

Gilbert Grape

Standard 3240-04	Students will construct various machines and compare the work done by them.	<i>Topic:</i> Changes in force, motion, and energy. <i>Course:</i> # 3240
Objective 02	Design and analyze complex machines.	
ILO's	<p>2b. Formulate research questions and hypothesis.</p> <p>2c. Plan field studies, controlled experiments, and other investigations.</p> <p>5e. Solve problems by applying science principles and procedures.</p> <p>6b. Prepare written and oral reports describing the findings of investigations and the reasoning which led to the conclusions.</p> <p>6d. Construct tables, graphs, charts, diagrams and models to describe and summarize data.</p>	

Description of Activity:

Title: Gilbert Grape

Overview: Students will construct and use simple machines in two skill building activities. They will construct a complex machine which can crush a grape.

Duration: 2-5 45 minute periods

Materials: (materials for skill builders is listed on them) Students need to provide materials for their machine. Suggestions for materials include popsicle sticks, paper cups, rubber bands, string, weights, pulley, wheels. grapes provided by teacher.

Overview: Students will construct and use simple machines in two skill building activities. They will then construct a grape crusher using 3 simple machines.

Background Information:

Simple machines reduce or change the direction of forces needed to do work. Compound machines contain two or more simple machines. The energy must be transferred from one machine to the other. Machines are designed for specific tasks and their efficiency depends on how well forces are conserved and transferred.

Teaching and Learning Strategies:

This experiment includes two skill building activities-The Marshmallow Catapult (a lever activity) and The Pulley Lab. The other simple machines, the inclined plane and wheel and axle, should be introduced in discussion, demonstration, or experiment. After developing this knowledge and skill, students will be ready to design and test their grape crushing device.

Development of Laboratory Skill and Tools:

The Marshmallow Catapult Lab will introduce students to levers and to the idea of energy transfer. Energy for the catapult is provided by rubber bands and transferred to the lever. The Pulley Lab will also give students an idea of how force can change direction in a simple machine as well as be reduced. See both labs on following pages.

Invitation to Learn

Machines are all around us and contribute greatly to our quality of life. Design and manufacture of machines is an important part of the American economy and employment picture. The first thing necessary to design a machine is to decide what you want it to do. In this activity an important industry, grape juice manufacturers, need a grape crusher. Question: **Who can build a grape crusher using 3 simple machines?**

The students can work in groups of 2-4 and need to start with the Student Designed Experiment worksheet on next page. As they formulate a design they will need to bring in materials to make it. It might be a good idea to have a few on hand. As students build their machines, provide grapes for them to test. On the last day have a student demonstration of their machines. They should be able to identify the simple machines and how energy is transferred from one to the other. If you want to make it a contest, see who can crush the most grapes in a minute.

Summary of Learning

Multiple Choice:

1. What is the fulcrum of the marshmallow catapult?

- a. at the horizontal pencil
- b. the milk carton
- c. the rubber band
- d. the vertical pencil

answer: a

2. What type of simple machine does the marshmallow catapult represent?

- a. inclined plane
- b. wedge
- c. screw
- d. lever

answer: d

3. How does a movable pulley affect the force needed to lift a mass?

- a. it changes the direction
- b. it increases the force
- c. it changes direction and decreases force
- d. it decreases force and decreases distance pulled

answer: c

Strategies to Share Learning:

This activity would be a fun one to videotape and share with the school on a student news broadcast. Class winners could compete with one another or with other schools.

Student Designed Experiment Format

TITLE: Gilbert Grape

PURPOSE: How can we link three simple machines to make a complex machine which can crush a grape?

PREDICTION: (What is a possible answer?)

MATERIALS: (What will I use to find out?)

PROCEDURES: (What designs do I want to try?)

DATA: (What happened?)

ANALYZE RESULTS: (What does my data mean? Is there more than one way to view the data? Could I have done something differently?)

CONCLUSIONS: (What did I learn?)

Student Designed Experiment Scoring Rubric

RESPONSE	CRITERIA	RATING
Exemplary	Completes all steps. Experiment is logical and clear. Data is recorded and thoroughly analyzed. Diagrams are present. Prediction made. Conclusions thorough and thoughtful.	6
Competent	Completes all steps. Experimental procedures lack thoroughness. Data is recorded, analysis not complete. Conclusions too brief.	5
Satisfactory	Completes nearly all steps. Some procedures lacking or illogical. Data recorded but poorly analyzed. Conclusion does not accurately sum up experiment.	4
Nearly Satisfactory	Completes most steps. Procedures missing. Data recorded but not analyzed. Conclusion inadequate.	3
Fails to Complete	Most steps missing. Data recorded but procedures do not indicate it's origin. Conclusion missing.	2
Fails to Begin Effectively	Directions not followed. Nearly all steps missing. Doesn't show understanding of how to develop experiment.	1
No Attempt Made	Does not begin experiment.	0

Teacher Page

Skill building activity for "Gilbert Grape"

Title: Marshmallow Catapult Lab

Description: Students will make a catapult and use it to fling a marshmallow into a bucket.

Materials: one-cup milk carton, scissors, graph paper, one 2-inch rubber band per two students and other rubber band sizes as requested, toothpick, 2 pencils, tape, small match box (can be made from a 3 by 5 card and tape), mini marshmallows, hole punch.

Background: A catapult is a lever built specifically to throw something. They have been used since ancient times in warfare but have other useful purposes. r.

The competition phase can be done depending on your facility and interest. Accuracy or distance or both can be tested. Explain which you will test for at the beginning of the lab.

Safety suggestions: Goggles need to be worn while any student is testing the catapults. Catapults may be tested only in designated "firing ranges" where projectiles go toward a wall with no one in their path. No unauthorized use of catapults.

Student Page

Name _____

Title: Marshmallow Catapult

Purpose: To build a catapult capable of flinging a mini-marshmallow into a bucket 3 meters away. (or what your teacher directs)

Materials: one-cup milk carton, scissors, graph paper, one 2-inch rubber band per two students and other rubber band sizes as requested, toothpick, 2 pencils, tape, small match box, mini marshmallows, hole punch

Prediction:

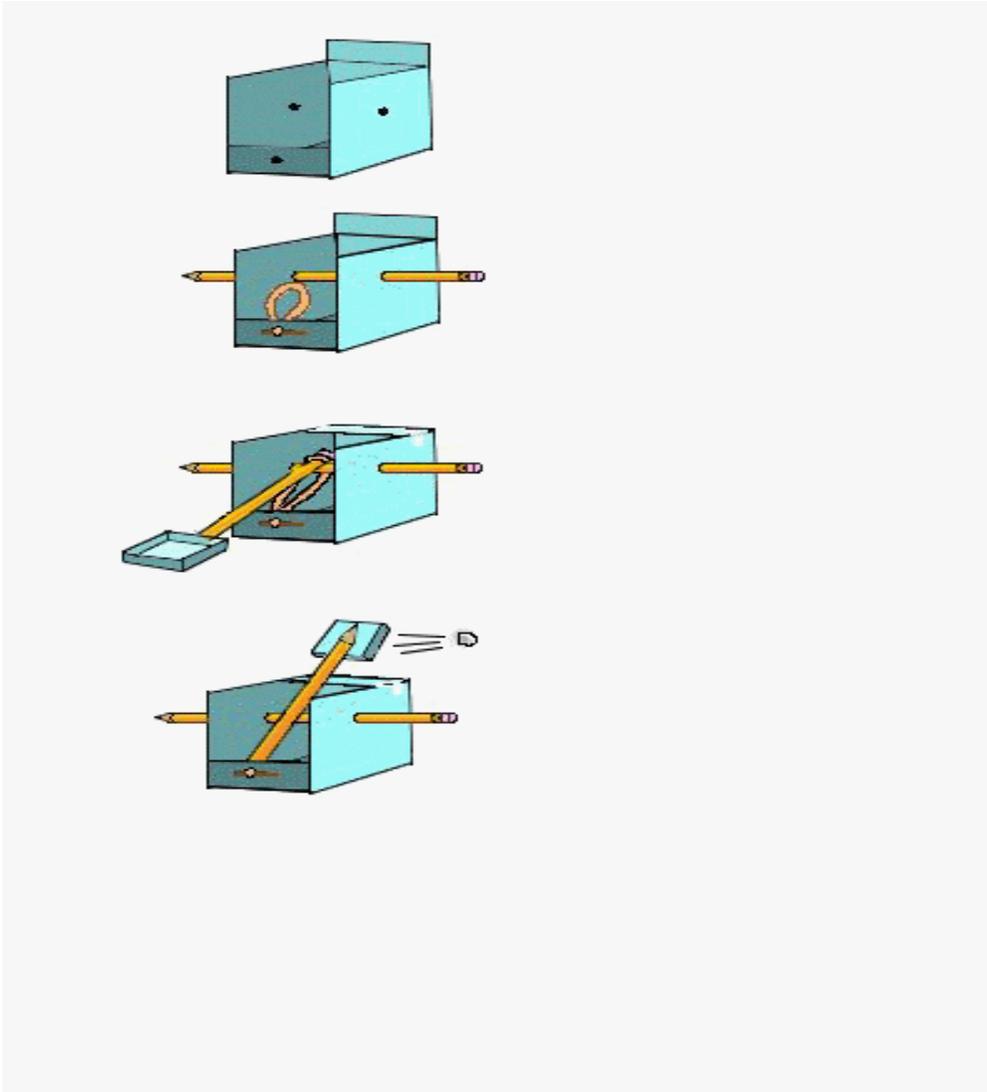
Procedure: (see diagrams on next page)

1. Cut off the top of the milk carton and then cut the carton as show in diagram 1. Cut holes the size of a pencil in both sides and in the back.
2. Push a rubber band through the hole in the back and hold it in place with a toothpick. Push a pencil through the holes in the sides.
3. Cut the tray of a match box in half lengthwise. If you don't have a matchbox make one of a 3 by 5 card and tape. Using tape, attach the box to the sharpened end of the second pencil with the pencil to the outside.
4. Select one of the three rubber bands to complete the remainder of the procedure.
5. Lay the pencil across the other with the eraser end facing the front of the catapult. Loop the rubber band over the eraser end. Fold the front flap of the milk carton in, crease it, and tape it down.
6. Do a trial test of your catapult to make sure it works properly. Place a marshmallow in the holder, pull back the pencil, an then release. Make any adjustments needed, and modifications to make the catapult work better.
7. On your data, make a sketch of your catapult and the results of your throws.

Data:

(your drawing)

throws: 1 _____ 2 _____ 3 _____



Analysis:

1. What factors seemed to make the winning design the best?
2. What kind of simple machine is a catapult?

3. What stores and transfers energy in a catapult?
4. If you were starting over, what would you do differently?
5. What are three ways a catapult could be used to help people?

Conclusion:

Teacher Page

Skill building lab for "Gilbert Grape"

Title: Pulley Lab

Description: Students will construct several pulley systems and see which one gives the greatest mechanical advantage.

Materials: pulleys (single and double), mass, ring stand and ring, spring balance

Background Information: A fixed pulley is attached and hangs from a solid object. A moveable pulley is able, of course, to move. A single fixed pulley changes the direction the force is applied to move an object. It feels easier because gravity is now helping. It takes a moveable pulley to reduce the force needed to lift the object. The mechanical advantage of a pulley system is about equal to the number of supporting ropes on the moveable pulleys. The mechanical advantage is always less due to friction and the weight of the moveable pulleys.

Student Page

Name _____

Title: Pulley Lab

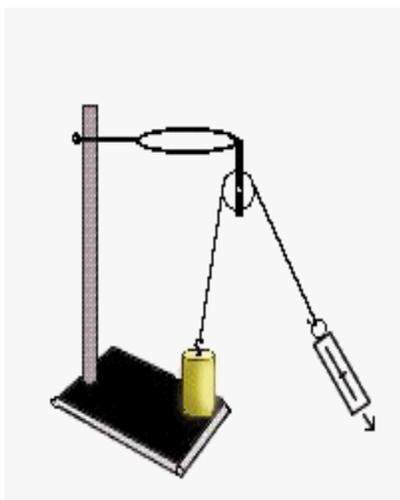
Purpose: To discover which pulley system has the greatest mechanical advantage.

Materials: pulleys, string, ring stand and ring, spring balance, mass.

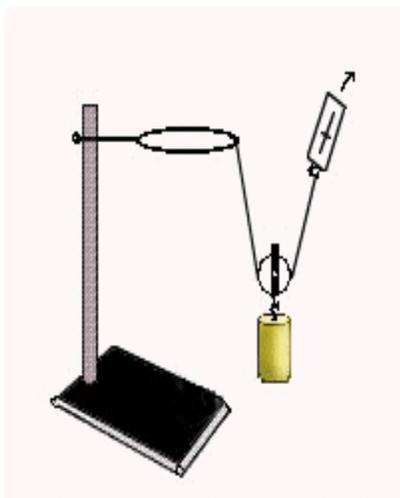
Prediction:

Procedure:

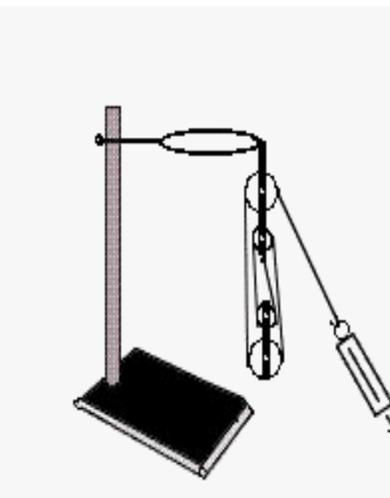
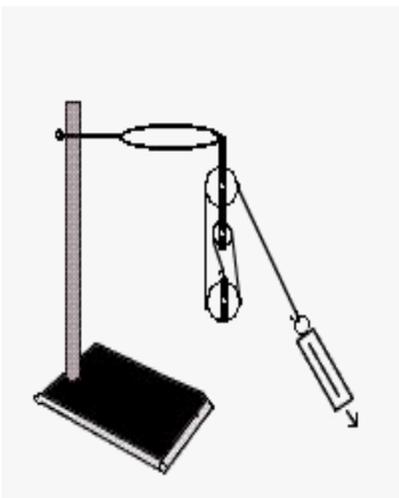
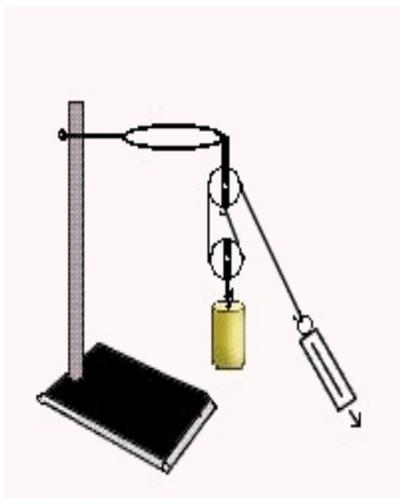
1. Find the resistance force of the mass using the spring balance.
2. Set up the system below. Find the effort force and record on the data table.



3. Set up the moveable pulley below. Find the effort force and record.



4. Set up the systems shown in the diagrams below, find your effort force and record.



5. Calculate the mechanical advantage for each pulley by dividing the resistance force (weight of the mass on the spring balance) by the effort force (how hard you pulled on the spring balance)

Data:

Pulley System	Resistance	Effort	Mech. Advantage
single fixed			
single movable			
pulley A			
pulley B			
pulley C			

Analysis:

1. Was there a difference in the mechanical advantage for the single fixed pulley and the single movable pulley? Explain your answer:
2. As you add pulleys, what happened to the effort force you used to raise the mass?
3. Why would anyone use a single fixed pulley if it does not give you a mechanical advantage?
4. A machine never gives you something for nothing. Although the effort force is decreased, something else is increased. What must be increased?

Conclusion: