Title: **Levers: What Can Leverage Do For Me?**

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This is one lesson from a unit on simple machines. This is the lesson on levers. Each lesson about each simple machine could be done in any order within the unit.

Problem to be studied: Identify the three classes of levers and describe how they work

Content Standard(s):

3.2.7. D Know and use the technological design process to solve problems.

Process Standard(s):

3.2.7. B Apply process knowledge to make and interpret observations.
The following are the specific process skills addressed from this standard:
Observation, Classification, Communication, Measuring, Experimenting, Controlling Variables, Design

Assessment Strategies: (Evaluation)

Formative Evaluation:

1. **The teacher will observe students for accuracy and understanding during the building of their models and the recording on their lab reports.**
2. **The teacher will ask the students questions about the parts of the lever in their models and seek reasonable explanations for the principles of force and motion.**
3. **The teacher will ask students about their rationale for their siege weapon designs during the building period.**

Summative Evaluation:

1. **The teacher will collect the students' lab reports and check for the accuracy of the drawings and labeling.**
2. **The students' presentations of their models to the class will also identify the parts of the lever and where the fulcrum, resistance, effort, and force are located.**
3. **Students will use the rubric for the design brief's requirements for their siege weapon.**
4. **Students will record in their journals the following information: drawings with parts of the lever labeled, a graphic organizer of the three classes of levers, organized test results that list weights of boulders and trials of launches attempted, drawings of designs with labels and modifications, and student reflections about what they are learning about levers and the research on the historical background of levers.**

Suggested Grade Level:

4, 5, 6

Materials:

Video clip from Cirque Du Soleil teeter board act or a Road Runner / Wile E. Coyote cartoon or Monty Python and the Holy Grail

Classroom K'nex set for levers

Student lab report sheets

Pencils

Colored paper for each student

Scissors

Design Brief and Rubric

Shoeboxes

Aluminum foil

Journals

Balances

Measuring tapes

Procedures:

Engage: Show a video clip from a teeter board act like Cirque du Soleil or from a Road Runner and Wile E. Coyote cartoon using a lever. A clip from Monty Python and the Holy Grail showing the catapult could also be used. The website "brainpop" could be used to show a clip of a lever also. This will be the starting point for reviewing the basic parts of a lever. The vocabulary needed is

fulcrum, resistance (load), effort, and force. As a class, the students will develop a KWL chart on levers.

Explore: Students will work in groups of three. Students will use a classroom K'nex kit on levers to explore the three kinds of levers by making a model of each type from cards provided in the set. There will be three groups of cards. There will be two or three different models of each type of lever in a group. For example, group one will contain class one levers. Group two will be class two levers and so on. After building their model the students will record on a lab report where the fulcrum is in relationship to where the effort and resistance are located. They will need to draw a picture and label these parts on their lab report. Students will share their findings with the class.

At the same time, in conjunction with social studies and a study of the Middle Ages in Europe, the students will research siege weapons like catapults and trebuchets. This will show them how levers were used in history. This will also give them background for their next assignment. Students may use the Internet or other sources for their research. Some websites are listed below.

Explain: The students will make a Dinah Zike foldable to summarize what they know about the three kinds of levers. This is a graphic organizer for the students. This will go into the students' science journals to be used to help them classify their lever in the siege weapon.

Elaborate: In order to show what the students learned about levers, the students will design and build a model of a siege weapon to meet certain specifications as described in the design brief below. The students will use K'nex to build their models. Students will draw and label the parts of the lever in their siege weapon. Students will use their journals to record their design and testing results along with modifications made. They will write and draw in their journals with appropriate details as specified in the design brief.

Related Web Sites:

http://www.sirinet.net/~jgjohnso/simple.html
http://www.mos.org/sln/Leonardo/InventorsToolbox.html
http://sln.fi.edu/qa97/spotlight3/spotlight3.html
http://www.brainpop.com/tech/simplemachines/lever/index.weml?&tried_cookie=true
http://www.pbs.org/wgbh/nova/lostempires/trebuchet/
http://members.iinet.net.au/~rmine/gctrebs.html#foolish
http://icatapults.freeservers.com/plans.htm
http://www.weirdrichard.com/trebuchet.htm
http://www.wikipedia.org/wiki/Catapult

Sources consulted in developing this lesson:

K'Nex Simple Machines Educators Guide. 1998. ISBN 1-887004-09-5.
Macaulay, David. 1988. *The Way Things Work.* Boston: Houghton Mifflin Co.
Zike, Dinah. 2001. *Big Book of Science.* San Antonio, TX. ISBN 1-882796-18-7.

Design Brief
"Can't-Ya-Pult" Me Over the Wall?

The Context: The students are studying Europe. In our studies we will learn about Leonardo daVinci, Galileo, Newton, and other famous scientists and artists from different periods in European history. In our study of the Middle Ages, we will look at castles. Incorporating our physics of simple machines, the students will design and build a catapult or siege weapon of choice to send a boulder over a castle wall. There are some interesting websites included that give background and design ideas in the lesson plan.

The Situation: King Louie needs to protect his castle. There are invaders outside his castle walls. Louie wants to drop boulders on the invaders. Help King Louie by building a catapult or siege weapon of choice that will send boulders over the castle wall onto the invaders.

The Challenge: Your group must build a catapult or siege weapon using the K'nex set that will send a boulder (balls of aluminum foil) over the castle wall (a shoe box). Your weapon will be placed at the line of fire. It must shoot the largest boulder it is capable of over the castle wall onto the enemy (X marks the spot -- a four floor tile area marked with an "X".)

The Limitations: You may only use the parts that are available in the K'nex set provided for building your catapult or siege weapon. You may use the direction card on catapults to help you with your design. Your weapon may not be taller than 15 cm. You will be limited to using boulders that are in the loading bin.

The Rules: You must draw a picture of your catapult or siege weapon. You must also draw any modifications with labels and details of why this is an improvement. You may alter the design from the K'nex card to improve your siege weapon. You must identify what class lever your design is and label it on your drawing design. You must be able to launch over the heaviest boulder possible into the targeted area. You need to measure the weight of the boulder before launching it and record this data in your journals. You should organize the data of your trial runs and be ready to repeat launching boulders. You will get two chances to hit the target area during the final attack. Good luck!

Project Assessment

	4	3	2	1
Understanding the Problem	Thorough understanding of problem. Effective use of problem solving strategies.	Problem was generally understood. Evidence of problem solving strategies	Partial Understanding of problem. Attempted use of problem solving strategies.	Unable to demonstrate understanding of problem. Some attempt to solve problem was made.
Modifications to Original Design	Modifications made to initial design were important to improve design and backed by good reasons. Documentation was detailed and drawings were made.	Modifications made were important to improve initial design. Reasons for improvement were sketchy. Documentation was present.	Modifications to initial design made no improvement. Reasons for change were not made. Documentation is present but limited.	Modifications to initial design reduced performance but were kept. No reasons given. Documentation is not present.
Operation of Model	The model works smoothly and no adjustments are required.	The model works but is somewhat awkward.	The model works but requires constant adjustment.	The model does not work.
Repeated Operation of Model	Model works repeatedly without lengthy re-setting required.	Model works repeatedly but requires a lengthy resetting period.	Model works sporadically and requires a lengthy resetting period.	Model works only once.
Collection of Data	Data collected, well organized, and show detailed drawings of design with labeling.	Data collected, organized, and has drawings of design with labels.	Some data is collected. Unorganized and drawings of design are limited.	Little data. No organization. No drawings of design.
Rules and Limitations	All design rules and limitations were followed.			

Student Lab Report Sheet

Name _____ **Date** _____

Title of Lab: (What do I want to find out?)

Hypothesis: (What do I think will happen?)

Materials Used: (What materials do I need?)

Procedure: (What do I need to do first, second, third, etc.?)

Data: (How did I record my testing? Did I draw a picture or make a chart?)

Conclusion: (What did I find out from my test?)

New Question(s): (What new questions can I ask from what happened during my testing?)