Fifth Grade Unit on Work, Force and Motion

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Unit Overview

Students will engage in lessons designed to stimulate interest in simple machines and build conceptual knowledge of work. Beginning with the concept of forces, students will recognize the role of forces in their daily lives and connect the scientific concepts with everyday experiences. The unit also provides a lesson about work and how work, force, and distance are related. Finally, students will manipulate levers to further understand how work is done in a system.

Unit Objectives and Benchmarks and Standards Addressed

As a result of completing this unit, students will be able to:

1. Explain that a force is a push or pull in a certain direction. (MT Science *Standard* 2 *Benchmark* 5)
2. Identify, diagram and explain the effects of balanced and net forces on motion. (MT Science *Standard* 2 *Benchmark* 5-6)
3. Demonstrate and explain the concept of work. (MT Science *Standard* 2 *Benchmark* 5)
4. Distinguish between the parts of a lever, the effort force, and the load force. (MT Science *Standard* 2 *Benchmark* 5-6)
5. Demonstrate that forces can change the speed and direction of an object's motion. (MT Science *Standard* 2 *Benchmark* 5)
6. Explain the inverse relationship of distance and force in using a lever to do work. (MT Science *Standard* 2 *Benchmark* 5)
7. Use evidence to recognize and explain how longer levers provide greater force than shorter levers. (MT Science *Standard* 1 *Benchmark* 1-3, *Standard* 2 *Benchmark* 6)
8. Identify levers used in students' lives and explain the advantages they afford in doing work. (MT Science *Standard* 2 *Benchmark* 6, *Standard* 5 *Benchmark* 2)
9. Explain and diagram how an atlatl, a traditional weapon of many American Indian tribes, functions as a lever. (MT Science *Standard* 2 *Benchmark* 6, *Standard* 5 *Benchmark* 2, *Standard* 6 *Benchmark* 1)
10. Document the benefits of the atlatl to Indigenous peoples and note specific types used by different cultures throughout history. (MT Science *Standard* 6 *Benchmark* 1)
11. Identify and explain the historical and contemporary use of levers in American Indian cultures. (MT Science *Standard* 6 *Benchmark* 1)

Time/Scheduling

4 lessons: each 60-180 minutes long
Scheduling of Tribal Elders and/or guests should be done as far in advance as possible

Materials

- soccer ball

- chart paper/markers
- Pre-Assessment of Levers, Forces, and Work (Appendix A)
- Friction and Force Analogies (Appendix B)
- Computers with Internet Access
- Suggested Websites (listed in Explore or Explain sections in individual lessons)
- Paper for student diagrams
- Rubric for Cartoon, Paragraph, or Speech (Appendix C)

For each group of 2-3 students:

- 2x6 board, at least 6 feet long
- milk crate (object to act as a fulcrum)
- heavy object (ex: bundled books, free weights from school gym in a box)
- chart paper and markers to record positions and ratings
- Assortment of levers (ex: scissors, can opener, fingernail clippers, car jack, lock cutters)
- Checklist for Lever Assessment (Appendix D)
- Tribal Elder or Tribal Consultant with knowledge of atlatl use
- Chuck-Its and tennis balls (minimum of 1 per group of 4)
- Tribal Elder or Tribal Consultant with knowledge of the use of levers in American Indian cultures

An Important Note About Tribal Protocol Relevant to This Unit

Students must be informed of proper protocol when a Tribal Elder is invited to speak. The teacher should model and the class should practice appropriate behavior, including listening when another person is speaking, asking appropriate questions, and escorting Elders to and from the classroom. The teacher should prepare coffee and/or beverages for the Elder, and if possible, provide transportation. Gifting the Elder at the end of the visit is also recommended.
The Bitterroot has spiritual significance to the Salish and Pend d' Oreille people and is a subject that should be treated respectfully. It is advisable to work with respected tribal elders when teaching about the Bitterroot.

Culturally Competent Elements of the Unit

- Use of analogies
- Personification of inanimate concepts in analogies (friction and force)
- Storytelling
- Voluntary presentations
- Tribal guest speakers to demonstrate and discuss contemporary and historical use of levers
- Place based field trips
- Research and assignments focusing on traditional use of levers
- Diagrams and art based assignments
- Lessons engage prior knowledge and daily experiences
- Visual and kinesthetic models
- Teacher led demonstrations

- Cooperative problem solving
- Discussion of ideas and validation of different perspectives during problem solving
- Metacognitive, self-reflective thinking encouraged by use of student choice in assessments, rubrics, and ability to change answers from pre-assessment
- 5E lesson model
- Hands on experiences

Pre-Unit Assessment

Prior to beginning the unit, administer a pre-assessment on levers, forces, and work (See Appendix A.). Collect and photocopy the assessment, using the copies to guide instruction and gauge changing depth of understanding throughout the unit. Return the originals to students, directing them to change their answers as their thinking changes throughout the unit. Provide time at the end of each evaluation for students to rework their ideas.

Lesson #1 – Forces

Summary of the lesson

Students will begin with a pre-assessment of force, work, and simple machines that will be used throughout the unit to gauge changes in conceptual knowledge and guide further teaching. This lesson introduces students to forces, including gravity and friction, and provides a foundation for upcoming lessons about net and balanced forces and effort and load forces.

Grade level

5/6

Approximate time required

60 minutes

Learning Objectives

Students will be able to:

1. Explain that a force is a push or pull in a certain direction. . (MT Science *Standard* 2 *Benchmark* 5)
2. Demonstrate that forces can change the speed and direction of an object's motion. (MT Science *Standard* 2 *Benchmark* 5)

Resources/materials

soccer ball
chart paper/markers
Pre-Assessment of Levers, Forces, and Work (Appendix A)
Friction and Force Analogies (Appendix B)

Teacher Preparation

Teacher should be prepared with chart paper, markers, and soccer ball while outside. Scribing students' hypotheses may need to be done outside while the discussion is taking place.

Background Information

A force is a push or pull in a certain direction (also referred to as a vector). Forces are exerted on us every day; examples would include the downward force from gravity, and friction when a box is pushed along the ground. The total of all forces results in a net force, which produces our direction of motion (or lack of motion). See Lesson #2 Background Information section for more information about balanced and net forces.

Procedure

Engage

Take students outside and form collaborative working groups. Explain that they will observe an early elementary student and an eighth grade student as they kick balls across a set distance to a finish line. Before the demonstration, ask students to observe the setup and discuss predictions, possible outcomes, and hypotheses regarding the results. -

- If both students kick the same ball, over the same grass, at the same time, whose ball do you think will reach the finish line first? Why?
- What are some of the variables in this setup?
- Who do you predict will have the stronger kick?
- Besides strength of the kick itself, what else could change how fast the ball moves?

Encourage students to discuss their ideas with their partners and to generate additional questions that could be investigated.

Explore

Ask students to watch the demonstration and discuss the results with their group, particularly in light of the predictions they made previously. Encourage students to alter the demonstration set up to test other variables (kicking on cement versus grass, kicking golf balls instead of soccer balls, etc.) they mention in their discussions. Make available resources, such as stop watches, chart paper, and gym balls of different sizes, that student groups can use in testing their ideas. Encourage them to record their findings in a systematic fashion.

Explain

Ask students to discuss their findings within their own group and then with the whole class. Provide prompts as needed to stimulate and deepen discussion such as “When the ball was kicked over cement instead of grass…” or “Changing the strength of the kick…”. Encourage but do not require that every student contribute to the discussion.

Present the word “force” on chart paper and ask students to describe how they’ve used this word before or how they would explain what a force is to someone younger than them. Chart responses around the word force on the paper in a different colored marker. Work the discussion to generate an accurate definition of force. Using the same colored marker as the word force, provide students the actual definition of force (a push or a pull in a specific direction).

Elaborate

Facilitate an interactive discussion with the class about how forces interact to affect motion. Solicit student examples of pushing and pulling forces that they know of that affect the motion of objects. Ask students to identify the forces that affected the motion of the kicked ball. Ask them to hypothesize as to why the ball rolls more slowly on grass then concrete. Guide the discussion toward the concept of friction, and its affect on the ball’s motion. Write the word “friction” on the board and ask students to discuss/act out common experiences involving friction (ex: trying to roller skate on gravel, pushing a heavy box across the floor).

Evaluate

Students will be asked to write an analogy for force and an analogy for friction (Appendix B). If there is a word they'd like to use that is not provided, they may do so. Also, give students time to review and revise their ideas from the pre-assessment.

Lesson #2- Balanced and Net Forces

Summary of the lesson

Students will engage in a research assignment to describe the difference between net forces and balanced forces. They will be required to diagram an example of a system that involves both forces. Their knowledge is assessed with a choice of assignments involving these forces, accompanied by a Rubric for Cartoon, Paragraph, or Speech (Appendix C).

Grade level

5/6

Approximate time required

50 minutes for research on computers
60 minutes for remainder of lesson

Learning Objectives

Students will be able to identify, diagram and explain the effects of balanced and net forces on motion. (MT Science *Standard* 2 *Benchmark* 5-6)

Resources/materials needed

Computers with Internet Access
Suggested Websites (listed in Explore section below)
Paper for student diagrams
Rubric for Cartoon, Paragraph, or Speech (Appendix C).
Pre-Assessment of Levers, Forces, and Work (Appendix A)

Teacher Preparation

Students should be provided with an individual computer for research. Some of the websites provide videos, so computers with working headsets are suggested. Teacher may suggest that students take notes in a science journal, or provide a template for note-taking.

Background Information

Since forces are applied in specific directions, they are sometimes opposing each other in a system. Forces that are equal in strength and opposing in direction are said to be balanced. Balanced forces result in either no motion (ex: gravity force versus the force of Earth pushing up on your feet allows you to stand on the ground) or constant velocity. A net force is the sum of all forces acting on an object. If an object has a net force acting on it, it will speed up, slow down or change direction.

Procedure

Engage

Present a few correct analogies from the previous lesson. Ask volunteers to explain why they are accurate.

Begin dropping non-bouncy, heavy objects onto the ground. Ask students if there is a force acting upon the objects. Students' prior knowledge will most likely lead them to discuss gravity. Pose this challenge question on the board: "If gravity is a force (a push or pull in one direction) that affects all objects on Earth, what keeps objects from crashing through the floor?"

Explore

Ask students to work with a partner to conduct research on the Internet to answer the challenge question. Some examples of relevant sites that students might find useful are listed below. Require students to apply their research to diagram the answer to the challenge question.

Suggested sites for student research:

- Balanced and Unbalanced Forces – Provides definitions and examples of familiar situations involving balanced and unbalanced forces
  http://schools.utah.gov/curr/science/sciber00/8th/forces/sciber/forces.htm

- Assignment Discovery: Net Force – Short video that shows forces acting on a moving canoe with arrows, explains net force
  http://videos.howstuffworks.com/science/forces-videos-playlist.htm#video-29422

- Newton's First and Second Laws of Motion – Provides brief explanations of Newton's Laws of Motion with illustrative examples
  http://library.thinkquest.org/10796/ch4/ch4.htm#Sec2

Explain

Ask student volunteers to present and explain their diagrams to the class. Build on the students' explanations to facilitate a whole group discussion and flesh out students' understandings of balanced and net forces.

Elaborate

Ask students to list experiences in which they have "defied" gravity. Encourage students to tell stories about trampolines, the high jump, skateboarding tricks, slam-dunking a basketball etc. List these on the board along with the words "net force." Ask students to assist you in diagramming the forces in the examples on the board. Tell students they can remember net force by thinking of slam-dunking into a basketball **net**, defying gravity, and having one force being stronger than the other.

Evaluate

Provide students with a choice of assessments including creating a cartoon, writing a paragraph, or giving a speech. Their projects should demonstrate the difference between balanced forces and net forces and give examples of each from their own experience. The rubric for scoring the assessments is provided in Appendix C. Allow time for students to rework their ideas from the pre-assessment as needed.

Lesson #3 – Understanding Work Through Use of Levers

Summary of the lesson

Students will engage in a hands-on inquiry of how to use a lever to lift a heavy object. They will collaboratively decide the positioning of the fulcrum in order to decrease the amount of effort force needed to lift a heavy object, thus beginning their understanding of work and how force and distance are inversely related.

Grade level

5/6

Approximate time required

90 minutes from Engage to Explain I
90 minutes from Elaborate I to Evaluate.

Learning Objectives

Students will be able to:

1. Demonstrate and explain the concept of work. (MT Science *Standard* 2 *Benchmark* 5)
2. Distinguish between the parts of a lever, the effort force, and the load force. (MT Science *Standard* 2 *Benchmark* 5-6)
3. Explain the inverse relationship of distance and force in using a lever to do work. (MT Science *Standard* 2 *Benchmark* 5)

Resources/materials needed

For each group of 2-3 students:

- 2x6 board, at least 6 feet long
- milk crate (object to act as a fulcrum)
- heavy object (ex: bundled books, free weights from school gym in a box)
- chart paper and markers to record positions and ratings
- Online Resources listed in Explain I
- Assortment of levers (ex: scissors, can opener, fingernail clippers, car jack, lock cutters)
- Checklist for Lever Assessment (Appendix D)
- Pre-Assessment of Levers, Forces, and Work (Appendix A)

Teacher Preparation

Depending on class size and individual strengths of students, teacher should test lever setups prior to student exploration. Teacher should be sure that the object to be lifted is light enough to ensure safety, but heavy enough to prove that the lever is makes lifting the object easier. The object should also be heavy enough that changing the fulcrum position creates an obvious difference in the amount of effort force needed to lift it vertically.

Background Information

Work is done when an object moves in same the direction as that of the force acting on it. Work is done by a lever, a simple machine, when an object (load) moves a given distance after a force (effort force) is applied. The effort force required to move the load can be decreased if the distance the lever arm is able to move vertically is increased. Force and distance work inversely to guarantee that the input work is equal to the output work in the system. Similarly, if the vertical distance moved by the lever arm is decreased, the amount of effort force applied must be increased. This relationship is explained by the formula Work=Force x Distance.

Procedure

Engage
Distribute the heavy objects around the gym floor. Show students the heavy objects and conduct a discussion of the forces present and acting on the objects (balanced, gravity, force of floor pushing up on object). Break students into groups of 2-3, and ask them to work together to design a way to lift the object without using any materials but themselves. Give groups three minutes to design a plan and try to move the objects - the objects should be light enough for students to lift without hurting themselves, but heavy enough to produce a slight struggle. Ask students to rate how hard it was to move the object using a scale of 1-10, with 10 being the hardest.

Present the following dilemma: "What if you were hunting or hiking with your friend and a heavy object fell on your friend's leg? Your friend cannot stand up, and the object is too heavy to lift just by grabbing it with your hands (demonstrate). You are about a half a day's walk into the woods already and it's cold, so you can't leave your friend to get help. You must find a way to move the object off your friend's leg. What are you going to do?" Discuss ideas and validate suggestions.

Explore
Supply student groups with a fulcrum (milk crate or rock) and a 2x6 board. Direct students to devise a way to lift their object.

After student groups have successfully lifted their objects (this may occur at different times), instruct groups to work together to diagram their design, paying close attention to where the fulcrum was placed. Have each group rate the difficulty of lifting the object, again using the 1-10 scale. Record each group's rating near their diagrams.

Explain I
Begin a discussion by comparing group's diagrams and setups. Encourage and scaffold students' discourse about the board's position, distance the 2x6 moved vertically, amount of effort they needed to input, and what they might consider their *effort force* and *load force.* Teacher should interject and write terms on the board as the ideas come up in discussion. Expand these ideas with a teacher led discussion of the concepts of work, simple machines, lever, lever arm and

fulcrum. Use additional resources (see suggestions below) like diagrams, PowerPoint presentations, and/or video to provide reinforcement of these ideas.

Additional Resources:

- Work and Simple Machines PowerPoint – Slides 1 to 10 are useful for 5th grade http://education.jlab.org/jsat/powerpoint/**work_and_simple_machines**.ppt

- Introduction to Levers – an html version of a PowerPoint with animated diagrams. http://74.125.155.132/search?q=cache:RoLUzKhiFIQJ:www.generalpatton.org/education/lesson_plans/Simple_machines.ppt+work+and+simple+machines+powerpoint&cd=3&hl=en&ct=clnk&gl=us&client=firefox-a

  *To retrieve the PowerPoint version of this document, Google "Work and Simple Machines PowerPoint" and click on **PowerPoint Presentation** with the website: www.generalpatton.org/education/lesson.../**Simple_machines.ppt**
  Slides 1, 8, 9, and 10 discuss levers.

- Bill Nye the Science Guy – Video called "Simple Machines: Episode 10"

Elaborate
Give student groups a second opportunity to lift the heavy object. This time ask them to move the fulcrum position at least 3 different times, diagram each position, and rate each lift with the 1-10 scale. Require groups to create a data table and record the fulcrum position and rating for each trial. The creation of the data table will promote further discourse about the possible set-ups and key concepts of the activity.

Ask student volunteers to present their diagrams and conclude which position was most effective in lifting the object. They should use their rating scale as evidence of which position was easiest to lift. If not mentioned in the presentation, teacher should question how force and distance changed with each position and how work was done in the system.

Explain II
Conduct a teacher led discussion that guides students to first, realizing and defining the inverse relationship of the distance of the load from the fulcrum and the effort required to lift the load and second, that work in equals work out in this system. PowerPoints from the Resource List above may be valuable for this portion of the lesson.

Elaborate II
Bring in some example of levers commonly found in students' daily lives and ask them to explain how force and distance act inversely in doing work with each lever (e.g., scissors, can opener, fingernail clippers, car jack, lock cutters).

Evaluate
Students will be given an exit slip depicting a see-saw with a large elephant on one side and a small elephant on the other. Ask students to 1) mark a position on the see-saw where the large elephant should sit to allow the small elephant to lift it vertically with the least amount of effort

force, and 2) defend their reasoning in writing. A checklist for scoring the exit slip is provided in Appendix D. Provide time for students to rework their ideas from the pre-assessment as needed.

Lesson #4 – Traditional and Contemporary Levers in Use

Summary of the lesson

Students will participate in a presentation from a Tribal Elder or Tribal Consultant explaining the use of a traditional lever used as a hunting weapon. Students will model the use of this lever by conducting experiments with Chuck Its and tennis balls to observe how increasing the length of the lever arm increases the speed at which the arm moves, which results in an increased distance that the ball travels.

Grade level

5/6

Approximate time required

45-60 minutes for atlatl demonstration
90 minutes for remainder of lesson

Learning Objectives

Students will be able to:

1. Use evidence to recognize and explain how longer levers provide greater force than shorter levers. (MT Science *Standard* 1 *Benchmark* 1-3, *Standard* 2 *Benchmark* 6)
2. Identify levers used in students' lives and explain the advantages they afford in doing work. (MT Science *Standard* 2 *Benchmark* 6, *Standard* 5 *Benchmark* 2)
3. Explain and diagram how an atlatl, a traditional weapon of many American Indian tribes, functions as a lever. (MT Science *Standard* 2 *Benchmark* 6, *Standard* 5 *Benchmark* 2, *Standard* 6 *Benchmark* 1)
4. Document the benefits of the atlatl to Indigenous peoples and note specific types used by different cultures throughout history. (MT Science *Standard* 6 *Benchmark* 1)
5. Identify and explain the historical and contemporary use of other levers in American Indian cultures. (MT Science *Standard* 6 *Benchmark* 1)

Resources/materials needed

- Milk crate, 2x6 board, and heavy object from Lesson #3
- Tribal Elder or Tribal Consultant with knowledge of atlatl use
- Chuck-Its and tennis balls (minimum of 1 per group of 4)
- Chart paper and markers for recording data
- Tribal Elder or Tribal Consultant with knowledge of the use of levers in American Indian cultures
- Pre-Assessment of Levers, Forces, and Work (Appendix A)

Teacher Preparation

Review the Tribal Protocol explained in the beginning of the unit. Be sure to schedule Tribal Consultants and Elders as far in advance as possible. Fair weather will be necessary for experimentation with the Chuck Its and demonstration of the atlatl. The gym will not work as a substitute in case of poor weather.

Background Information

Work is done when an object moves in the direction of the force acting on it. Work is done by a lever, a simple machine, when an object (load) moves a given distance after a force (effort force) is applied. The effort force can be decreased if the distance the lever arm is able to move vertically is increased. The vertical distance the lever moves is increased when the length of the lever arm where the effort force is applied is also increased. Force and distance work inversely to guarantee that the input work is equal to the output work in the system. Similarly, if the vertical distance moved by the lever arm is decreased, the amount of effort force applied must be increased. This relationship is explained by the formula Work=Force x Distance.

Atlatls have been used traditionally in cultures from all around the world. Specifically, they are designed to lengthen the distance from a person's elbow to the end of the atlatl that holds a long dart. Its use results in darts that travel at faster speeds, and therefore farther distances, in a given amount of time. Cultures, specifically American Indian Tribes of the Northwest United States, historically used atlatls as weapons for harvesting game (deer, elk, bison, etc.).

Procedure

Engage

Using the same milk crate and 2x6 board used in the previous lesson, demonstrate the movement of the lever arms. Focus students' attention on the time it takes for each arm to reach its destination. Move the fulcrum several times and repeat the demonstration. Students should observe that each arm reaches its destination simultaneous with the other, regardless of the length of the lever arms. Pose the following question for small group discussion: "How can each arm reach its destination simultaneously when they often have to travel different distances?" After a few minutes, have groups share their answers with the whole class. Lead the class discussion to the formal conclusion that the longer lever arm in each case must travel to its destination *faster* because it has a longer distance to go in the same amount of time. Write the conclusion on the board for all to see.

Explore

Invite a tribal guest instructor to come to your school to teach about the cultural history of the atlatl and to provide an atlatl demonstration. Allow students to work in groups to use the atlatl and Chuck Its and make qualitative visual observations of the increasing speed of the lever arm with its increasing length.

Next, have groups of students conduct an experiment in which they compare the distance a tennis ball travels when it is thrown with just the hand, and then with Chuck Its of two different lengths. Allow practice time so that students gain proficiency in using the Chuck Its. Discuss the control of potential variables in the experiment (maintain constant force from their arm and constant form from their body when throwing the tennis ball, use the same size ball, use the same thrower in each trial, etc.). Remind students to collect data from their trials and to conduct at least three trials with each of the three levers.

Explain

Bring the whole class back to the classroom and graph each group's distance data on the board on a common graph. Have students look for general trends in the data. Data should show a general increase in the distance of the ball thrown with the unaided arm to the short Chuck It and then to the long Chuck It. Ask students to answer the question: "An atlatl or Chuck-It makes the ball go faster because…" verbally, in writing, or with a diagram. Ask student volunteers to present to the whole class. Work together to formulate a proper hypothesis that relates the length of the lever to the force it produces.

Elaborate

Have students conduct Internet research on the history of the atlatl. Assign each student a different culture to research. Have them create an advertisement for their culture's atlatl explaining why someone would want or need one.

Invite a Tribal Elder to visit the classroom to discuss and demonstrate the use of levers in American Indian cultures, specifically a pecé (pronounced "petseh"), a Bitterroot digging tool that is still used today. Please consult the notes on Tribal Protocol at the beginning of this unit in regards to working with elders and teaching about the Bitterroot.

A field trip to a location where levers are being used in contemporary culturally relevant settings is also recommended. For example, students could observe the use of complex machinery by S & K Environmental Restoration, Inc. (website: *http://www.skercorp.com)*, but also the use of simple levers as digging tools on a field trip to tribal forestry, tribal greenhouses, tribal fire control, etc.

Additional Resources for this extension:

- *The Gift of the Bitterroot: A Salish and Pend d'Oreille Story* by Johnny Arlee
- *Challenge to Survive: History of the Salish Tribes of the Flathead Indian Reservation* Unit I

Evaluate

Allow students one last opportunity to revise their pre assessment. Ask student volunteers to share their answers with the class and to defend their positions.

Appendix A: Pre-Assessment of Levers, Forces, and Work

Question	I think:	Lesson 1 After today, I think:	Lesson 2 After today, I think:	Lesson 3 After today, I think:	Lesson 4 After today, I think:
Do you agree that all forces cause objects to move?	Yes/No Why?	Yes/No Why?	Yes/No Why?	Yes/No Why?	Yes/No Why?
Can changing the position of heavy objects increase your ability to lift them?	Yes/No Why?	Yes/No Why?	Yes/No Why?	Yes/No Why?	Yes/No Why?
Do you use a simple machine called a lever on a daily basis?	Yes/No Why?	Yes/No Why?	Yes/No Why?	Yes/No Why?	Yes/No Why?

Appendix B: Friction and Force Analogies

Friction and Force Analogy

Complete each analogy below. Choose one of the three terms provided for each analogy, or create one of your own.

1. Force is like a ______________________________________ because

   ____.

Boxer
Monster
River

2. Friction is like (a) ______________________________________ because

   ____.

Stop sign
Molasses
Homework assignment

Appendix C: Rubric for Cartoon, Paragraph, or Speech

Balanced and Net Forces

Name: ______________________________________ Date: ______________

Title of Work: _____________________________________

	Criteria			Points
	1	2	3	Total
Definitions	Some definitions of force, balanced force, and net force are given. It is unclear if student understands his/her definitions.	Somewhat broad definitions of force, balanced force, and net force are given. Student understands his/her definitions.	Accurate, detailed definitions of force, balanced force, and net force are given. Student could teach his/her definitions.	____
Examples	Student attempts to give examples of balanced and net forces in daily life with some accuracy and originality.	One ORIGINAL real-life, daily example of balanced forces and one ORIGINAL real-life, daily example of net forces are presented.	Two ORIGINAL real-life, daily examples of balanced forces and two ORIGINAL real-life, daily examples of net forces are presented.	____
			Total---->	____

Teacher Comments:

Appendix D: Checklist for Lever Assessment

Did the student:

- ☐ Mark an accurate position for the elephant to sit to minimize the amount of effort force needed from the baby elephant to lift it? (close to the fulcrum)

Use the terms accurately in the written explanation?

- ☐ net force
- ☐ effort force
- ☐ load force
- ☐ fulcrum
- ☐ lever

- ☐ Accurately explain how increasing the vertical distance moved by the baby elephant decreases the amount of force needed to lift the elephant in the written explanation?

- ☐ Accurately explain how work was done in the system, both input work and output work?

Each box is worth 2 points. One point may be awarded if the student did not include the item in the written explanation, but is able to verbally answer a question related to it.

Teacher Feedback:

Total Score: ______ out of 16 possible points