goldberg machine
- Ask the student to identify the different machines that would help solve the dilemma in Project Treehouse*

English Language Learner (ELL)

- Use cooperative grouping
- Encourage support from common language speakers who are more proficient in English
- Grant extra time for completing assignments
- Use assistance from a parent, volunteer, or teacher's aide
- Provide teacher-created templates and graphic organizers

Credits

Two teachers who participated in the Intel® Teach Program contributed this idea for a classroom project. A team of teachers expanded the plan into the example you see here.

Assessment Plan

Assessment Plan

Assessment Timeline

Before project work begins

- Journals

- Anecdotal Observations
- Questioning

Students work on projects and complete tasks

- Informal Conferences
- Creativity Checklist

- Project Checklist
- Presentation Rubric

After project work is completed

- Presentation Rubric

- Journals

Before beginning to study simple machines, use students' journal entries to determine prior understanding of the topic in order to plan instruction and address individual and group needs. As students manipulate various kinds of simple machines and explore relevant Web sites, take anecdotal notes to assess student understanding of the concepts of force and work.

While students discuss the effects of automation in small groups, take notes to help with the development of questions to deepen students' thinking. During the large-group discussion, ask probing questions to highlight areas of incomplete knowledge and misunderstanding of basic concepts.

As students work with a small group to create a new invention, conduct frequent, informal group and individual conferences to determine students' ability to apply their learning about simple machines. After students have created their machines, ask them to self-assess their creativity with the creativity checklist.

As students create multimedia presentations to share their projects, students use the project checklist and the presentation rubric to help them manage their time and to make sure that their presentation meets the expectations for quality. The completed presentation is assessed with the presentation rubric. Finally, journal entries describing what students have learned can help dictate what topics need to be readdressed in later units.

Content Standards and Objectives

Targeted Content Standards and Benchmarks

Targeted Texas Content Standards and Benchmarks

Science Texas Essential Knowledge and Skills

- Demonstrate safe lab practices
- Plan and implement investigations
- Collect information by observing and measuring
- Construct explanations
- Construct graphs, tables, maps, and charts
- Collect and analyze information using tools
- Demonstrate that repeated investigations may increase reliability
- Connect concepts with the history of science and contributions of scientists
- Use models and identify limitations

National Educational Technology Standards (NETS)

- Use technology tools to enhance learning, increase productivity, and promote creativity
- Use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works
- Use technology to locate, evaluate, and collect information from a variety of sources
- Use technology tools to process data and report results

Student Objectives

Students will be able to:

- Understand the difference between effort and work
- Describe simple machines and tell how they accomplish work
- Identify how simple machines are used in daily life
- Identify simple machines that work together as components of more complex machines
- Measure and record changes in the position and direction of the motion of an object to which a force such as a push or pull has been applied
- Use a spreadsheet to collect, sort, and display data
- Use scientific processes to create a new simple machine
- Evaluate mechanisms of newly designed simple machines
- Create a multimedia presentation to synthesize learning

Resources

Materials and Resources

Printed Materials

- Hewitt, S. (1998). *Machines we use*. New York: Children's Press.
- Hodge, D. (1998). *Simple machines starting with science*. Buffalo, NY: Kids Can Press.
- Jones, C. (1991). *Mistakes that worked*. New York: Doubleday Dell Publishing Group, Inc.
- Nankivell-Aston, S. (2000). *Science experiments with simple machines*. New York: Franklin Watts.
- Richard, J. (2000). *Work and simple machines*. Brookfield, CT: Copper Beech Books.
- Wells, R. (1996). *How do you lift a lion?* Morton Grove, IL: Whitman Publishing.

Supplies

- Science journal
- Data collection and measurement tools, such as stopwatches, balance scales, and measuring tapes

Internet Resources

- Boston Museum of Science
  www.mos.org/sln/Leonardo/InventorsToolbox.html*
  Inventor's Toolbox on this site provides information on simple machines
- COSI Science Center, Columbus and Toledo, Ohio
  www.cosi.org/files/Flash/simpMach/sm2.html* (Macromedia Flash Player* is required.)
  Best used as a guided demonstration
- Hands-On Technology, Marvelous Machines
  www.galaxy.net/~k12/machines*
  Series of experiments involving simple machines
- The Franklin Institute
  http://sln.fi.edu/qa97/spotlight3/spotlight3.html*
  Simple Machines section shows six simple machines in action
- Rube Goldberg Gallery
  www.rube-goldberg.com/html/gallery.htm*
  A collection of Rube Goldberg inventions
- Project SMART96
  www.ed.uri.edu/SMART96/ELEMSC/SMARTmachines/machine.html*
  A collection of classroom activities
- *Design and Discovery* Key Concepts
  www97.intel.com/DISCOVER/DesignDiscovery/DD_Session5/default.aspx
  Background information on simple and compound machines

Other Resources

- Simple machines lab kit (GEMS from the Lawrence Hall of Science offers one, as well as a separate levers and pulleys kit) or other materials for creating a simple machines

Technology—Hardware

- Digital camera to take pictures of simple machines for wall display
- Internet connection for online lessons and Web site exploration and research
- Projection system to project lawn mower site for all students to participate together
- Scanner to scan pictures of simple machines that can be printed and labeled
- Video camera to take video of student machines in action

Technology—Software

- Database or spreadsheet for graphing activities
- Desktop publishing software to publish multimedia presentation
- Encyclopedia on CD-ROM for simple machine research
- Image processing software for labeling simple machines

Go-Go Gadget: How Creative Was I?

Skill	Specific Example
1. I thought of and considered many ideas before choosing one.	
2. I noticed what was unusual in ordinary objects.	
3. I carefully thought about ideas in order to decide if they were good ones.	
4. I tried new ideas.	
5. I was not afraid to make mistakes.	
6. I set goals that made me think and work hard.	
7. I added details to my own and others' ideas to make them more real.	

Name ________________________________ **Date** _______________

Student Checklist

Go-Go Gadget

- ☐ We included a summary of the simple or compound machine we created.
- ☐ We chose one simple machine from our invention.
- ☐ We described the simple machine and explained how it accomplishes work.
- ☐ We listed examples of the simple machine in daily life.
- ☐ We listed ways the machine makes life easier.
- ☐ We included pictures, data collection, and analysis of some kind.
- ☐ We answered the questions, Could we live without this machine? and, Does it make life easier?
- ☐ We included a conclusions page.
- ☐ We included a citation page.
- ☐ We followed the correct format.
- ☐ We edited our work.
- ☐ We turned in our final presentation.

Project Rubric for Go-Go Gadget Multimedia Presentation

	4	3	2	1
Concept Understanding Slide(s)#: ESC#:	I can identify simple machines in the world around me by themselves and when they are part of more complicated machines. I can elaborate on specific ways that simple machines make life easier.	I can identify simple machines in the world around me when they are by themselves and can often see them in more complicated machines. I can explain some ways that simple machines make life easier.	With help, I can identify simple machines in the world around me. With prompting, I can explain some ways that simple machines make life easier.	I have a hard time identifying simple machines in the world around me. I cannot explain ways that simple machines make life easier.
Scientific Process Slide(s)#: ESC#:	I effectively use scientific skills and knowledge to create a machine. I use a spreadsheet to collect, sort, and display data.	I use some scientific skills and knowledge to create a machine. I use a spreadsheet to show data.	With help, I use some scientific skills and knowledge to create a machine. With help, I use a spreadsheet to show data.	I have a lot of trouble using scientific skills and knowledge to create a machine. I do not use a spreadsheet to show data.
Machine Slide(s)#: ESC#:	I describe my simple machine accurately and realistically, and I explain in detail how my machine accomplishes its work by showing the transfer of force. I describe the specific ways that my machine makes life easier, and I back up my claims with logical, well-thought-out reasons.	I describe my machine accurately and explain how it accomplishes its work by showing the transfer of force. I explain how my machine makes life easier, and I give good reasons for my claims.	I describe my machine, but I leave out some important points. I explain how my machine makes life easier.	I leave out lots of important information when I describe my machine. I do not explain how my machine makes life easier.

Presentation: Organization Slide(s)#: ESC#:	My presentation has an introductory slide that explains what the presentation is about and a concluding slide that emphasizes the most important points. My presentation is arranged in a logical order.	My presentation has an introductory slide, a concluding slide, and is arranged in a reasonable order.	My presentation is missing either an introductory slide or a concluding slide, or my presentation is arranged in a confusing order.	My presentation is confusing and does not seem to be in any particular order.
Presentation: Appearance Slide(s)#: ESC#:	I have an appropriate amount of text on each slide, and I use graphics and special effects to help me communicate my meaning.	I usually have an appropriate amount of text on each slide, and the graphics and special effects I use do not detract from what I am saying.	Sometimes I have too much text on a slide, or occasionally my graphics and special effects detract from what I am saying.	I have too much text on many slides, and my graphics and special effects seem more important than what I am saying.
Presentation: Writing Slide(s)#: ESC#:	I have no errors in spelling, capitalization, punctuation, or language usage.	I have no errors in spelling, capitalization, punctuation, or language usage that detract from meaning.	I have some errors in spelling, capitalization, punctuation, or language usage that detract from meaning.	I have so many errors in spelling, capitalization, punctuation, and language usage that understanding what I am saying is difficult.

Simple Machines—Teacher Background Information

Glossary

Force is energy exerted or brought to bear on an object. *Pushes* and *pulls* refer to the direction of the force. Everything around you is pushing or pulling, and being pushed and pulled. Whenever you push on something, it pushes back. When you increase the distance of movement, you use less force. This is Newton's Third Law of Motion.

Gravity is a pulling (attracting) force between one object and another. The more matter, the bigger the pull.

A simple machine is a device that helps us to perform work more easily. The three fundamental simple machines are the lever, pulley, and inclined plane, and three adaptations of these are the wheel and axle, wedge, and screw. To make any simple machine do work, we need to apply a force on it.

Work is defined as force acting on an object to move it across a distance. Pushing, pulling, and lifting are common forms of work. Machines make work easier by changing force or distance, or by changing the direction of the force. A force can be applied and still not be considered work if there is no movement. Imagine pushing on a huge boulder with all your might. You are exerting a force against the object, but since you cannot cause it to move, no work has occurred. You are doing work when you use a force to cause motion. To measure the amount of work you do, multiply the force by the distance the object moved. The work that comes out of a machine can never be greater than the work put into a machine.

Simple Machines

There are six simple machines. The lever, pulley, and inclined plane, and the wheel and axle, wedge, and screw which are modifications of these machines.

A lever is a simple machine made up of a stiff arm or arms that pivot or turn. The point on which a lever turns is called the *fulcrum*. The load is the force of the object you are trying to move. Levers are classed by the relative position of the arm, fulcrum, and load. The three types of levers are:

- **First class lever**—A first class lever has the fulcrum in the center. A playground seesaw is a first class lever. One end lifts an object up just as far as the other end is pushed down.
- **Second class lever**—A second class lever has the load in the center. A wheelbarrow is a second class lever. The long handles are the arms of the lever, and the fulcrum is the front wheel.
- **Third class lever**—A third class has the effort and load on the same side of the fulcrum with the effort in the middle. The effort is always more than the load (which is a mechanical disadvantage), meaning that you always get less force out than you put in. A fishing pole is a third class lever. When the pole is given a tug it pivots around the fulcrum that is your wrist. One end stays still as the other end flips in the air catching the fish (moving the load).

A pulley is a simple machine made of a rope or chain wrapped around a wheel. It extends the force on a load over a longer distance for mechanical advantage. We use a pulley twice a day here at school, as we raise and lower our flag on the flagpole.

An inclined plane is a kind of simple machine with no moving parts; it is simply a straight slanted surface, like a wheelchair ramp or playground slide. An inclined plane functions by extending the force on a load over a longer distance for mechanical advantage.

Modified Simple Machines

A wheel and axle is a modified pulley. A wheel and axle is made of a large wheel attached to a post or axle. Sometimes, the wheel or axle has a crank or handle. Together the wheel and axle move to create machines, like your bicycle or skateboard.

A wedge is the active twin of the inclined plane. A wedge does useful work by moving. In contrast, the inclined plane always remains stationary. A wedge consists of a pair of inclined planes set back-to-back, that can sustain sliding or rolling motion. Instead of the resistance being moved up an inclined plane, the inclined plane moves the resistance. We use wedges to keep our door open with our doorstop.

A screw is an inclined plane wrapped around a post or shaft. We use a screw when we change the height of our swivel chair. An auger is a good example of a load moving along a spiraling inclined plane. Also see Archimedes' water screw: www.mcs.drexel.edu/~crorres/Archimedes/Screw/SourcesScrew.html*.

Composite or Complex Machines

Composite machines are any machines that incorporate two or more simple machines. Some complex machines are a winch, hoist, windmill, sail-powered land yacht, and propeller-powered car.

Simple to composite machines:
www.cosi.org/visitors/exhibits/gadgets*

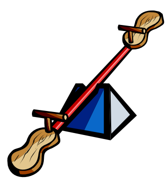
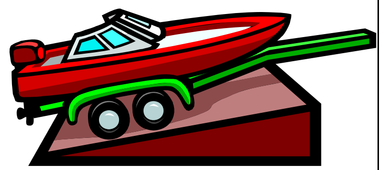
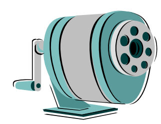
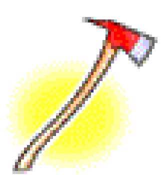
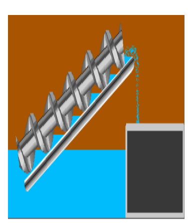
Aspire Simple and Complex Machines tutorial:
http://sunshine.chpc.utah.edu/javalabs/java12/machine*

Leonardo's Mystery Machines: www.mos.org/sln/Leonardo/LeosMysteriousMachinery.html*

Gadget Research

(Note to the teacher: Save this page as a key, then it can be used as an assignment sheet by deleting the sample responses.)

Name ________________________   Date _______________

Simple Machine		
LEVER	**INCLINED PLANE**	**WHEEL AND AXLE**
A lever is an arm that turns against a point (fulcrum). There are three classes of levers. You can tell what kind, depending on the position of the fulcrum.	*A straight, slanted surface allows a load to be moved over a longer distance, so less force is required.*	*A wheel is fixed to a shaft or axle and they move together. Sometimes the wheel has a crank or handle.*
Example Picture or Diagram		
 *seesaw*	 boat ramp	 *pencil sharpener*
Citation		
Edheads: Activate your Mind http://edheads.org/activities/simple-machines/index.htm*	Work is Simple with Simple Machines www.ed.uri.edu/SMART96/ELEMSC/SMARTmachines/machine.html*	The Franklin Institute Online Simple Machines http://sln.fi.edu/qa97/spotlight3/spotlight3.html*
Simple Machine		
WEDGE	**SCREW**	**PULLEY**
A wedge turns an inclined plane down and uses it to push things apart. A wedge is basically two inclined planes set back-to-back.	*A screw works by moving a load across a spiraling inclined plane. The screw on a piano stool lets the seat go up or down. Often a lever, like a screwdriver, works to give force to the screw.*	*In a pulley, a cord moves up or down easily over a wheel. If you attach something to the cord, it can be moved up or down. With a pulley, you trade force for distance, making work easier.*
Example Picture or Diagram		
 *axe*	 *Archimedes' water screw*	 *flagpole*
Citation		
The Franklin Institute Online Simple Machines http://sln.fi.edu/qa97/spotlight3/spotlight3.html*	Edheads: Activate your Mind http://edheads.org/activities/simple-machines/index.htm*	Franklin Institute Online Simple Machines http://sln.fi.edu/qa97/spotlight3/spotlight3.html*

Instructions for Creating a Spreadsheet

Step 1: ***Creating a worksheet and entering data.***

1. Open a worksheet in spreadsheet software.
2. In cell A1, type the title ***Machine.*** In cell B1, type ***How many minutes by machine?*** (You may use another time unit, such as hours.) In cell C1, type ***How many minutes on my own?***
3. In column A, beginning in cell A2, list the machines students used in their human automation investigation. In columns B and C, beginning in cells B2 and C2, type in how much time it took for each category. Continue typing in the time it took until data is entered for all the machines.

	A	B	C
1	Machine	How many minutes by machine?	How many minutes on my own?
2	Dishwasher	40	70
3	Washing Machine	30	60
4	Electric Mixer	10	20
5	Electric Knife	5	15
6	**Average**	21.25	41.25

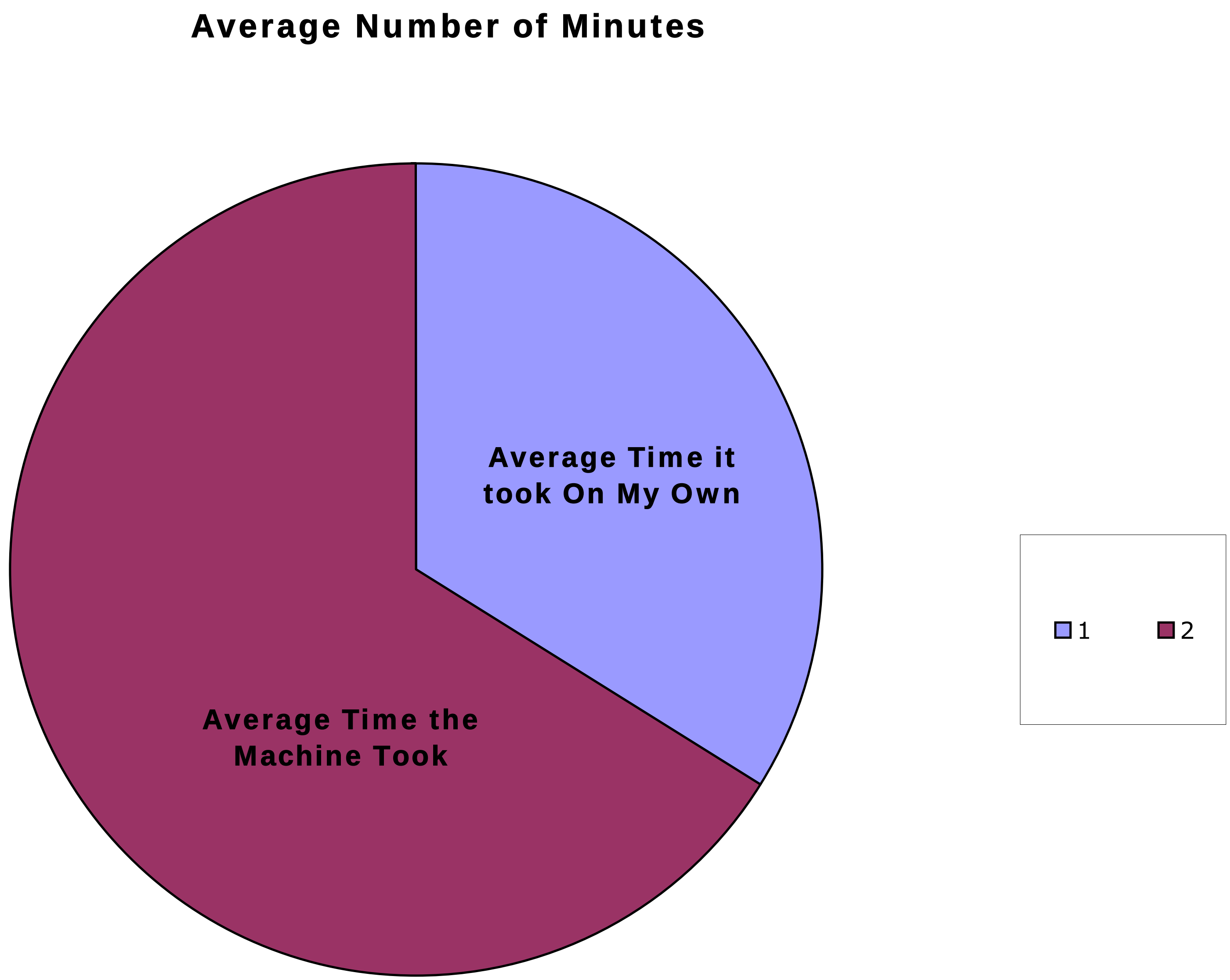
Step 2: ***Entering a formula.***

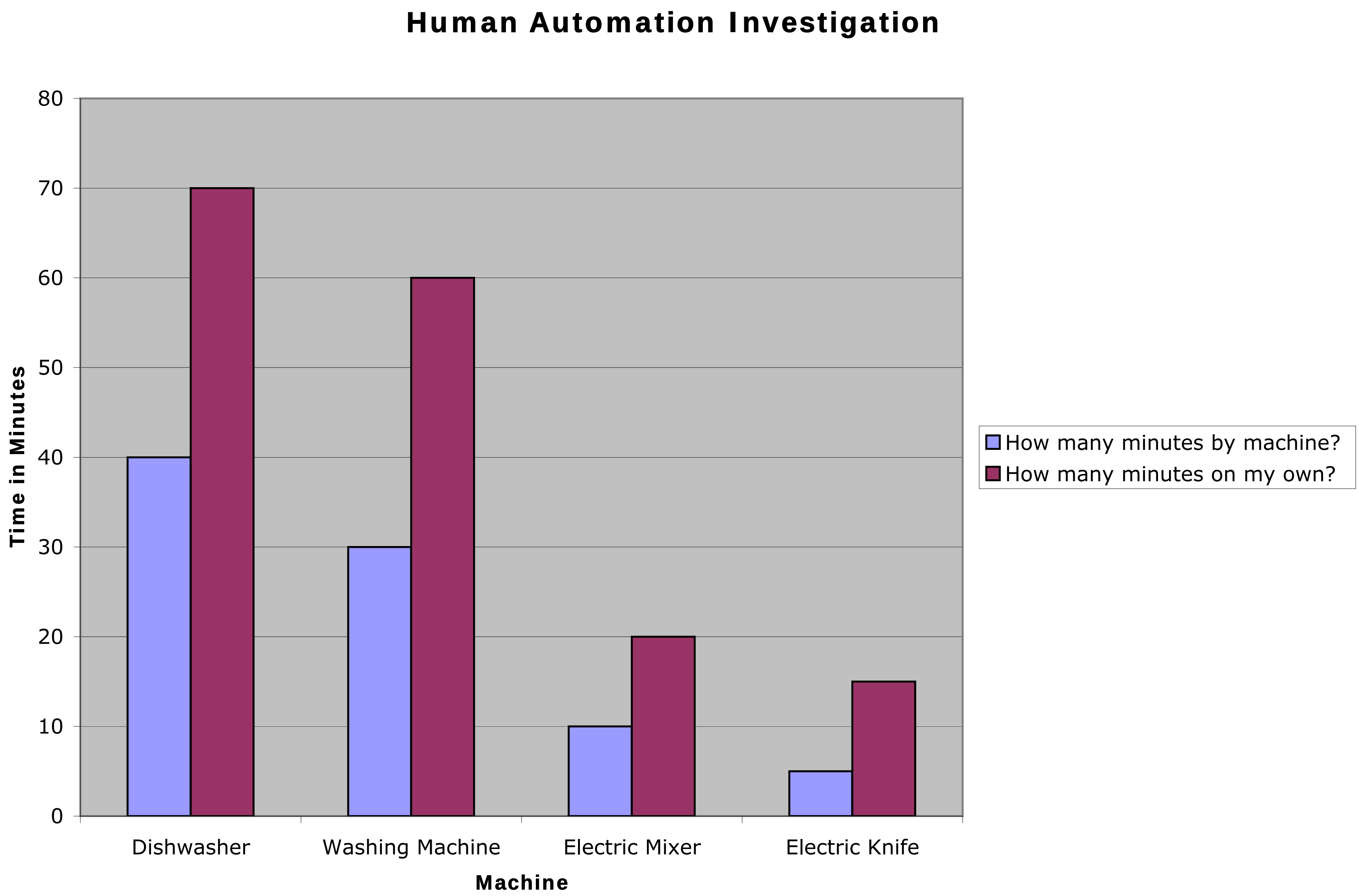
1. In column B, click the cell below your last entry.
2. On the **Insert** menu, click **Function**. The Insert Function dialog box opens.
3. Choose **Average** function, and click **OK**.
4. The range of data you want averaged should appear next in the Number 1 text box in the Function Arguments dialog box in the format of B2:B5. Click **OK**.
5. The average should now appear. Repeat steps 1 through 4 for column C.

Step 3: ***Graphing the data.***

1. Highlight the cells you want to graphs (for example, in the sample spreadsheet above, you would highlight cells A1 through C5). You may want to create two different charts—one without the "average" data and one that is only the "average" data. (See the sample **human automation data** spreadsheet).
2. Choose **Chart** on the **Insert** menu.
3. Click the column chart type, and then click **Next**.
4. Click the **Data Range** tab verify that **Columns** is selected in the Series In section, and then click **Next**.
5. In Step 3 of the Wizard (Chart Options), click the **Titles** tab.
6. Add titles for the chart and its axes.
7. Click the **Gridlines** tab and experiment with gridline options. Choose gridlines that make understanding your data easier.
8. Click the **Legend** tab, choose a location for the legend, and then click **Next**.
9. Place the chart as an object on the original worksheet so that you can see the worksheet entries as you examine the chart, or place it on a separate sheet.
10. Follow the same procedure to create a chart representing that average—a pie chart works well to show the average data as you can use the text box tool to type in ***Minutes by Machine*** and ***Minutes on my own.***

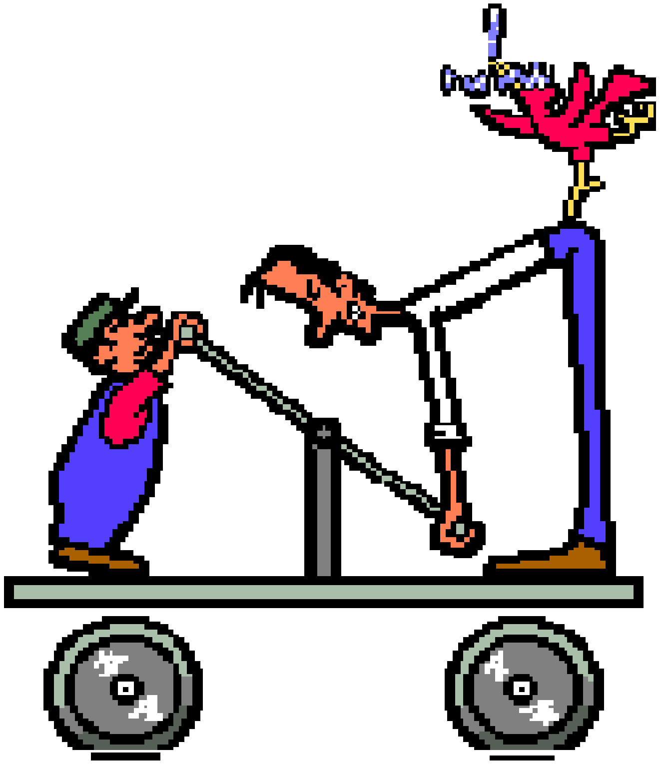
Machine	How many minutes by machine?	How many minutes on my own?
Dishwasher	40	70
Washing Machine	30	60
Electric Mixer	10	20
Electric Knife	5	15
Average	21.25	41.25


Average Number of Minutes
Average Time it took On My Own
Average Time the Machine Took
1
2



Human Automation Investigation
80
70
60
50
40
30
20
10
0
Time in Minutes
Dishwasher
Washing Machine
Electric Mixer
Electric Knife
Machine
How many minutes by machine?
How many minutes on my own?

GO, GO, GADGET!



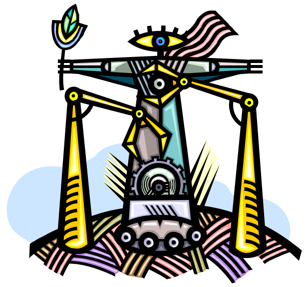
Our Gadget

A Simple Machine at Work

Conclusions

By: Kristin, Kelly, and Brian

INTRODUCTION



A machine is a device for performing work.

Most of the time machines make life easier.

New machines are invented all the time by people that come up with great ideas for making something they must do easier. Sometimes the ideas are so good that the inventor ends up becoming very rich and famous.

We decided it would be fun to come up with our own invention that would make our lives easier.

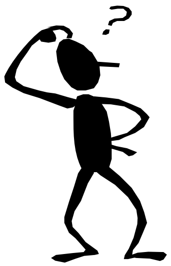
We brainstormed work we had to do, then we thought about ideas for an invention that could do that work. Finally, we followed the scientific process to design and test our Go-Go Gadget.

THE SCIENTIFIC PROCESS

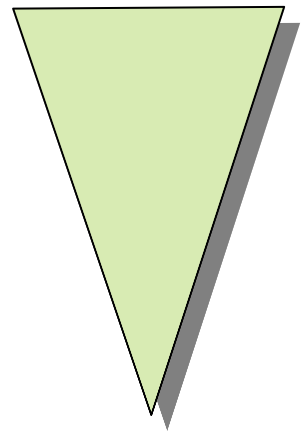
Purpose: To design a gadget to help us open our books faster. Our gadget's simple machine will be a wedge.

Materials: Straw, rod, pencil-top eraser, glue, ribbon, tape

Hypothesis: We think the Go-Go Gadget will open books faster than using just our hands.



Our Simple Machine: What is a Wedge?



Two inclined planes joined back to back.

Wedges are used to split things.
A lifting machine may use a wedge to get under a load. It does useful work by moving and can be used to help with sliding or rolling movements.

Examples: axe, zipper, knife, doorstop

HOW A WEDGE MAKES OUR LIVES EASIER

Without a wedge, we would not be able to split things quickly. Wedges make opening things easier by using less effort.

Axes are needed to cut lumber. The wedge saves time so we can get the work done quicker.

PROCEDURES

This is how we built our gadget:

Gadget Photo would go here

1. We put the rod through the straw.

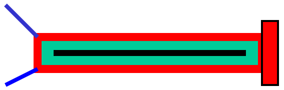
2. We put some glue on the pencil-top eraser and put it on one end of the rod.

3. We tied the ribbon around the other end and taped it shut.

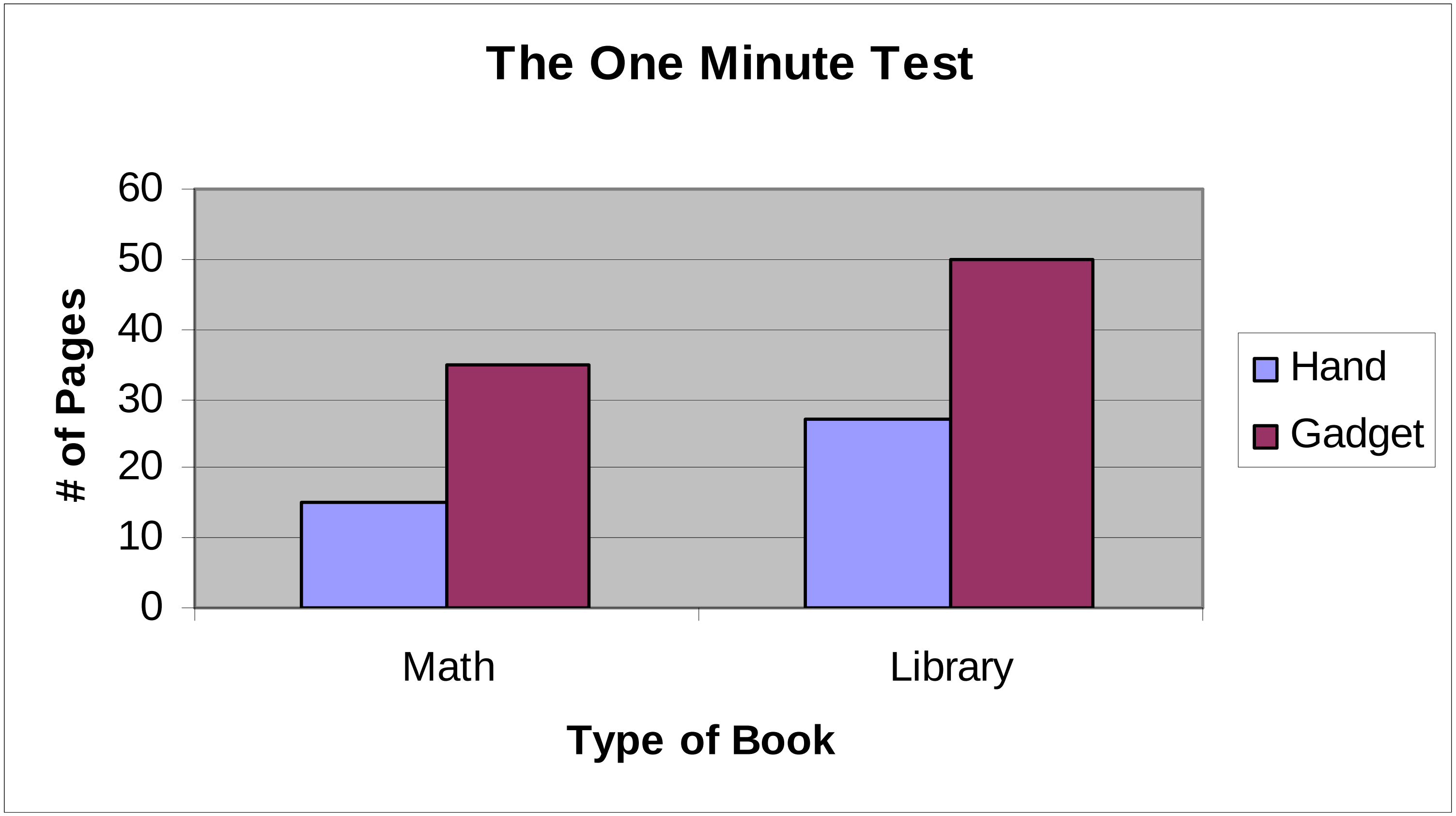
PROCEDURES (CONTINUED)

We used our page-turner gadget to turn the pages of books.

We used force to push our page-turner gadget and our page-turner did the work for us.



Analysis:
Go-Go Gadget vs. The Hand



CONCLUSIONS

- Using a simple machine made the work easier. We applied less effort and were able to open our books faster.

- We turned 21 more math book pages and 22 more library book pages in one minute by using our simple machine than by using just our hands.

OUR GO-GO GADGET MAKES LIFE EASIER

- Our Go-Go Gadget makes life easier because the wedge helps you go faster and get more done. When you can get things done quicker then you've accomplished more work.

- We could live without this Go-Go Gadget. This machine saves time while turning pages but is not necessary to have in daily life. We don't think you have to turn pages that quickly, especially when you are reading.

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