4/25/2014

Assessing with Learning Progressions in Science

FOSS LEVERS & PULLEYS

Instructional Tools | **Contributors: Linda Reichlin, Anjeannette Hammer, Caitlin Gregory, Sandra Krause, Kathryn Peck, Sue Malone, Linda Varner and Laura Cross**

Northwest Educational Service District 189
Together We Can

Instructional Tools

In this packet you will find a set of instructional supports for science materials. These documents represent the work-in-progress of teachers in the Assessing with Learning Progressions in Science Project, a Math Science Partnership through the Northwest Educational Service District in Washington State. While we encourage others to use the materials, please know the power of these tools lies in the collaborative discussion and analysis that occurs during their creation. We strongly suggest that anyone utilizing these tools make them your own, adjusting them to fit your teaching context and district priorities. Professional development tools to aid you in this process are available on the ALPS project web page www.nwesd.org/nwalps. For access to editable versions of these documents please contact Nancy Menard nmenard@nwesd.org.

Overview of the Tools (not every unit tool-set will include all of these tools)

Unit Overview

The unit overview grid lays out learning targets or important scientific ideas from Washington State Standards for each investigation in the module and clarifies the success criteria for each learning target. It also details the formative assessments that have been designed to assess each target in the investigation.

Learning Progressions

A learning progression is a graphical representation of the path students take toward mastery of a science "big idea". The ALPS *Learning Progression* documents include a description of an important big idea from the *Washington State Science Learning Standards* and the progression of building-block learning targets that students master on their way toward an understanding of that big idea. For each building-block learning target the student success criteria is identified and one or more formative assessment tasks to elicit evidence of student understanding are suggested.

Formative Assessment Tasks

The suggested formative assessment tasks are examples of tools used by the teachers in the ALPS project to gather evidence of student understanding. The *Assessment Task Cover Sheet* details each assessment and gives administration tips and suggestions for instructional adjustments based on some of the common student struggles they encountered.

Student Work Samples

Selected student work samples from students in ALPS classrooms give a picture of the range of student responses gathered from sample formative assessments. The *Student Work Sample Cover Sheet* describes the student work samples and the teacher's interpretation of student understanding.

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Levers & Pulleys Unit Plan with Formative Assessment (NW ALPS)

Lesson		Learning Targets & Success Criteria	Assessment	Vocabulary	Materials
Pre-Teaching					
Pre-teach Force (Optional – if your students need it)	**Force**	Prerequisite Skills • The relative strength of two forces can be compared by observing the difference in how they move a common object (2-3 PS1D) • Motion can be described as a change in position over a period of time (2-3 PS1A) • There is always a force involved when something starts moving or changes its speed or direction of motion (2-3 PS1B) • There's always a force involved in any change of motion or direction. (2-3 PS1B)	Lessons: Use the attached portion of the Interact unit, *Roller Coaster*, to pre-teach concepts about force.	○ Force	○ Selections from the Interact unit, *Roller Coaster*
Investigation 1: Levers					
1-1 Introduction to Levers *Simple Machines*	**Systems**	🎯 Mechanical systems change forces and motions. ✓ I can show how forces and motion are changed by a simple machine.	Step 6: Walk around and ask students to identify the fulcrum and show where to put their finger to make the load easier to lift and harder to lift.	○ Lever ○ Lever Arm ○ Fulcrum ○ Load ○ Effort ○ Newtons	○ Spring scales w/ rubber bands ○ Loads w/ rubber bands ○ Half-meter sticks ○ Binder clips ○ Dowels ○ Pencil-top erasers ○ Duct tape
	Systems	🎯 Mechanical systems, like levers, use the placement of fulcrum, effort and load to give an advantage where the setup is the input and the advantage is the output. ✓ I can diagram a lever that includes a load, fulcrum and effort and makes effort easier or harder.	Step 8: Draw two pictures of lever systems. In the first, show where on your lever you press in order to use the least amount of force. In the second, show where you press in order to use the most amount of force. Label the load and effort in each picture.		
	Inquiry	🎯 Questions and hypotheses should drive the investigation. ✓ Given a question, I can write a hypothesis.	Write the question in front of the class. Students record hypotheses on post-its, pair & share with a neighbor and stick them up in front of the class.		

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Lesson		Learning Targets & Success Criteria	Assessment	Vocabulary	Materials
1-2 Lever Experiment A *Class-1 Levers*	**Force**	◎ An object that is not moving has balanced forces. Unbalanced forces will cause changes in the motion or direction of an object. ✓ In a simple machine, I can identify the forces that are balanced when the machine isn't moving. I can identify the unbalanced forces involved in a change of motion.	Use the data from the graph (Student Sheet 4) to answer: "What is the relationship between the load and the effort in a lever system?"	○ Two-coordinate graphs ○ Advantage	○ Student Sheet 4 ○ Student Sheet 5 ○ See 1-1
	Systems	◎ We can predict the advantage of the system based on the setup. ✓ I can explain how types of mechanical systems will affect the advantage.	Response Sheet – Levers (Student Sheet 5): Students decide which lever will provide the greatest advantage and explain why.		
Design Challenge 1	**Engineering**	◎ Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. ◎ Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem ◎ Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		○	○ See 1-1
1-3 Lever Experiment B *The Wheel and Axle*	**Force**	◎ An object that is not moving has balanced forces. Unbalanced forces will cause changes in the speed or direction of an object's motion. ✓ In a simple machine, I can identify the forces that are balanced when the machine isn't moving. I can identify the unbalanced forces involved in a change of motion.	Use the data from the graph (Student Sheet 6) to answer: "What is the relationship between the load and the effort in a lever system?"	○	○ Student Sheet 6 ○ See 1-1
	Inquiry	◎ A valid investigation has one manipulated (independent) variable while other variables are controlled (dependent). ✓ I can identify the controlled and manipulated variables in my investigation.	Student Sheet 6: Before doing the experiment, write down which variables will be controlled and which variable will be manipulated.		

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Lesson		Learning Targets & Success Criteria	Assessment	Vocabulary	Materials
Investigation 2: More Leverage					
2-1 Lever Classes	**Inquiry**	Scientific reports and investigations should be replicable and clearly communicate findings and how variables were affected. ✓ Given a framework, I can use a systematic approach to record and communicate data so that my experiment can be replicated.	Students complete the investigation framework and draw diagrams of the lever systems they discover in their notebooks. Students trade diagrams with a partner to replicate the lever systems.	○ Class-1 levers ○ Class-2 levers ○ Class-3 levers	○ See 1-1
2-2 Lever Diagrams *Class-2 Levers*				○ Diagram	○ Student Sheet 10 ○ Student Sheet 11 ○ See 1-1
2-3 Real-World Levers *Class-3 Levers*				○	○ Student Sheet 12 ○ Broom ○ Nutcracker ○ Scissors ○ Bottle Opener ○ Pliers ○ Tweezers ○ Hammer ○ Lever diagram posters ○ Lever picture posters
2-4 Lever Pictures *The Inclined Plane*				○	○ Student Sheets 16-17

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Lesson		Learning Targets & Success Criteria	Assessment	Vocabulary	Materials
Investigation 3: Pulleys					
3-1 One-Pulley Systems *Pulleys*	**Systems**	Mechanical systems, like pulleys, use wheels and ropes to give an advantage where the setup of the pulley system is the input and the advantage is the output. ✓ I can diagram a pulley that includes a load, rope, wheel and effort and makes effort easier.	Step 9: Student Sheet 18 Students diagram four types of pulley systems and describe how the type of pulley changes the advantage. With 3-1, diagram the single-fixed and single-movable pulleys. Continue during 3-2, step 6 with double pulleys.	○ Pulley ○ Fixed pulley ○ Movable pulley ○ Mechanical advantage ○ Directional advantage	○ Student Sheet 18 ○ Half-meter sticks ○ Binder clips ○ Spring scales w/ paper clip ○ Loads w/ rubber band ○ Single pulleys ○ Ropes ○ Heavy books ○ Duct tape
Design Challenge 2	**Engineering**	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		○	○ See 3-1
3-2 Two-Pulley Systems *Dear Boss*	**Inquiry**	A conclusion needs to be tied to the question and hypothesis and supported by the data gathered. ✓ I can generate a scientific conclusion to a specific question based on the data gathered.	Step 9: Students record conclusions. Students pair-share and give each other feedback on what they should add to make a more complete conclusion. Teacher walks the room and listens in on conversations.	○ Simple machine	○ Student Sheet 19 ○ See 3-1
3-3 Pulley Game *The Wedge*	**Force**	Changing the load, position or effort in a machine will change the advantage. ✓ I can move the load, position or effort to change the advantage in a simple machine.	Math Extension (Student Sheet 30): Students will demonstrate that the advantage can be changed by changing the type of pulley used in the system.	○	○ Student Sheet 30 ○ See 3-1

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Lesson		Learning Targets & Success Criteria	Assessment	Vocabulary	Materials
Investigation 4: Pulleys at Work					
4-1 Effort in Pulley Systems *The Work of Pulleys*				○	○ Student Sheet 20 ○ See 3-1 ○ Pulley system posters
4-2 Measuring Distance *The Screw*	**Force**	Advantage is a gain in effort, distance or change of direction ✓ In a simple machine, I can predict the advantage or gain in effort, distance or change of direction for different unbalanced forces.	Student Sheet 24: Students predict the advantage and disadvantage of a pulley system in a given scenario.	○	○ Student Sheet 23 ○ Student Sheet 24 ○ See 3-1 ○ Cardboard sheets ○ White paper
Design Challenge 3	**Engineering**	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		○	○ See 3-1
4-3 Choosing Your Own Investigation *Thank You, Mr. Clumpet*				○	○

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Learning Progression

FOSS Levers & Pulleys: Force

Prerequisite skills:

The relative strength of two forces can be compared by observing the difference in how they move a common object (2-3 PS1D)

Motion can be described as a change in position over a period of time (2-3 PS1A)

There is always a force involved when something starts moving or changes its speed or direction of motion (2-3 PS1B)

There's always a force involved in any change of motion or direction. (2-3 PS1B)

Learning Target 1:

An object that is not moving has balanced forces. Unbalanced forces will cause changes in the motion or direction of an object.
(6-8 PS1C)
Inv. 1, Parts 2 and 3

Success Criteria:
In a simple machine, I can identify the forces that are balanced when the machine isn't moving. I can identify the unbalanced forces involved in a change of motion.

Formative Assessment:
Inv. 1-2, 1-3 (Student Sheets 4 & 6) Lever experiment A & B - Use the data from the graphs to answer: "What is the relationship between the load and the effort in a lever system?"

Learning Target 2:

Advantage is a gain in effort, distance or change of direction.

Inv. 4, Part 2

Success Criteria:
In a simple machine, I can predict the advantage or gain in effort, distance or change of direction for different unbalanced forces.

Formative Assessment:
Inv. 4-2 (Student Sheet 24) Students predict the advantage and disadvantage of a pulley system in a given scenario.

Learning Target 3:

Changing the load, position or effort in a machine will change the advantage.
(6-8 PS1C)
Inv. 3, Part 3

Success Criteria:
I can move the load, position or effort to change the advantage in a simple machine.

Formative Assessment:
Inv. 3-3 Math Extension (Student Sheet 30)

Students will demonstrate that the advantage can be changed by changing the type of pulley used in the system.

Big Idea:

Machines can change the forces or directions necessary to move an object.
(6-8 PS1C)

Northwest Educational Service District 189
Together We Can

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

LEVERS & PULLEYS

Big Idea: Machines can change the forces or directions necessary to move an object. (6-8 PS1C)

Formative Assessment Task Cover Sheet

Learning Target 1	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 1-2, 1-3 (Student Sheets 4 & 6) Lever experiment A & B - Use the data from the graphs to answer: "What is the relationship between the load and the effort in a lever system?"	**Administration Tips:** **Suggestions for Instructional Adjustments:** Depending on your students' experience level with graphing, it may help to scaffold the instruction by setting up the graph scales with them and plotting some sample points.
Learning Target: An object that is not moving has balanced forces. Unbalanced forces will cause changes in the motion or direction of an object. (6-8 PS1C) Inv. 1, Parts 2 and 3	
Success Criteria: In a simple machine, I can identify the forces that are balanced when the machine isn't moving. I can identify the unbalanced forces involved in a change of motion.	
Student Task Sheet Included: no Student Work Samples Included: no	

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

LEVERS & PULLEYS

Big Idea: Machines can change the forces or directions necessary to move an object. (6-8 PS1C)

Learning Target 2	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 4-2 (Student Sheet 24) Students predict the advantage and disadvantage of a pulley system in a given scenario.	**Administration Tips:** Encourage students to count the ropes and highlight the information about how Belinda can *only* lift one crate. **Suggestions for Instructional Adjustments:** Consider separating the two questions if your students often don't answer all questions completely.
Learning Target: Advantage is a gain in effort, distance or change of direction. Inv. 4, Part 2	
Success Criteria: In a simple machine, I can predict the advantage or gain in effort, distance or change of direction for different unbalanced forces.	
Student Task Sheet Included: no Student Work Samples Included: no	

Learning Target 3	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 3-3 Math Extension (Student Sheet 30) Students will demonstrate that the advantage can be changed by changing the type of pulley used in the system.	**Administration Tips:** Have the students create a systematic way of showing their answer. **Suggestions for Instructional Adjustments:** Do this assignment in two parts. First, have the students work on getting everyone to the top of the cliff. Second, have them figure out the fewest number of lifts. Make sure to do this in class and not as a homework assignment. A suggestion to take this learning further would be to set up a pulley system in your gym. Have students be the load by sitting on a mat and other students be the effort by pulling the rope to drag the mat along the floor. Revise the pulley system to make the load easier to pull. When using multiple pulleys, it becomes very clear to students how far they have to pull the ropes.
Learning Target: Changing the load, position or effort in a machine will change the advantage. (6-8 PS1C) Inv. 3, Part 3	
Success Criteria: I can move the load, position or effort to change the advantage in a simple machine.	
Student Task Sheet Included: no Student Work Samples Included: no	

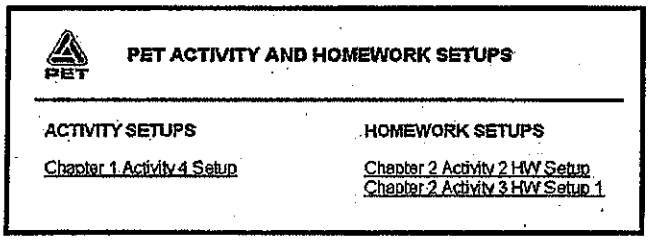
 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Important: *See the notes at the end of this appendix regarding compatible operating systems and browsers.*

Use a computer connected to the Internet. After starting up your web browser you can access the simulators at:

http://cpucips.sdsu.edu/petsims

(You should check with your instructor to determine if the *url* for the simulator has changed.) When you go to this page you will see two lists of links, one for the simulator setups for in-class activities, the other for setups to be used in homework assignments. (The top of the page and the first few links should be similar to those shown below.)



To access one of these setups simply click on the relevant link.

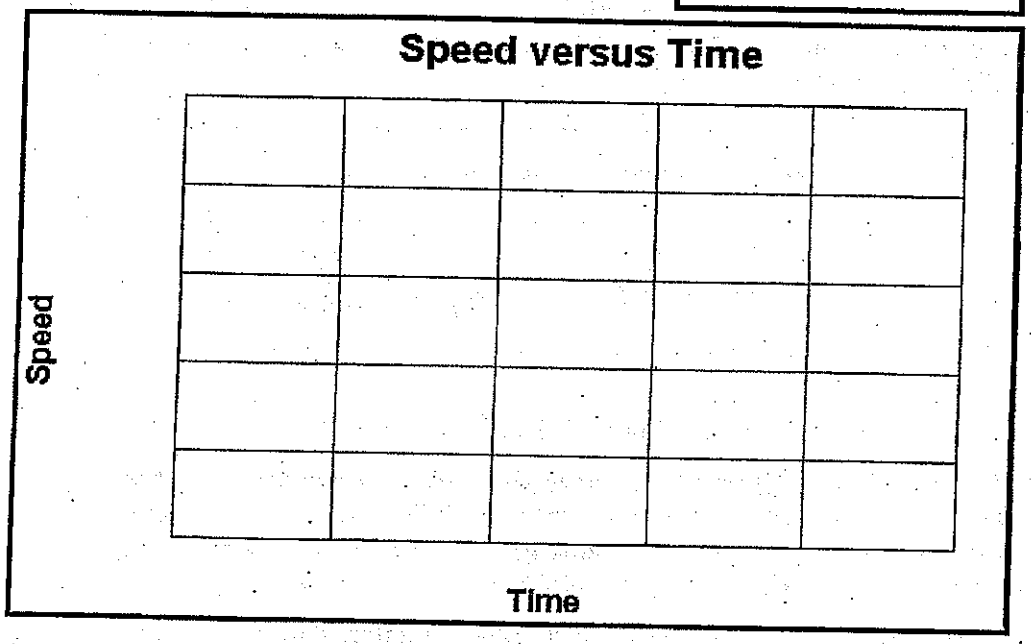
Note that, depending on the speed of your Internet connection, it may take up to several minutes for the setup to fully load. Do not attempt to use your computer until the loading process is complete or it may interrupt the download and you will have to start all over again!

Once the setup is fully loaded you can run the simulator. The simulators are Java applets; on some of the latest versions of web browsers, you may need to click once on the simulator to activate the Java program.

Initial Ideas

Think about a soccer player kicking a stationary ball. As he interacts with it, by kicking it, the ball starts to move. After the kick, the ball rolls across the grass and gradually comes to a halt.

Sketch a speed-time graph for the motion of the ball. Be sure to include both the motion of the ball while the player's foot is touching it, and its motion after the foot has lost contact with it.



Using a colored pencil, indicate the period on the graph during which you think the foot was in contact with the ball and briefly explain your reasoning.

Using a different-colored pencil, indicate the period on the graph during which you think there was a force pushing the ball forward. Again, explain your reasoning.

Why do you think the ball gradually slows down and eventually stops after it has been kicked?

Now draw two pictures of the ball and use arrows to show what **forces** (if any) you think are acting on the ball at two different times during its motion. Label your arrows to show where the forces come from.

i) During the time foot was in contact with the ball.

ii) After the foot has lost contact and the ball is rolling across the grass.

Briefly explain the reasoning behind your pictures.

Discuss your ideas with your team and try to agree on what the speed-time graph and 'force' picture(s) should look like. Sketch your team's graph and picture(s) on a large presentation board.

Participate in a whole-class discussion about these questions. Make a note of any ideas or reasoning that are different from those of your team.

Why do you think the ball gradually slows down and eventually stops after it has been kicked?

Now draw two pictures of the ball and use arrows to show what **forces** (if any) you think are acting on the ball at two different times during its motion. Label your arrows to show where the forces come from.

i) During the time foot was in contact with the ball.

ii) After the foot has lost contact and the ball is rolling across the grass.

Briefly explain the reasoning behind your pictures.

Discuss your ideas with your team and try to agree on what the speed-time graph and 'force' picture(s) should look like. Sketch your team's graph and picture(s) on a large presentation board.

Participate in a whole-class discussion about these questions. Make a note of any ideas or reasoning that are different from those of your team.

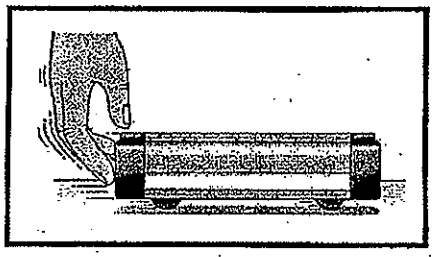
Collecting and Interpreting Evidence

EXPERIMENT: Is the motion of the cart after it has been pushed the same as during the push?

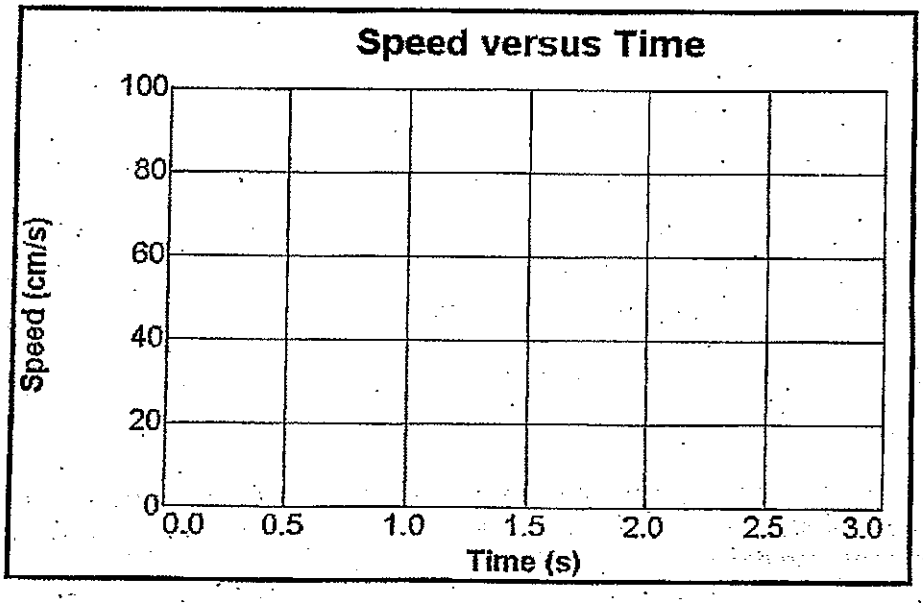
YOU WILL NEED:

- Low-friction cart
- Track
- Access to a Motion Sensor connected to a computer
- Access to the *I&M Computer Simulator*

STEP 1: Open the Motion Sensor data collection file for this experiment. Place your cart at rest on the track about 20-30 cm in front of the Motion Sensor. Start collecting Motion Sensor data and then have one of your team give the cart a quick push away from the sensor. (Stop the cart when it reaches the other end of the track.)



Sketch the speed-time graph for the motion of the cart.



What happens to the speed of the cart while the hand is actually in contact with it? Does it speed up quickly, slow down quickly, or move at a reasonably constant speed?

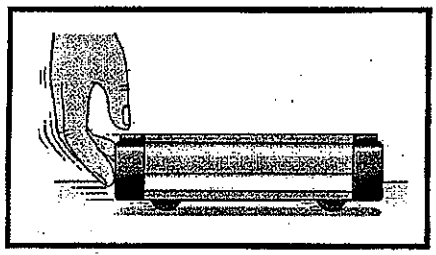
Collecting and Interpreting Evidence

EXPERIMENT: Is the motion of the cart after it has been pushed the same as during the push?

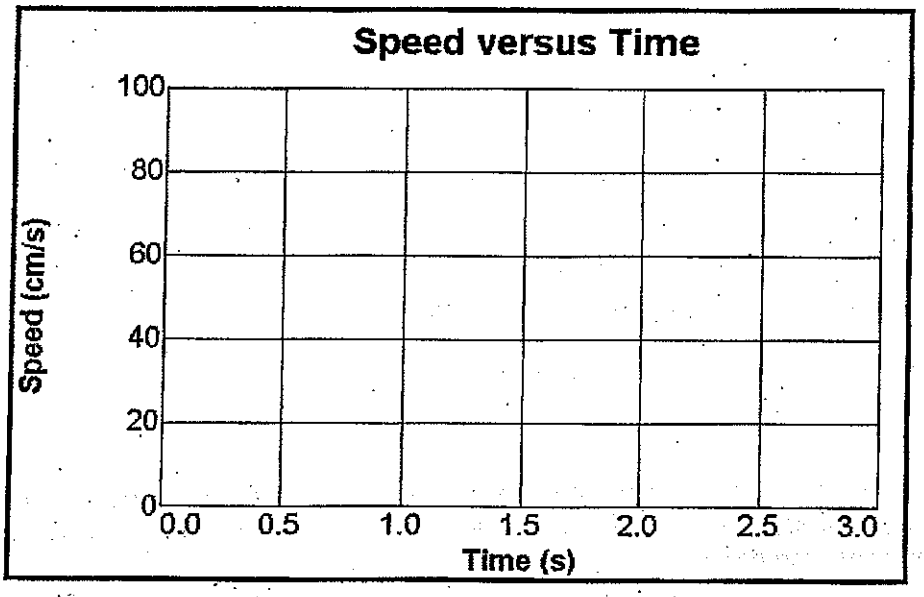
YOU WILL NEED:

- Low-friction cart
- Track
- Access to a Motion Sensor connected to a computer
- Access to the *I&M Computer Simulator*

STEP 1: Open the Motion Sensor data collection file for this experiment. Place your cart at rest on the track about 20-30 cm in front of the Motion Sensor. Start collecting Motion Sensor data and then have one of your team give the cart a quick push away from the sensor. (Stop the cart when it reaches the other end of the track.)



Sketch the speed-time graph for the motion of the cart.



What happens to the speed of the cart while the hand is actually in contact with it? Does it speed up quickly, slow down quickly, or move at a reasonably constant speed?

LEVERS & PULLEYS

Big Idea: Machines can change the forces or directions necessary to move an object. (6-8 PS1C)

Target 1, Assessment: *Speed/Time Graphs*

Formative Assessment Student Work Cover Sheet

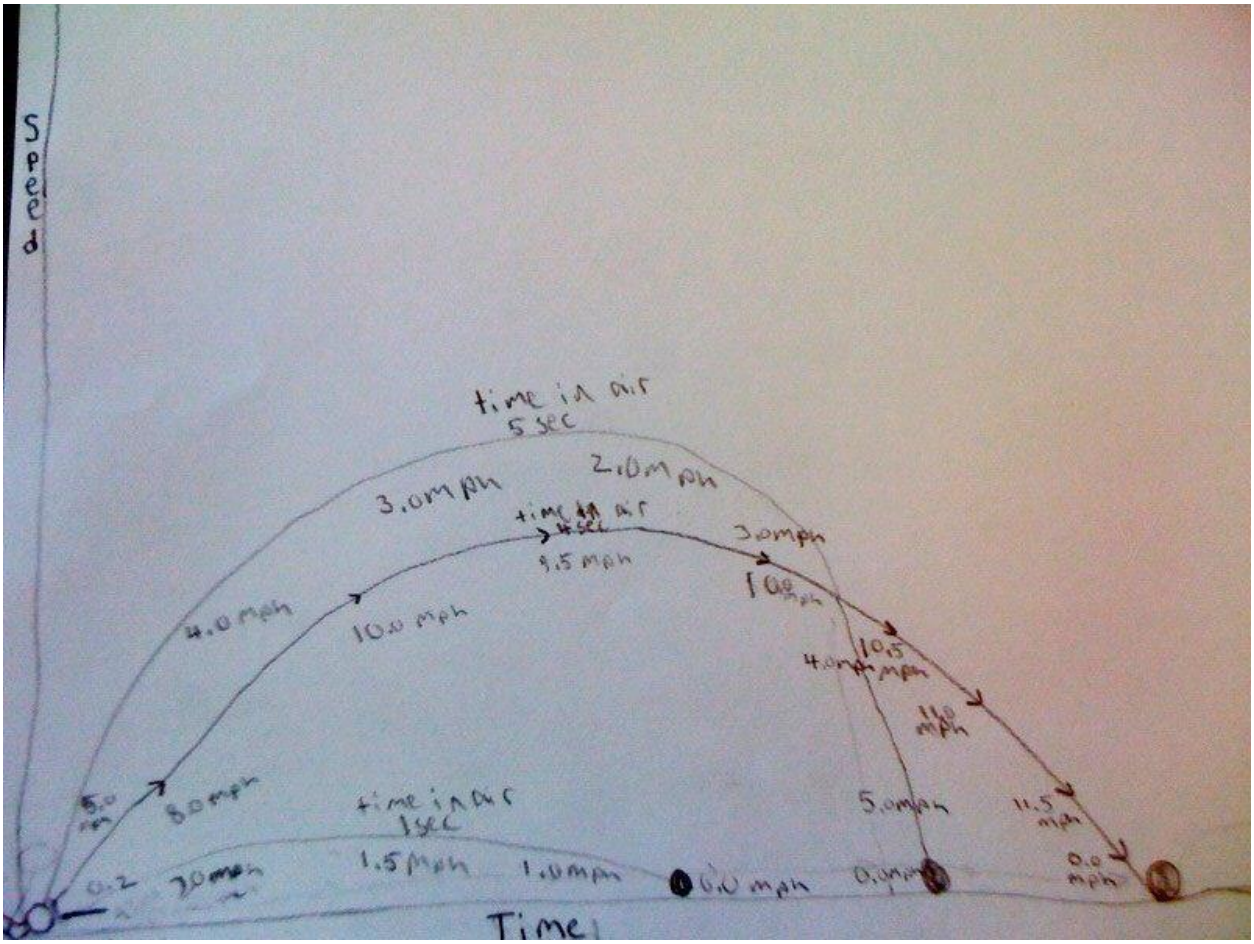
Student Work Description

Sample 1: These students seemed to be showing the arc of the ball travelling through the air rather than the speed of the ball as evidenced by the fact that the ball's speed decreases as the graph continues to climb. The speed of the ball in this graph continues to increase after the foot has lost contact.

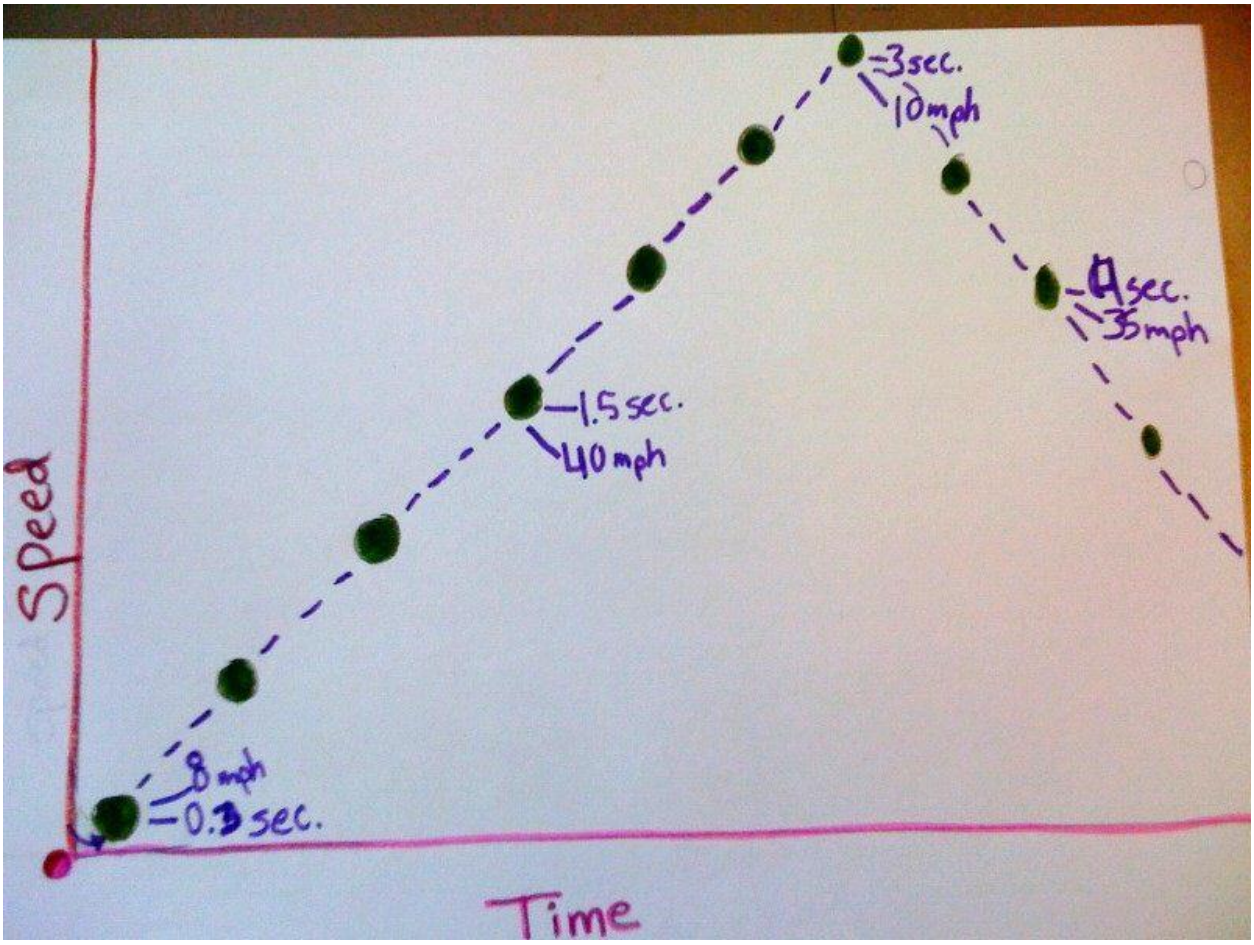
Sample 2: This group of students had some differing ideas. They also seemed to think that their graph was supposed to show the ball travelling through the air. The lowest line seems to show that the student understood that the ball would be fastest immediately after the kick and then slow down. The other two lines show an increase in speed after the ball was kicked.

Sample 3: This student did not seem to understand how to draw a graph. It also shows that the student did not understand the relationship between speed and force.

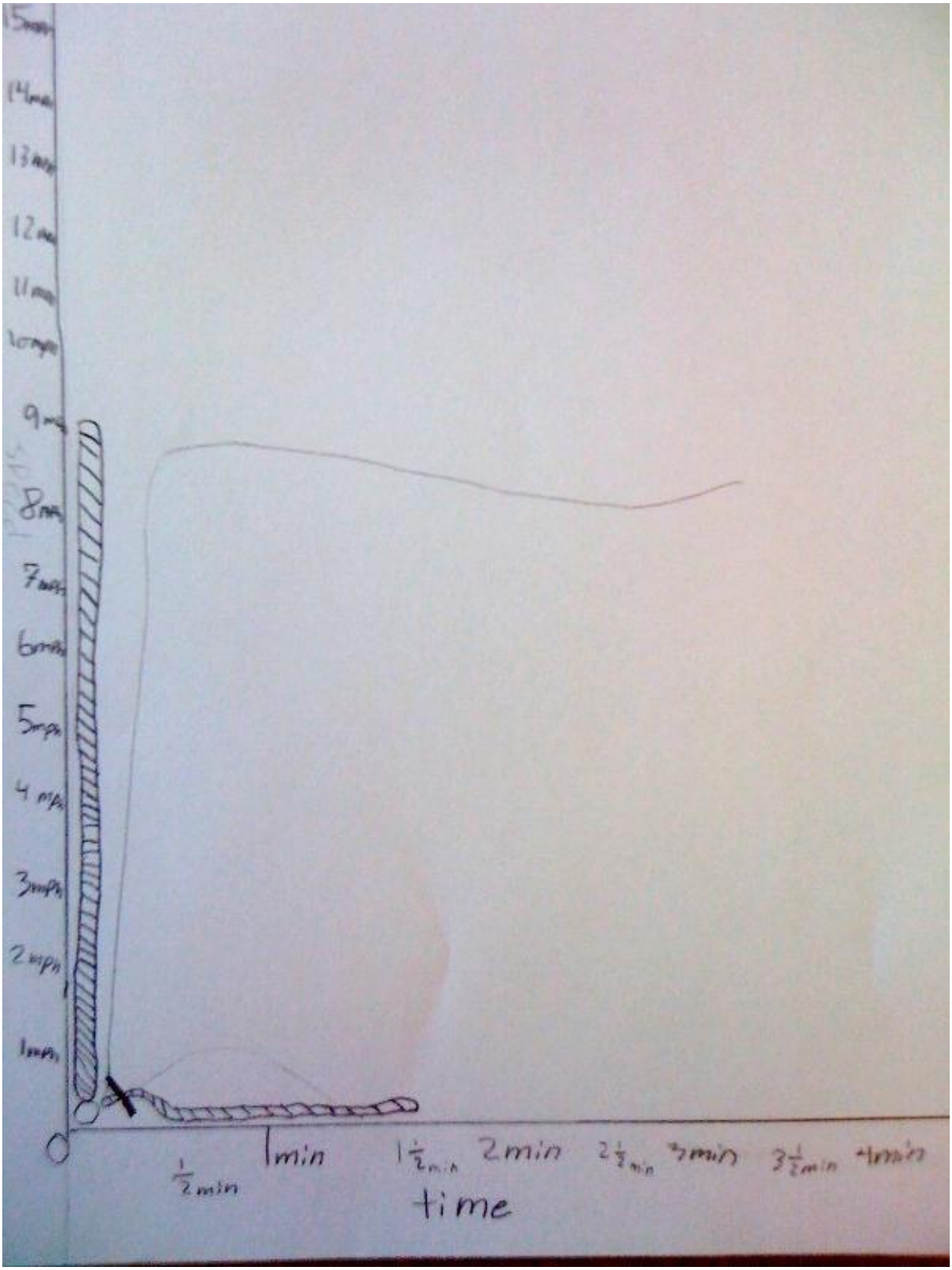
 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.


Speed
time in air
5 sec
3.0 mph
2.0 mph
4.0 mph
10.0 mph
9.5 mph
3.0 mph
10.5 mph
11.0 mph
11.5 mph
5.0 mph
8.0 mph
time in air
1 sec
1.5 mph
1.0 mph
0.0 mph
0.0 mph
Time

Sample 1



Sample 2



Sample 3

Learning Progression: Inquiry

Materials: FOSS Levers & Pulleys **Grade level: 5-6**

Prerequisite skill:

There are different variables that affect our investigations. (6-8 INQD)

Learning Target: **1**

Questions and hypotheses should drive the investigation.
(4-5 INQA-B, 6-8 INQA-B)
Inv. 1, Part 1

Success Criteria:
Given a question, I can write a hypothesis.

Formative Assessment:
Inv. 1-1: Write the question in front of the class. Students record hypotheses on post-its, pair & share with a neighbor and stick them up in front of the class.

On-going: Student-generated hypotheses for individual investigations

Learning Target: **2**

Scientific reports and investigations should be replicable and clearly communicate findings and how variables were affected.
(4-5 INQD, 6-8 INQC & G)
Inv. 2. Part 1

Success Criteria:
Given a framework, I can use a systematic approach to record and communicate data so that my experiment can be replicated.

Formative Assessment:
Inv. 2-1: Students complete the investigation framework and draw diagrams of the lever systems they discover in their notebooks. Students trade diagrams with a partner to replicate the lever systems.

Learning Target: **3**

A valid investigation has one manipulated (independent) variable while other variables are controlled (dependent).
(6-8 INQD)
Inv. 1, Part 3

Success Criteria:
I can identify the controlled and manipulated variables in my investigation.

Formative Assessment:
Inv. 1-3: Before doing the experiment, write down which variables will be controlled and which variable will be manipulated.

Learning Target: **4**

A conclusion needs to be tied to the question and hypothesis and supported by the data gathered.
(4-5 INQG, 6-8 INQF)
Inv. 3, Part 2

Success Criteria:
I can generate a scientific conclusion to a specific question based on the data gathered.

Formative Assessment:
Inv. 3-2 Step 9: Students record conclusions. Students pair-share and give each other feedback on what they should add to make a more complete conclusion. Teacher walks the room and listens in on conversations.

Big Idea:

Valid experiments and investigations have specific criteria: asking questions, data collection, analysis and reporting.
(4-5 INQA-H, 6-8 INQA-G)

Later big ideas that build on this big idea include:

Northwest Educational Service District 189
Together We Can

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

LEVERS & PULLEYS

Big Idea: Valid experiments and investigations have specific criteria: asking questions, data collection, analysis and reporting. (4-5 INQA-H, 6-8 INQA-G)

Formative Assessment Task Cover Sheet

<table>
<tr><th colspan="2">Learning Target 1</th></tr>
<tr><th>Assessment Task Details</th><th>Teacher Background</th></tr>
<tr><td>Brief Description of the Assessment Task: Inv. 1-1: Write the question in front of the class. Students record hypotheses on post-its, pair & share with a neighbor and stick them up in front of the class.</td><td rowspan="4">Administration Tips: Use the sentence stem “If…then…because…” to help students write a complete hypothesis.

Suggestions for Instructional Adjustments: Any feedback should be directed towards writing a complete hypothesis rather than the correctness of student thinking.</td></tr>
<tr><td>Learning Target: Questions and hypotheses should drive the investigation. (4-5 INQA-B, 6-8 INQA-B) Inv. 1, Part 1</td></tr>
<tr><td>Success Criteria: Given a question, I can write a hypothesis.</td></tr>
<tr><td>Student Task Sheet Included: no
Student Work Samples Included: yes</td></tr>
</table>

LEVERS & PULLEYS

Big Idea: Valid experiments and investigations have specific criteria: asking questions, data collection, analysis and reporting. (4-5 INQA-H, 6-8 INQA-G)

Learning Target 2	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 2-1: Students complete the investigation framework and draw diagrams of the lever systems they discover in their notebooks. Students trade diagrams with a partner to replicate the lever systems.	**Administration Tips:** **Suggestions for Instructional Adjustments:** After students have attempted to replicate lever systems, discuss what information was missing from the diagrams and try again.
Learning Target: Scientific reports and investigations should be replicable and clearly communicate findings and how variables were affected. (4-5 INQD, 6-8 INQC & G) Inv. 2, Part 1	
Success Criteria: An object that is not moving has balanced forces. Unbalanced forces will cause changes in the motion or direction of an object.	
Student Task Sheet Included: no Student Work Samples Included: no	

LEVERS & PULLEYS

Big Idea: Valid experiments and investigations have specific criteria: asking questions, data collection, analysis and reporting. (4-5 INQA-H, 6-8 INQA-G)

Learning Target 3	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 1-3: Before doing the experiment, write down which variables will be controlled and which variable will be manipulated.	**Administration Tips:** **Suggestions for Instructional Adjustments:** Review the vocabulary (controlled and manipulated variables). Make sure that students understand that only one thing should be changed while everything else stays the same.
Learning Target: A valid investigation has one manipulated (independent) variable while other variables are controlled (dependent). (6-8 INQD) Inv. 1, Part 3	
Success Criteria: I can identify the controlled and manipulated variables in my investigation.	
Student Task Sheet Included: no Student Work Samples Included: no	

Learning Target 4	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 3-2 Step 9: Students record conclusions. Students pair-share and give each other feedback on what they should add to make a more complete conclusion. Teacher walks the room and listens in on conversations.	**Administration Tips:** Be sure to emphasize the inclusion of evidence, data and/or diagrams in the conclusion. **Suggestions for Instructional Adjustments:** When providing feedback, ask students a question that will cause them to think more deeply about what they could add to their conclusions.
Learning Target: A conclusion needs to be tied to the question and hypothesis and supported by the data gathered. (4-5 INQG, 6-8 INQF) Inv. 3, Part 2	
Success Criteria: I can generate a scientific conclusion to a specific question based on the data gathered.	
Student Task Sheet Included: no Student Work Samples Included: no	

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

LEVERS & PULLEYS

Big Idea: Valid experiments and investigations have specific criteria: asking questions, data collection, analysis and reporting. (4-5 INQA-H, 6-8 INQA-G)

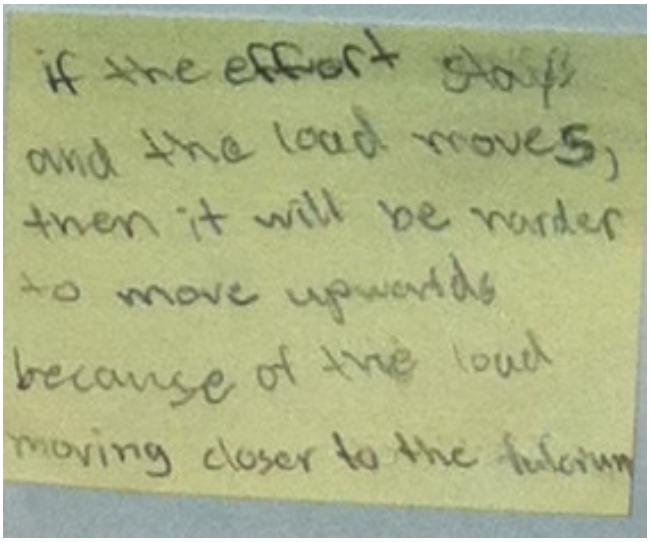
Target 1, Assessment: Hypothesis

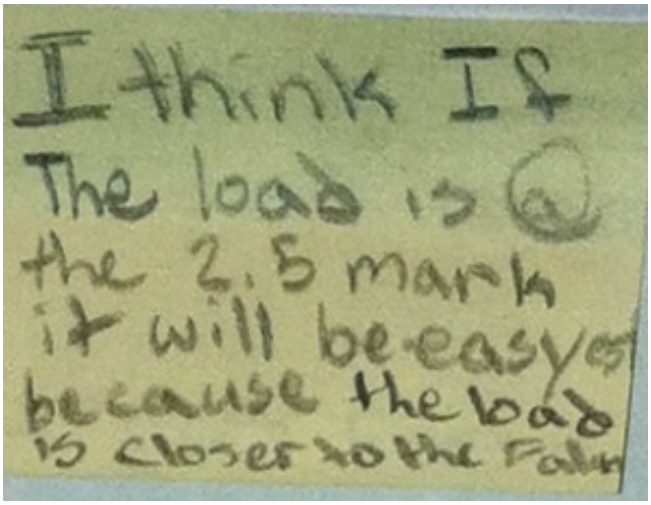
Formative Assessment Student Work Cover Sheet

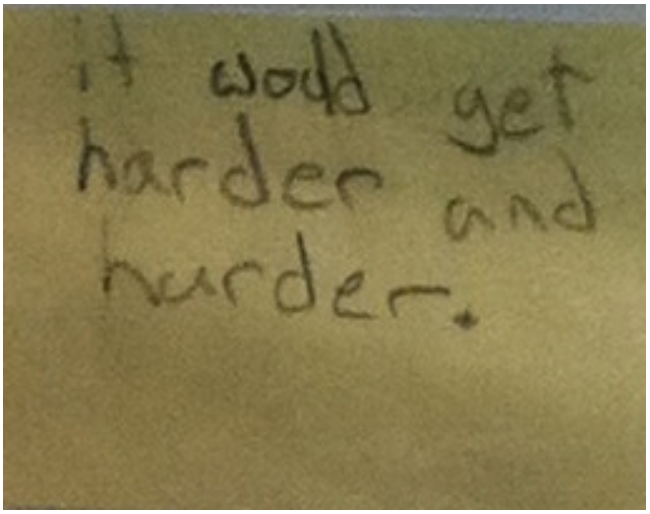
Student Work Description

Sample 1: The first student used the "If…then…because…" structure. The second used "If…because…" and the third did not use the structure and was unclear about what they were describing.

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.


if the effort stays
and the load moves,
then it will be harder
to move upwards
because of the load
moving closer to the fulcrum


I think If
The load is @
the 2.5 mark
it will be easyer
because the load
is closer to the Fulc


it wodd get
harder and
harder.

Learning Progression: Systems

Materials: FOSS Levers & Pulleys **Grade level: 5-6**

Prerequisite skill: Understand the difference between mechanical and non-mechanical systems.

Learning Target:

Mechanical systems change forces and motions.

Inv. 1, Part 1

Success Criteria:
I can show how forces and motion are changed by a simple machine.

Formative Assessment:
Inv. 1-1 Step 6: Walk around and ask students to identify the fulcrum and show where to put their finger to make the load easier to lift and harder to lift.

Learning Target:

Mechanical systems, like levers, use the placement of fulcrum, effort and load to give an advantage where the setup is the input and the advantage is the output.
(4-5 SYSC)

Success Criteria:
I can diagram a lever that includes a load, fulcrum and effort and makes effort easier or harder.

Formative Assessment:
Inv. 1-1 Step 8: Draw two pictures of lever systems. In the first, show where on your lever you press in order to use the least amount of force. In the second, show where you press in order to use the most amount of force. Label the load and effort in each picture.

Learning Target:

Mechanical systems, like pulleys, use wheels and ropes to give an advantage where the setup of the pulley system is the input and the advantage is the output.
(4-5 SYSC)

Success Criteria:
I can diagram a pulley that includes a load, rope, wheel and effort and makes effort easier.

Formative Assessment:
Inv. 3-1 Step 9 (Student Sheet 18): Students diagram four types of pulley systems and describe how the type of pulley changes the advantage. With 3-1, diagram the single-fixed and single-movable pulleys. Continue during 3-2, step 6 with double pulleys.

Learning Target:

We can predict the advantage of the system based on the setup.

Inv. 1, Part 2

Success Criteria:
I can explain how types of mechanical systems will affect the advantage.

Formative Assessment:
Inv. 1-2 Response Sheet – Levers (Student Sheet 5): Students decide which lever will provide the greatest advantage and explain why.

Big Idea:

Systems have inputs and outputs. We can predict what will happen if input is changed.
(4-5 SYSC)

Later big ideas that build on this big idea include:

Northwest Educational Service District 189
Together We Can

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

LEVERS & PULLEYS

Big Idea: Systems have inputs and outputs. We can predict what will happen if input is changed. (4-5 SYSC)

Formative Assessment Task Cover Sheet

Learning Target 1	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 1-1 Step 6: Walk around and ask students to identify the fulcrum and show where to put their finger to make the load easier to lift and harder to lift.	**Administration Tips:** You might find it helpful to keep a checklist as you walk around. **Suggestions for Instructional Adjustments:** Discuss any errors in thinking with students as you come across them.
Learning Target: Mechanical systems change forces and motions. Inv. 1, Part 1	
Success Criteria: I can show how forces and motion are changed by a simple machine.	
Student Task Sheet Included: no Student Work Samples Included: no	

LEVERS & PULLEYS

Big Idea: Systems have inputs and outputs. We can predict what will happen if input is changed. (4-5 SYSC)

Learning Target 2	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 1-1 Step 8: Draw two pictures of lever systems. In the first, show where on your lever you press in order to use the least amount of force. In the second, show where you press in order to use the most amount of force. Label the load and effort in each picture.	**Administration Tips:** Either walk around to check student understanding or collect the drawings and provide feedback. **Suggestions for Instructional Adjustments:** Reinforce the learning target and use of vocabulary at the start of the next lesson.
Learning Target: Mechanical systems, like levers, use the placement of fulcrum, effort and load to give an advantage where the setup is the input and the advantage is the output. (4-5 SYSC) Inv. 1, Part 1	
Success Criteria: I can diagram a lever that includes a load, fulcrum and effort and makes effort easier or harder.	
Student Task Sheet Included: no Student Work Samples Included: no	

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

LEVERS & PULLEYS

Big Idea: Systems have inputs and outputs. We can predict what will happen if input is changed. (4-5 SYSC)

Learning Target 3	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 3-1 Step 9: Student Sheet 18. Students diagram four types of pulley systems and describe how the type of pulley changes the advantage. With 3-1, diagram the single-fixed and single-movable pulleys. Continue during 3-2, step 6 with double pulleys.	**Administration Tips:** Model the diagrams on the board for students. Make sure they add labels and use appropriate symbols for load and effort. **Suggestions for Instructional Adjustments:**
Learning Target: Mechanical systems, like pulleys, use wheels and ropes to give an advantage where the setup of the pulley system is the input and the advantage is the output. (4-5 SYSC) Inv. 3, Part 1	
Success Criteria: I can diagram a pulley that includes a load, rope, wheel and effort and makes effort easier.	
Student Task Sheet Included: no Student Work Samples Included: no	

Learning Target 4	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 1-2 Response Sheet – Levers (Student Sheet 5). Students decide which lever will provide the greatest advantage and explain why.	**Administration Tips:** Be sure that students read and respond to the full question. **Suggestions for Instructional Adjustments:** Review position of the fulcrum for the greatest advantage.
Learning Target: We can predict the advantage of the system based on the setup. Inv. 1, Part 2	
Success Criteria: I can explain how types of mechanical systems will affect the advantage.	
Student Task Sheet Included: no Student Work Samples Included: no	

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

LEVERS & PULLEYS

Big Idea: Systems have inputs and outputs. We can predict what will happen if input is changed. (4-5 SYSC)

Target 4, Assessment: *b) Response Sheet—Pulleys*

Formative Assessment Student Work Cover Sheet

Student Work Description

Sample 1: This student understood how the mechanical advantage related to the effort required.

Sample 2: While the student indicated the correct type of pulley, there is a misconception between the terms “effort” and “weight.”

Sample 3: This student chose the wrong type of pulley and did not address the need for any kind of advantage, whether directional or mechanical.

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Name _____

Date 1 _____

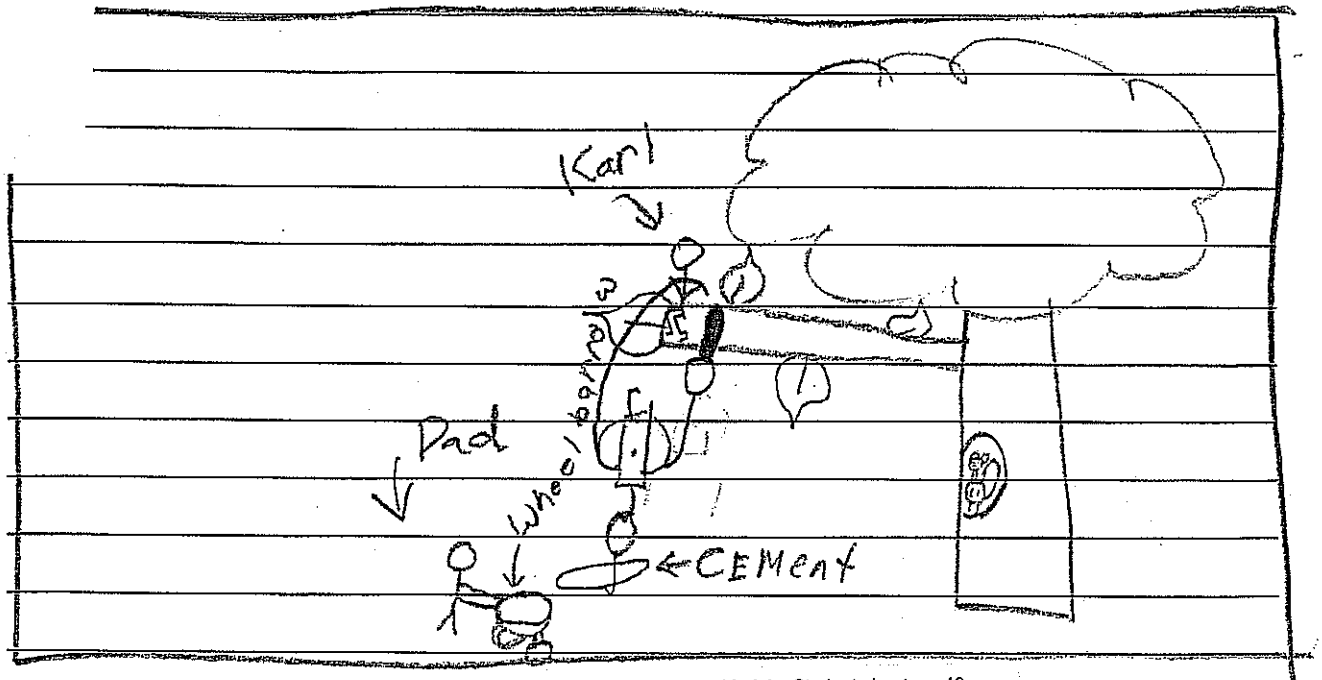
RESPONSE SHEET—PULLEYS

Karl told his brother Charles, "I just couldn't lift that 30-kg bag of cement into Dad's wheelbarrow until I got a pulley and a rope. Then it was easy."

Charles was surprised. "You got the cement into the wheelbarrow!? How did you do it? How much easier was it?"

Explain how you think Karl lifted the cement and how much effort he had to apply.

I believe Carl used a single-moveable. I think he used it, because it would give him a mechanical advantage, cutting the weight in half. It would be twice as easy, because the weight was half as much. Since the cement weighs 30, and by using a moveable it is cutting the weight to 15, it means he would only need half the effort that it would take lifting by hand.



FOSS Landforms Module, Student sheet no. 19, Response Sheet-Pulleys, 2005 of publication from the teacher guide. Developed at the Lawrence Hall of Science and published and distributed by Delta Education. Copyright © The Regents of the University of California. Used with permission.

Name _____

Date _____

RESPONSE SHEET—PULLEYS

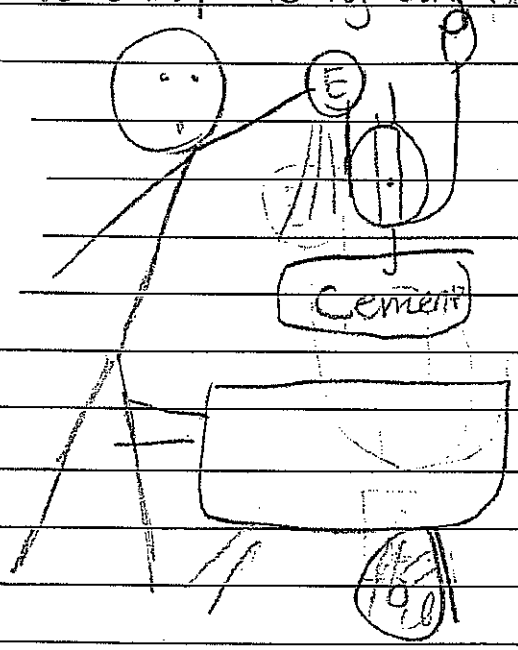
Karl told his brother Charles, "I just couldn't lift that 30-kg bag of cement into Dad's wheelbarrow until I got a pulley and a rope. Then it was easy."

Charles was surprised. "You got the cement into the wheelbarrow!? How did you do it? How much easier was it?"

Explain how you think Karl lifted the cement and how much effort he had to apply.

cement

I think Karl hooked it up to a movable pulley because it makes the cement only weigh half the amount, and because you would not need a directional advantage (because the wheel barrow is only about two feet high) than you would only have to carry 15 kg out of 30kg



KEY
L = load
E = Effort

FOSS Landforms Module, Student sheet no. 19, Response Sheet-Pulleys, 2005 of publication from the teacher guide. Developed at the Lawrence Hall of Science and published and distributed by Delta Education.

Name _____

Date _____

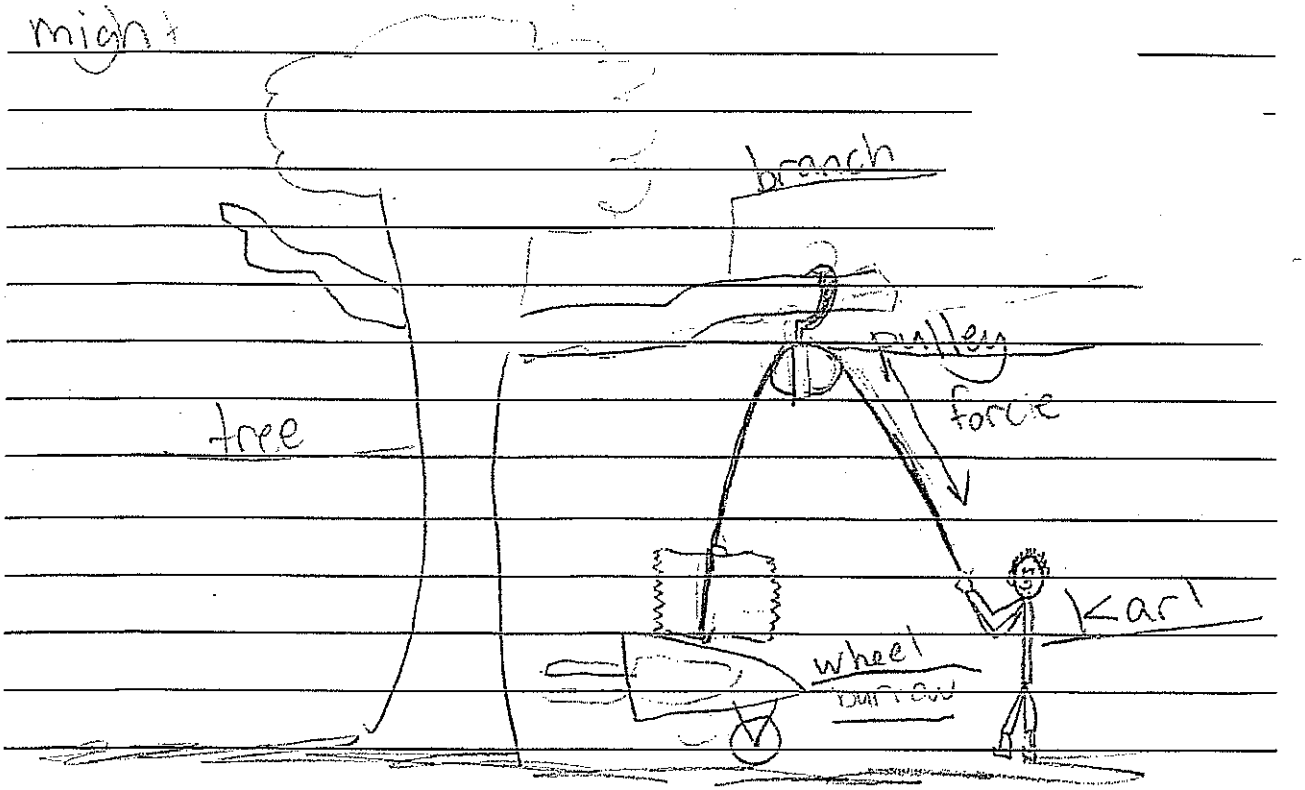
RESPONSE SHEET—PULLEYS

Karl told his brother Charles, "I just couldn't lift that 30-kg bag of cement into Dad's wheelbarrow until I got a pulley and a rope. Then it was easy."

Charles was surprised. "You got the cement into the wheelbarrow!? How did you do it? How much easier was it?"

Explain how you think Karl lifted the cement and how much effort he had to apply.

I think Karl used a V singal fixed pulley. This is how I picture it. I think he tied a rope to the bag of cement then threaded the rope through the pulley then attached the pulley to the tree and pulled down with all his might



Flip

FOSS Landforms Module, Student sheet no. 19, Response Sheet-Pulleys, 2005 of publication from the teacher guide. Developed at the Lawrence Hall of Science and published and distributed by Delta Education.

Learning Progression: Engineering Design Process

Materials: FOSS Levers & Pulleys **Grade level: 5-6**

Prerequisite skill: Vocabulary

- Criteria 3-5
- Constraints 3-5
- Variables 3-5
- Controlled Variables 3-5
- Similarity/Differences 3-5
- Model 3-5
- Prototype 3-5
- Systematic Process MS
- Iterative Testing MS (test more than once to successfully improve; leads to greater refinement: pg 74 MS ETS1-4 & MS ETS1. C)
- Modification MS
- Optimal MS

Define:
Defining and delimiting engineering problems involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or criteria.

Develop Solutions:
Designing solutions to engineering problems begins with generating a number of different possible solutions, then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem.

Optimize:
Optimizing the design solution involves a process in which solutions are systematically tested and refined and the final design is improved by trading off less important features for those that are more important.

Learning Target: A problem's solution(s) will have constraints or criteria.

Success Criteria: I can specify the constraints and criteria of a successful solution to a problem and identify the best solution.

Formative Assessment:

Design Challenge #1, #2, #3

Learning Target: Evaluate which solutions meet the criteria and constraints.

Success Criteria: I can generate and evaluate solutions that meet the criteria and constraints.

Formative Assessment:

Design Challenge #1, #2, #3

Learning Target: Design and/or develop models of possible solutions.

Success Criteria: I can create models of my solutions.

Formative Assessment:

Design Challenge #1, #2, #3

Learning Target: Tests are systematic, should follow criteria & constraints and data needs to be recorded.

Success Criteria: I can design a process to systematically test the solutions.

Formative Assessment:

Design Challenge #1, #2, #3

Learning Target: Analyze which solution best solves the problem by looking at data. Communicate other ideas.

Success Criteria: I can evaluate the data from testing to determine how well it met the criteria or constraints of the problem.

Formative Assessment:

Design Challenge #1, #2, #3

Learning Target: Refine the designs based on what best meets criteria.

Success Criteria: I can change my solution using the information I gathered to better meet the criteria or know that the optimal solution has been found.

Formative Assessment:

Design Challenge #1, #2

Big Idea:

Engineering Design Process

Later big ideas that build on this big idea include:

Northwest Educational Service District 189
Together We Can

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

LEVERS & PULLEYS

Challenge Title: Levers Design Challenge 1

Targeted Engineering Practices
☐ Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. ☐ Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem ☐ Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
Connected Scientific Content Ideas
☐ Force: Machines can change the forces or directions necessary to move an object. ☐ Inquiry: Valid experiments and investigations have specific criteria: asking questions, data collection, analysis and reporting. ☐ Systems: Systems have inputs and outputs. We can predict what will happen if input is changed.
Description of Student Success Criteria:
At the completion of this task students will be able to: ☐ Specify the constraints and criteria of a successful solution to a problem and identify the best solution. ☐ Generate and evaluate solutions that meet the criteria and constraints. ☐ Create models of solutions. ☐ Design a process to systematically test the solutions. ☐ Evaluate the data from testing to determine how well it met the criteria or constraints of the problem. ☐ Change the solution using the information gathered to better meet the criteria or know that the optimal solution has been found.

Teacher Instructions: Implementation Support
Timing of the task: Give this design challenge after lesson 1-2 **Required additional materials (not included in the kit):** none **Teacher Instructions:** Do this design challenge in two parts. Have the students analyze Randy and Kevin's lever systems first, discuss as a class and then have them design and test their own.

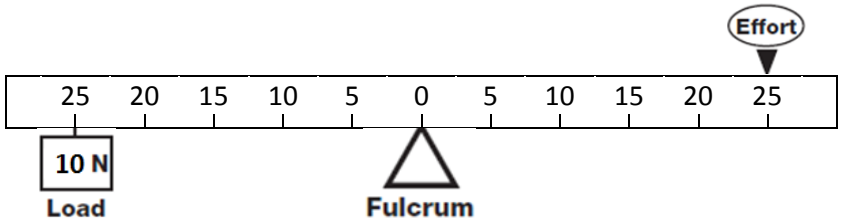
 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Name _____ Date _____

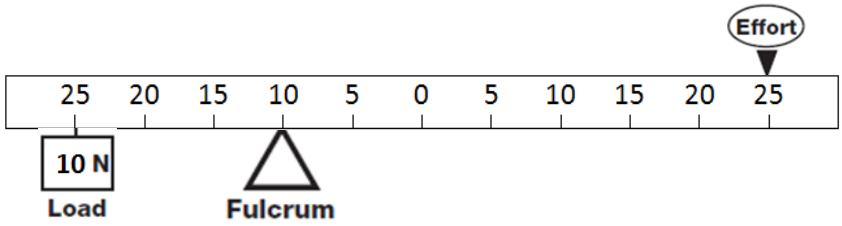
Levers Design Challenge – Investigation 1.2

Randy and Kevin had been working with levers for a couple of days. They were trying new ways to set up levers. They each set up a lever system. Both lever systems had the load hanging at the 25-cm position on one side, and the effort pressing at the 25-cm position on the other side.

Randy's Lever



Kevin's Lever



Randy said, "Our levers are the same. They will both take the same amount of effort to lift the load."

Kevin responded, "I don't think so. One of these systems will require less effort to lift the load."

Which student do you think was right Explain why you think so.

Name _____ Date _____

Criteria: Design a lever system that will have a greater mechanical advantage than Randy and Kevin's lever systems.

Constraints: Use a half-meter stick, 10 N load, dowel, duct tape, a heavy book, binder clip, pencil-cap eraser, rubber bands and a spring scale. Keep the load and effort at 25 cm on opposite sides.

Three Possible Solutions:

1.	2.	3.

Try all three of your possible solutions and record data on the table below:

	Position of fulcrum (cm)	Effort (scale + 0.5 N)	
1			
2			
3			

Circle the solution that provides the greatest advantage and explain why. Support your selection with data from the table.

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Name _____ Date _____

LEVERS & PULLEYS

Challenge Title: Levers Design Challenge 2

Targeted Engineering Practices
☐ Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. ☐ Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem ☐ Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
Connected Scientific Content Ideas
☐ Force: Machines can change the forces or directions necessary to move an object. ☐ Inquiry: Valid experiments and investigations have specific criteria: asking questions, data collection, analysis and reporting. ☐ Systems: Systems have inputs and outputs. We can predict what will happen if input is changed.
Description of Student Success Criteria:
At the completion of this task students will be able to: ☐ Specify the constraints and criteria of a successful solution to a problem and identify the best solution. ☐ Generate and evaluate solutions that meet the criteria and constraints. ☐ Create models of solutions. ☐ Design a process to systematically test the solutions. ☐ Evaluate the data from testing to determine how well it met the criteria or constraints of the problem. ☐ Change the solution using the information gathered to better meet the criteria or know that the optimal solution has been found.

Teacher Instructions: Implementation Support
Timing of the task: Give this design challenge after lesson 3-1 **Required additional materials (not included in the kit):** none **Teacher Instructions:** Be sure to give this design challenge before students are introduced to two-pulley systems. Some students may have difficulty understanding how to attach three loads to one pulley. Allow them to use rubber bands to attach the loads.

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Name _____ Date _____

Cement Design Challenge 2

Challenge: Design a prototype pulley system to lift an 80 pound bag of cement into a wheelbarrow.

Criteria: Design and create a prototype pulley system to lift **three** 240 gram weights, which represent an 80 pound bag of cement. The **final** design chosen should give the user optimal mechanical advantage.

Constraints: All **three** weights need to be lifted by a single pulley system at the same time. The pulley system must be operated by one person.

Plan Summary: Build a pulley system prototype out of the materials we have in class.

Steps to Do the Plan:

1. Design and build a single pulley system to lift a 720 gram load.
2. Zero the spring scale prior measuring the force (N)!
3. Test and record your data (Newtons of force it took to lift the 720 gram load) in the table.
4. Repeat steps 2 and 3 for design one.
5. Design and build a second single pulley system to lift a 720 gram load.
6. Repeat steps 2 and 3 for design two.
7. Choose the pulley system with the optimal mechanical advantage.
8. Use your test data to write a conclusion.

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Name _____ Date _____

Diagram of Pulley Designs

Design One	Design Two

Test Results

Designs	Newtons Trial #1	Newtons Trial #2	Newtons Trial #3	Newtons Average
One				
Two				

Conclusion: Choose the pulley system that solves the design challenge, and meets the criteria and constraints. Explain your thinking on how your design solves the challenge.

_____

_____

_____

_____

_____

_____

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

LEVERS & PULLEYS

Challenge Title: Levers Design Challenge 3

Targeted Engineering Practices
☐ Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. ☐ Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem ☐ Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
Connected Scientific Content Ideas
☐ Force: Machines can change the forces or directions necessary to move an object. ☐ Inquiry: Valid experiments and investigations have specific criteria: asking questions, data collection, analysis and reporting. ☐ Systems: Systems have inputs and outputs. We can predict what will happen if input is changed.
Description of Student Success Criteria:
At the completion of this task students will be able to: ☐ Specify the constraints and criteria of a successful solution to a problem and identify the best solution. ☐ Generate and evaluate solutions that meet the criteria and constraints. ☐ Create models of solutions. ☐ Design a process to systematically test the solutions. ☐ Evaluate the data from testing to determine how well it met the criteria or constraints of the problem. ☐ Change the solution using the information gathered to better meet the criteria or know that the optimal solution has been found.

Teacher Instructions: Implementation Support
Timing of the task: Give this design challenge after lesson 4-2 **Required additional materials (not included in the kit):** none **Teacher Instructions:** Use checkpoints after part A and B so that students don't move on without the correct information. Allow for students to choose either design as long as they back up their choice with logical evidence.

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Name: _____ Date _____

Levers & Pulleys - Design Challenge #3

Ted and Jan were working on a search and rescue team that needed to lift an injured climber out of a 20m ravine. Ted was at the top the ravine; Jan was at the bottom of the ravine. The injured climber weighs 720N. They have two pulleys and a rope in their rescue kit.

Scenario A: Jan is going to attach the injured climber to the pulley system and Ted will lift him out of the ravine.

- How should they set up their pulleys so Ted can lift the climber using as little effort as possible? Draw a diagram and set-up the pulley system.

- How much effort will Ted have to use? _____
- How far will Ted have to pull the rope? _____
- What is the mechanical advantage? _____

Note: Mechanical Advantage = $\frac{\text{Load}}{\text{Effort}}$

Name: _____ Date _____

Scenario B: Jan is going to attach the injured climber to the pulley system, and she is going to lift the climber from her position at the bottom of the ravine.

- How should they set up their pulleys so Jan can lift the climber using as little effort as possible? Draw a diagram and set-up the pulley system.

- How much effort will Jan have to use? _____
- How far will Jan have to pull the rope? _____
- What is the mechanical advantage? _____

Evaluate: Determine which scenario (A or B) provides the greatest advantage to lift the climber out of the ravine. Write an argument about why you feel this provides the greatest advantage including the following:

- Comparison of the mechanical advantages
- Comparison of the directional advantages
- Comparison of how far the ropes will be pulled
- The reason why you chose that scenario

Note: Mechanical Advantage = $\frac{\text{Load}}{\text{Effort}}$

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Student Growth Reflection

Teacher: [redacted]

Kit: Levers & Pulleys

Big Idea/learning targets assessed: Systems have inputs & outputs

Student #1: Alex

Describe how the student's learning changed over the course of the kit, site evidence from their assessment tasks.

On the first, Alex didn't actually give an example of a real-world, but he did on the 2nd. On the 2nd, he used 2 diagrams to show how to change the system. The explanations in the 2nd assessment are more clear.

Student #2: Rebekah

Describe how the student's learning changed over the course of the kit, site evidence from their assessment tasks.

Rebekah had a good understanding from the beginning. There isn't much change from the 1st to the 2nd except that she is able to decribe the change in effort (halves the effort) more clearly.

Student #1: Eleanor - was only here for 2nd assessment

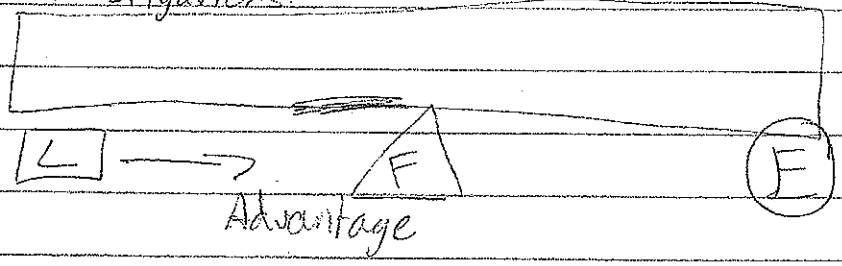
Describe how the student's learning changed over the course of the kit, site evidence from their assessment tasks.

Eleanor only has the 2nd assessment, but she showed an ability to diagram two systems and was able to describe the difference between them.

[redacted] ♡
11-4-13
Science

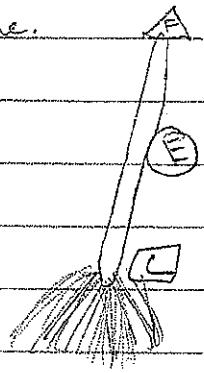
(1)

Investigations:



You can move the load closer to the fulcrum and the effort will be easier.

Real world: A broom can be used to sweep in a room or outside.



What's the advantage?

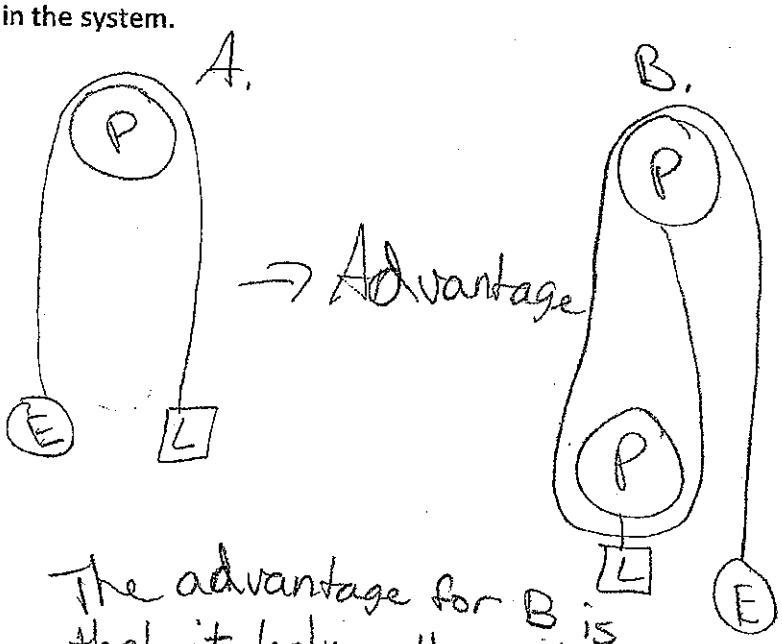
Name [redacted] 11-21-13 Date (2)

Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

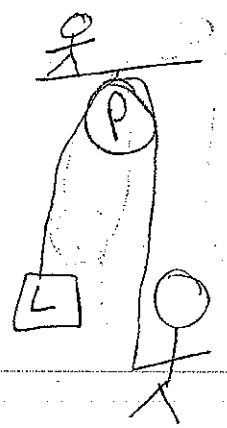
THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



The advantage for B is that it halves the weight of the load. Why?

APPLY...Describe an example of your chosen system from the real world.

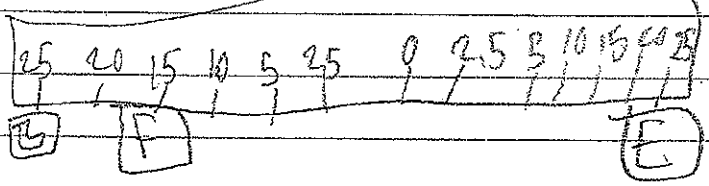


This is a pulley from the real world. The person on the bottom is lifting a Load (wood) up to his buddy. They are building something.

[redacted]

If the input is changed then to lift the effort will be easier because the input will change then the normal spot by putting the input closer to the load.

input is effort - are you moving effort closer to load?



A real world lever would require extra stregth then the lever I showed. By making a real world lever easier by putting the input closer the the load or farther from the effort.

What is a real-world lever?

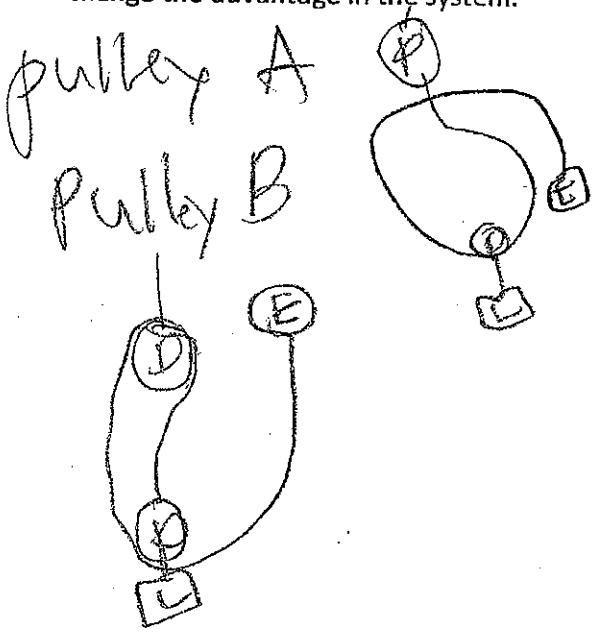
Name [redacted] Date 11-21-13 (2)

Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

THINK...Reflect on these ideas.

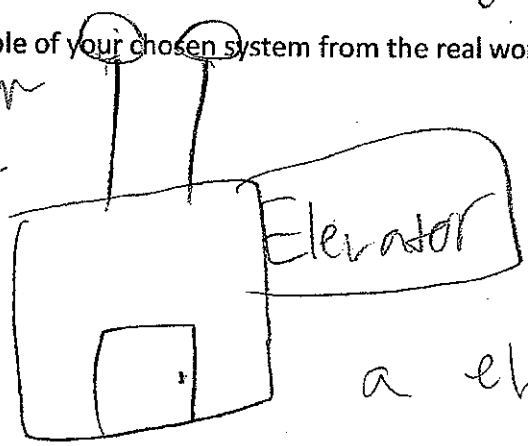
EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



Pulley B, would be easier because it has more ropes to support it than pulley A.

APPLY...Describe an example of your chosen system from the real world.

What kind of pulley system do you think they use?



I chosed a elevator because a elevator hes ropes to support when lifting up people and the heavy metal thing.

Name [redacted] Date 11/21/13 (2) (not here for 1)

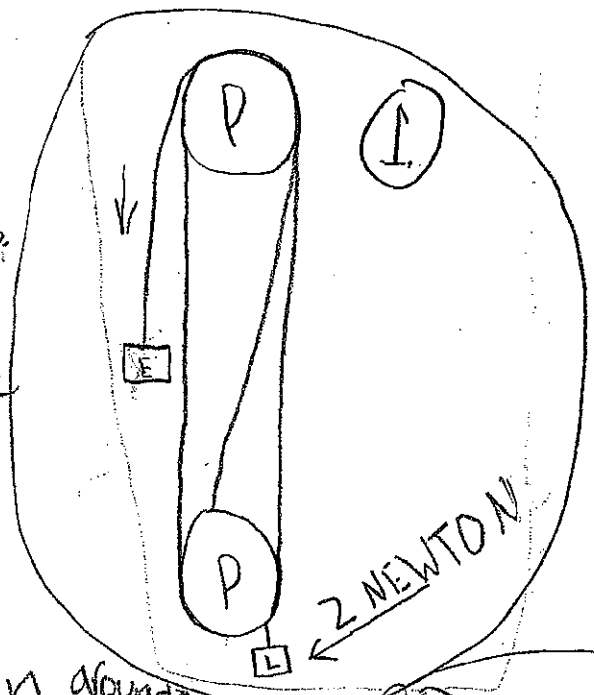
Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

THINK...Reflect on these ideas.

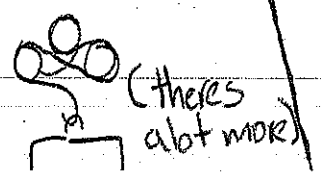
EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.

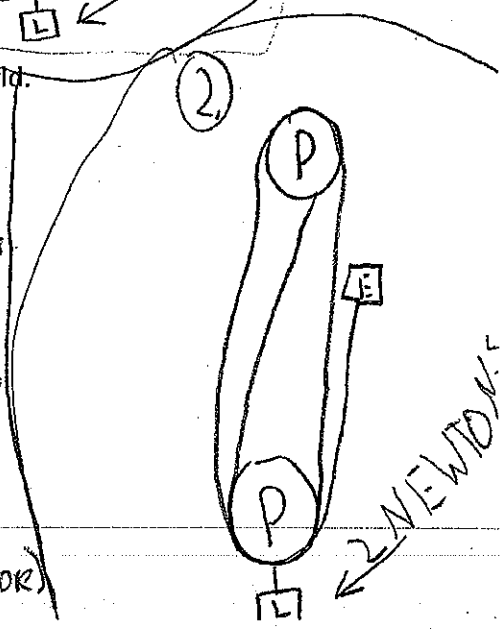
Well the more of supporting ropes you have the easyier it gets. When you pull down you get an advantage in ~~distance~~ direction. When you pull up you get an advantage in effort so I switched my design around.



APPLY...Describe an example of your chosen system from the real world.

An elevator has a lot of supporting ropes but instead of you pulling a rope/cable it's a machine. A elevator is a giant pully.





Student Growth Reflection

~~DON'T~~ MAIL BACK AFTER SCANNING

Teacher: [redacted]

Kit: Levers + Pulleys

Big Idea/learning targets assessed:

Student #1: Aryana 11/22, 1/8 (Did not do questions right away)

Describe how the student's learning changed over the course of the kit, site evidence from their assessment tasks.

Aryana was able to understand in both tests that if the fulcrum is closer to the load it is easier to lift a load. on her second she addressed that to improve advantage you can continue to move the fulcrum even closer to load.
In application she also mentioned the fulcrum needed to be closer to load to lift a building. She did not address this in her first effort.

Student #2: Jennifer

Describe how the student's learning changed over the course of the kit, site evidence from their assessment tasks.

Jennifer first used the idea of levers to lift loads. In her second reflection she was able to now use a pulley system. In the first reflection Jennifer could draw lever systems, but she was not clear about why there was mechanical advantage even though she moved the load closer to the fulcrum. In the second reflection when Jennifer used pulley systems she drew 2 systems - one with single-fixed pulley + one w/ 2 pulleys direction up. She knew pulling up and having more rope gives more mechanical advantage. That seemed more solid (!)

Student #1: Abby

Describe how the student's learning changed over the course of the kit, site evidence from their assessment tasks.

Abby began in the first reflection using levers and understood if you move fulcrum closer to load there would ~~be more~~ less effort. In the second she understood directional advantage and when you pull down or up. She understood that if she wanted directional advantage which pulley system to use. She also understood there was no mechanical advantage when pulling down. That seems a bit more complex idea than her first reflection.

Name [redacted] Date 1-8-19

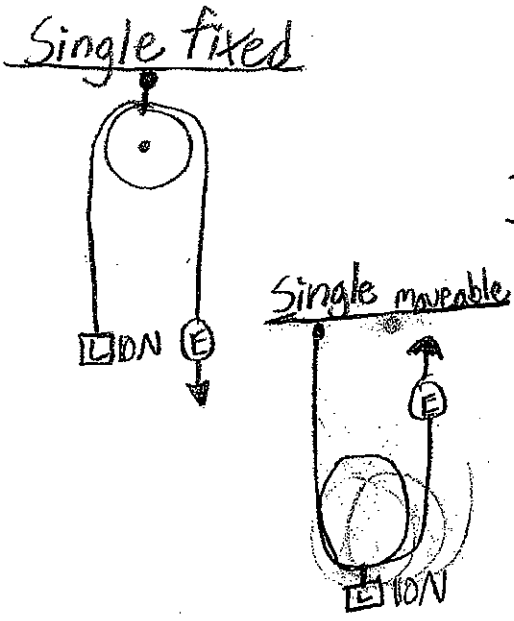
Levers and Pulleys Reflection

Clone

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



I drew an palley that can give you a directional advantage. If you were to use a single moveable you would get an machanicle advantage. If the load wheighs 10N the single fixed pulley would take 10N of force and the single movable would take 5N of force.

APPLY...Describe an example of your chosen system from the real world.

If I had to put cement blocks down I would use the Single fixed. It wont give me a machanicle advantage but it will give me a directional advantage. That means that it would be easier to use the single moveable pulley but you cant fly to pull up so you should use the single fixed

instead so you can stand on the ground it will be hevier but you are grounded.

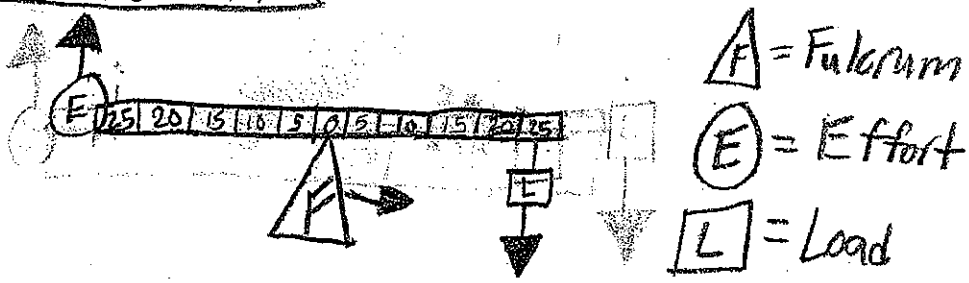
Name [redacted] Date 11-22-13

Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

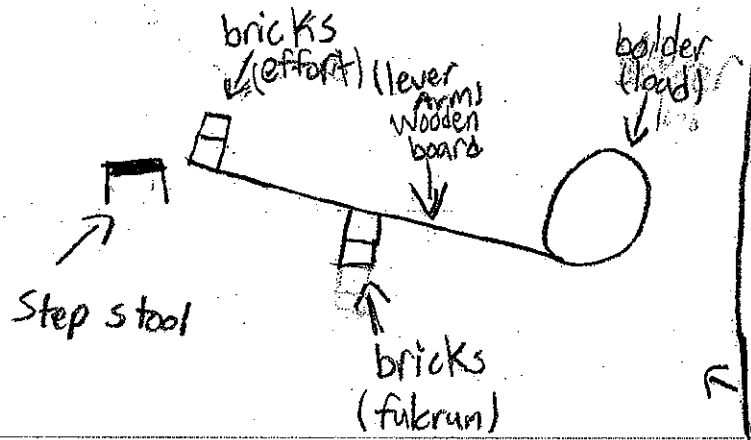
THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



If you start out with the fulcrum in the middle it will be harder to move the load. If you move the fulcrum closer to the load then it will be easier to lift the load.

APPLY...Describe an example of your chosen system from the real world.



If theres a big rock you need to move, get a wooden board, bricks, and a step stool if needed. Put the wooden board under the rock but first lay 2 bricks under the board for the fulcrum. The bolder will be

the load. The wooden board is your lever arm. The other 2 bricks are the effort, but so are you. There is a step stool to help you get on the bricks if needed.

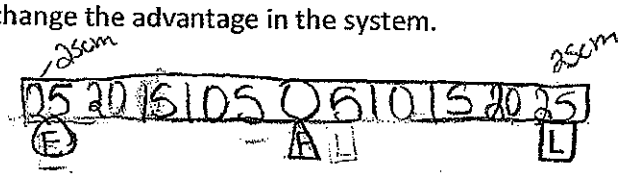
Name [redacted] Date 11/22/13

Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

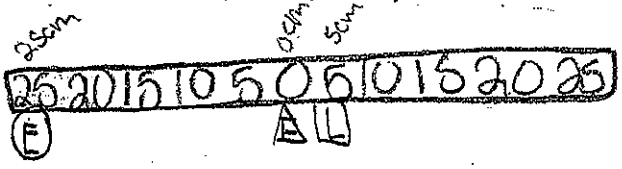
THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



how I would change it by puting the Load on 5cm and it will make mechanical advantage and easy

APPLY...Describe an example of your chosen system from the real world.



You would put the effort on the 25cm and the fulcrum and the load on 5cm to left a big things.

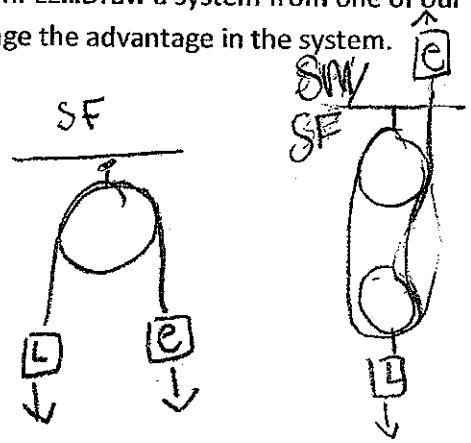
Name [redacted] Date 1/8/14

Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

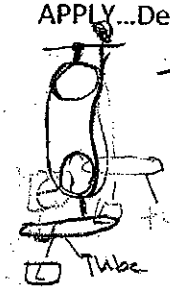
THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



In this pully system you chany it by what ariction the effort going up or down and how many rope it has to make it easy to lefft.

APPLY...Describe an example of your chosen system from the real world.



This pully system would be chosen in the real world is when you a left a big load for you to move it to some where

Name [redacted] Date Nov. 22nd 2013

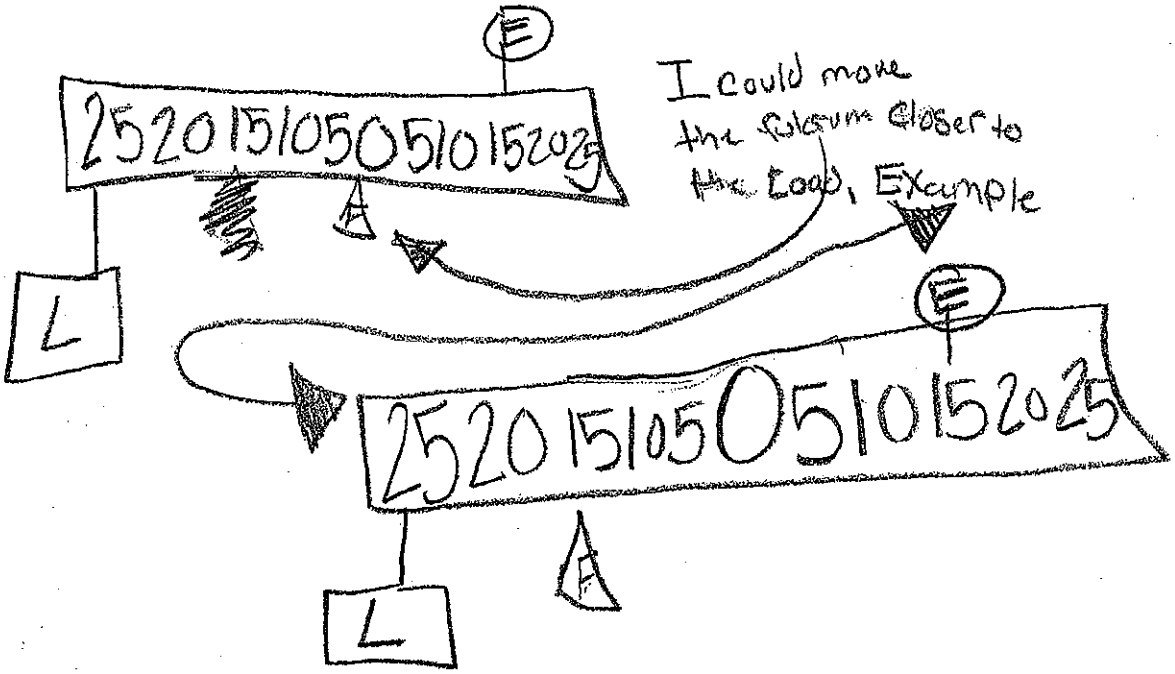
(1)

Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

THINK...Reflect on these ideas.

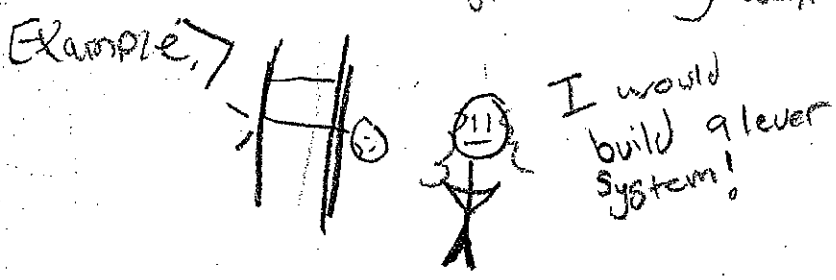
EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



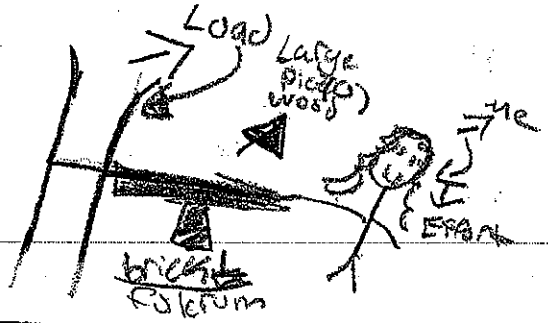
APPLY...Describe an example of your chosen system from the real world.

Let's say you were on a football field and the goal thing fell on a football player I obiously want to help them, So this is what I'd do.

Example,



I would build a lever System!



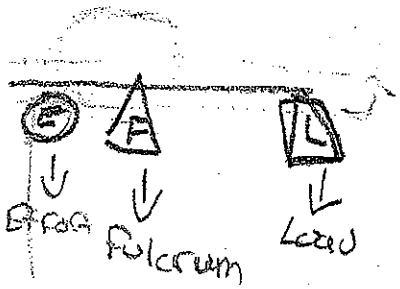
(2) Name [redacted] Date Jan. 8th 2014

Levers and Pulleys Reflection

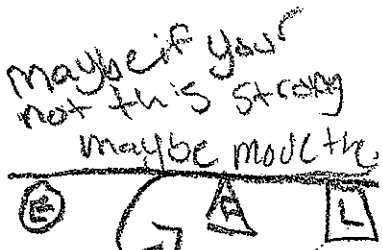
Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



You can change an advantage by the load staying in the same place, moving the fulcrum closer to the load and it would be easier to push down on.



Maybe if your not this strong maybe move the Closer to the Load even more!

APPLY...Describe an example of your chosen system from the real world.

Let's say you needed to lift a building Just how the Get new buildings, you would lift the building with the lever, fulcrum closer to the Load.

Student Growth Reflection

Teacher: [redacted]

Kit: Levers & Pulleys

Big Idea/learning targets assessed:

Student #1: Dylan

Describe how the student's learning changed over the course of the kit, site evidence from their assessment tasks.

Vocab - Depth of understanding
Better on Levers

Pulleys - can set up model! Incredible Diagrams and use of vocab.

Diagrams show two different systems ① Lever ② Pulleys

Student #2: Austin

Describe how the student's learning changed over the course of the kit, site evidence from their assessment tasks.

Levers Diagram - Accurate.
- correct use of vocab.

Pulley Diagram + Diagrams clear with mechanical advantage.

Student #1: Trevor

Describe how the student's learning changed over the course of the kit, site evidence from their assessment tasks.

Levers
- Examples are relevant and show great understanding of concepts!

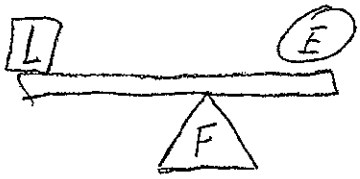
Name [redacted] Date 11-22-13

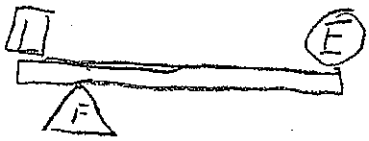
Levers and Pulleys Reflection

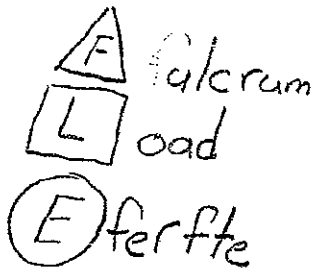
Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



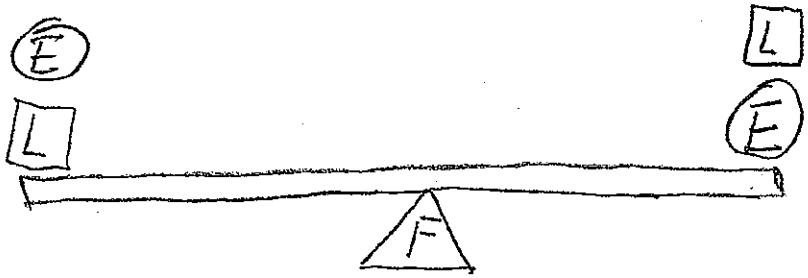




if you move the fulcrum (F) closer to the Load (L) your eferfte (E) decreasise

APPLY...Describe an example of your chosen system from the real world.

Se Saw



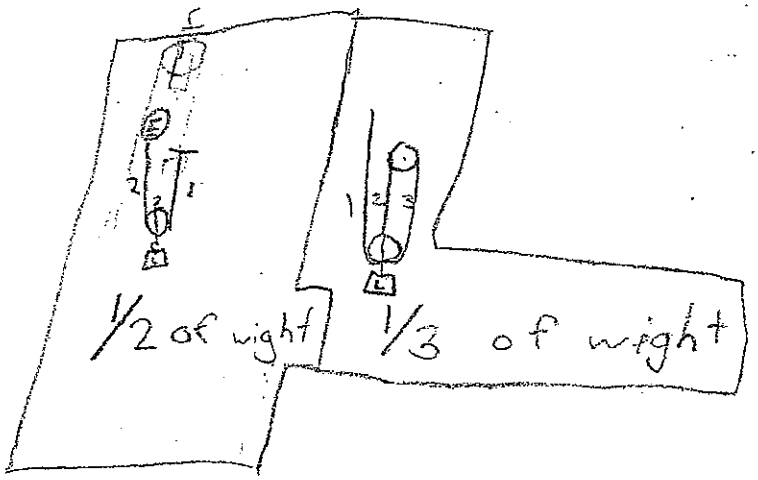
Name [redacted] Date 12-16-13

Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



APPLY...Describe an example of your chosen system from the real world.

Crane has a lot of pulleys to lift the load and to move the load. the pulley lifts and lowers the load. the other pulleys pull the pulley from far to close

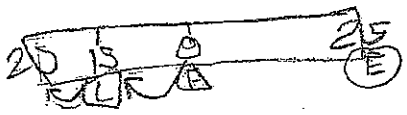
Na[redacted] Date_____

Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



If you have a Standerd Lever you can change that Standerd lever by giving it more of a mechanical advantag by changing the Load to 25, the fulcrue to the 15.

APPLY...Describe an example of your chosen system from the real world.

Say you have a fork but it is to heavy to pick up So if you have the fulcrum at the 15 and the Load at the 25 theh the less effort you will have to use.

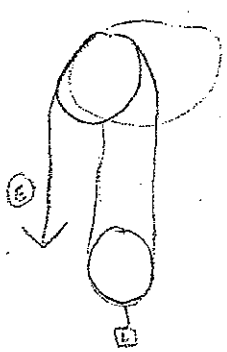
Name [redacted] Date_____

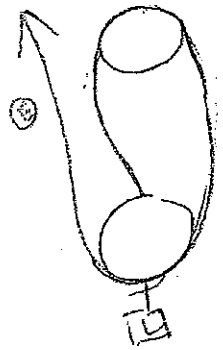
Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.





Well if you wanted to change the Advantage on this system you would change it to a SF/SM Effort up to make a greater advantage to lift up your load.

APPLY...Describe an example of your chosen system from the real world.

If you use my example in the real world it will help lift a lot of Stuff cause he gave to lift your load

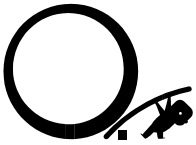
LEVERS & PULLEYS

Additional Information

Included in the documents:

- Glossary of Terms
- 1.1 Investigation Outline
- Spring Scale PowerPoint (Investigation 1.1)
- 1.3 Investigation Outline
- 2.1 Investigation Outline
- 3.1 Investigation Outline
- 3.2 Investigation Outline
- 4.1 Investigation Outline

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.



LEVERS & PULLEYS GLOSSARY

1. **Advantage**: a benefit obtained by using a lever (or other simple machine)
2. **Class-1 Levers**: have the fulcrum in the middle and the load and effort at the ends
3. **Class-2 Levers**: have the load in the middle and the fulcrum and effort at the ends
4. **Class-3 Levers**: have the effort in the middle and the fulcrum and load at the ends
5. **Diagram**: a drawing that describes the relationship of all the parts of a system
6. **Directional Advantage**: a change in direction that results from passing a rope through a pulley
7. **Effort**: the force needed to move a load or overcome a resistance
8. **Fixed Pulley**: has a wheel that is attached to something above the load
9. **Fulcrum**: the point where a lever arm pivots
10. **Lever**: a simple machine that people use to gain a mechanical advantage, such as making work easier
11. **Lever Arm**: a stick or beam free to pivot at a point
12. **Load**: the mass lifted or the resistance overcome by a lever
13. **Mechanical Advantage**: reduced the effort (force) needed to lift a load or overcome a resistance; it results from using a simple machine
14. **Movable Pulley**: has a wheel that is attached to the load
15. **Newtons**: effort is measured in newtons
16. **Pulley**: a wheel with a grooved rim in which a rope can run to change the direction of the pull (force) that lifts a load
17. **Simple machine**: any of the six basic devices that provide mechanical advantage, such as pulleys and levers
18. **Two-Coordinate Graphs**: show relationships between two variables

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Levers & Pulleys 1.1: Introduction to Levers

QUESTION: Where should you position the effort in a lever system in order to use the least amount of force?

PREDICTION/HYPOTHESIS:

If _____ then_____

because_____.

MATERIALS: 1 spring scale with rubber band, 1 load with rubber band, 1 modified half-meter stick, 1 binder clip, 1 dowel, 1 pencil-cap eraser, masking tape, heavy textbook

EXPERIMENT

Controlled Variable: _____Manipulated Variable: _____

EXPERIMENT

Procedure:

1. Set up a lever system:
    a. Tape a dowel to the side of a desk so that it sticks out 5 cm
    b. Place a heavy textbook on the end so that it stays in place
    c. Attach a binder clip under the zero position (middle) of the half-meter stick and flip both metal loops up
    d. Slide the metal loops over the open end of the dowel (this is now your lever)
    e. Adjust the location of the binder clip until the half-meter stick is balanced
    f. Slide a pencil-cap eraser onto the open end of the dowel
2. Hang the load at 15 cm
3. Using one finger, press at different points along the opposite side of the half-meter stick
4. Record observations

OBSERVATIONS

Draw two pictures of lever systems in your notebook. In the first, show where on your lever you should press in order to use the least amount of force. In the second, show where you should press in order to use the most amount of force.

PAUSE HERE AND WAIT FOR FURTHER INSTRUCTIONS

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

EXPERIMENT

Procedure:

1. Using spring scales:
    a. Always zero the scale before starting
    b. Always use the scale right side up, never upside down
    c. The measurement is read at the top of the indicator
    d. Pull on the hook at the bottom of the scale until the lever arm is level, then read the effort. This works best if one student pulls the scale while the other student reads the effort.
    e. Stop pulling before the scale goes past the 10-N limit
2. Attach the spring scale by placing the rubber band around the end of the half-meter stick that is opposite the load
3. Explore the different readings you get by placing the spring scale at different points along the half-meter stick.
4. Record the spring scale readings for each point along the half-meter stick on a table in your notebook.

ANALYSIS (What does your data tell you?)

Summary: I discovered that

_____

_____

_____

_____

CONCLUSION (Answer the original question and explain whether or not your hypothesis was correct)

_____

_____

_____

_____

_____

Levers & Pulleys 1.3: Lever Experiment B

QUESTION: What would happen to the effort needed to lift the load if the **effort stayed** at one location and the **load moved** farther and farther from the fulcrum?

PREDICTION/HYPOTHESIS:

If

_____then_____

because_____.

MATERIALS: 1 spring scale with rubber band, 1 load with rubber band, 1 modified half-meter stick, 1 binder clip, 1 dowel, 1 pencil-cap eraser, masking tape, heavy textbook

EXPERIMENT

Controlled Variable: _____**Manipulated Variable:** _____

EXPERIMENT

Procedure:

1. Set up a lever system: (See instructions from 1.1)
2. Hang the **spring scale at 10 cm**
3. Move the **load** from point to point and use the scale to measure the effort required

OBSERVATIONS

Record your data on Student Sheet #6 and graph your results.

ANALYSIS (What does your data tell you?)

Summary: I discovered that_____

_____

_____

_____

_____

CONCLUSION (Answer the original question and explain whether or not your hypothesis was correct)

_____

_____

_____

_____

Mathematics & Science Partnership under Title II, Part E
Funding information:
Program Code: 62
CFDA 84.366B

Levers & Pulleys 2.1: Lever Classes

QUESTION: Is there any advantage to moving the fulcrum to new locations along the lever arm?

PREDICTION/HYPOTHESIS:

If _____ then_____

because_____.

MATERIALS: 1 spring scale with rubber band, 1 load with rubber band, 1 modified half-meter stick, 1 binder clip, 1 dowel, 1 pencil-cap eraser, masking tape, heavy textbook

EXPERIMENT

Controlled Variable: _____Manipulated Variable: _____

EXPERIMENT

Procedure:

1. Set up a lever system (see 1.1 for instructions)
2. Attempt different arrangements of the load, effort, and fulcrum to see if any provide an advantage.

OBSERVATIONS: Draw diagrams of your new lever systems in your notebook.

ANALYSIS (What does your data tell you?)

Summary: I discovered that_____

_____

_____

_____

_____

CONCLUSION (Answer the original question and explain whether or not your hypothesis was correct)

_____

_____

_____

_____

_____

_____

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Levers & Pulleys 3.1: One-Pulley Systems

QUESTION: *Does a pulley provide an advantage when lifting a load?*

PREDICTION/HYPOTHESIS:

If _____ *then*_____

*because*_____.

MATERIALS: *1 half-meter stick, 1 binder clip, 1 spring scale with paper clip, 1 load with rubber band, 1 single pulley, 1 75cm rope, 1 heavy textbook, duct tape*

EXPERIMENT

Controlled Variable: _____***Manipulated Variable***: _____

EXPERIMENT

Procedure:

1. *Set up a pulley system:*
    a. *Clip a binder clip to the end of a half-meter stick*
    b. *Lay the stick on your desk so that only the clip extends over the edge*
    c. *Tape the stick to the desk and place a heavy textbook on the end to hold it in place*
2. *Use the pulley, rope and load to create a pulley system*

OBSERVATIONS: *Draw diagrams of your pulley systems on Student Sheet #18.*

ANALYSIS (What does your data tell you?)

Summary: *I discovered that*_____

_____

_____

_____

_____

CONCLUSION (Answer the original question and explain whether or not your hypothesis was correct)

_____

_____

_____

_____

_____

_____

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Levers & Pulleys 3.2: Two-Pulley Systems

QUESTION: *What is the advantage (if any) to using two pulleys at the same time?*

PREDICTION/HYPOTHESIS:

If _____*then*_____

*because*_____.

MATERIALS: *1 half-meter stick, 1 binder clip, 1 spring scale with paper clip, 1 load with rubber band, 2 single pulleys, 1 75cm rope, 1 heavy textbook, duct tape*

EXPERIMENT

Controlled Variable: _____***Manipulated Variable***: _____

EXPERIMENT

Procedure:

1. *Set up a pulley system (see instructions on 3.1)*
2. *Use the pulleys, rope and load to create a two-pulley system*

OBSERVATIONS: *Draw diagrams of your pulley systems on Student Sheet #18.*

ANALYSIS (What does your data tell you?)

Summary: *I discovered that*_____

_____

_____

_____

_____

CONCLUSION (Answer the original question and explain whether or not your hypothesis was correct)

_____

_____

_____

_____

_____

_____

Levers & Pulleys 4.1: Effort in Pulley Systems

QUESTION: Is there a relationship between the number of ropes supporting the load and the effort required to lift the load?

PREDICTION/HYPOTHESIS:

If _____then_____

because_____.

MATERIALS: 1 half-meter stick, 1 binder clip, 1 spring scale with paper clip, 2 loads, 2 single pulleys, 1 75cm rope, 1 heavy textbook, duct tape

EXPERIMENT

Controlled Variable: _____**Manipulated Variable:** _____

EXPERIMENT

Procedure:

1. Set up each pulley system (see instructions on 3.1)
2. Record data on the amount of effort required to lift 2 loads with each system.

OBSERVATIONS: Record your data on Student Sheet #20.

ANALYSIS (What does your data tell you?)

Summary: I discovered that_____

_____

_____

_____

_____

CONCLUSION (Answer the original question and explain whether or not your hypothesis was correct)

_____

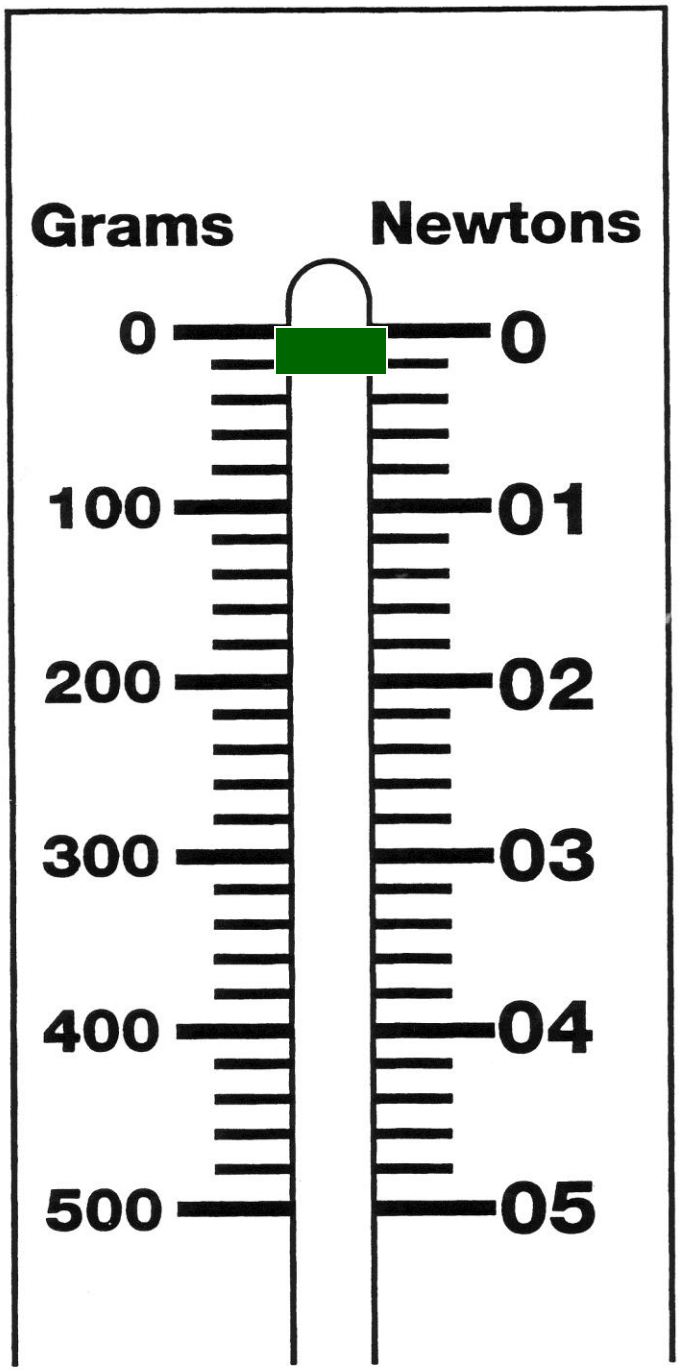
_____

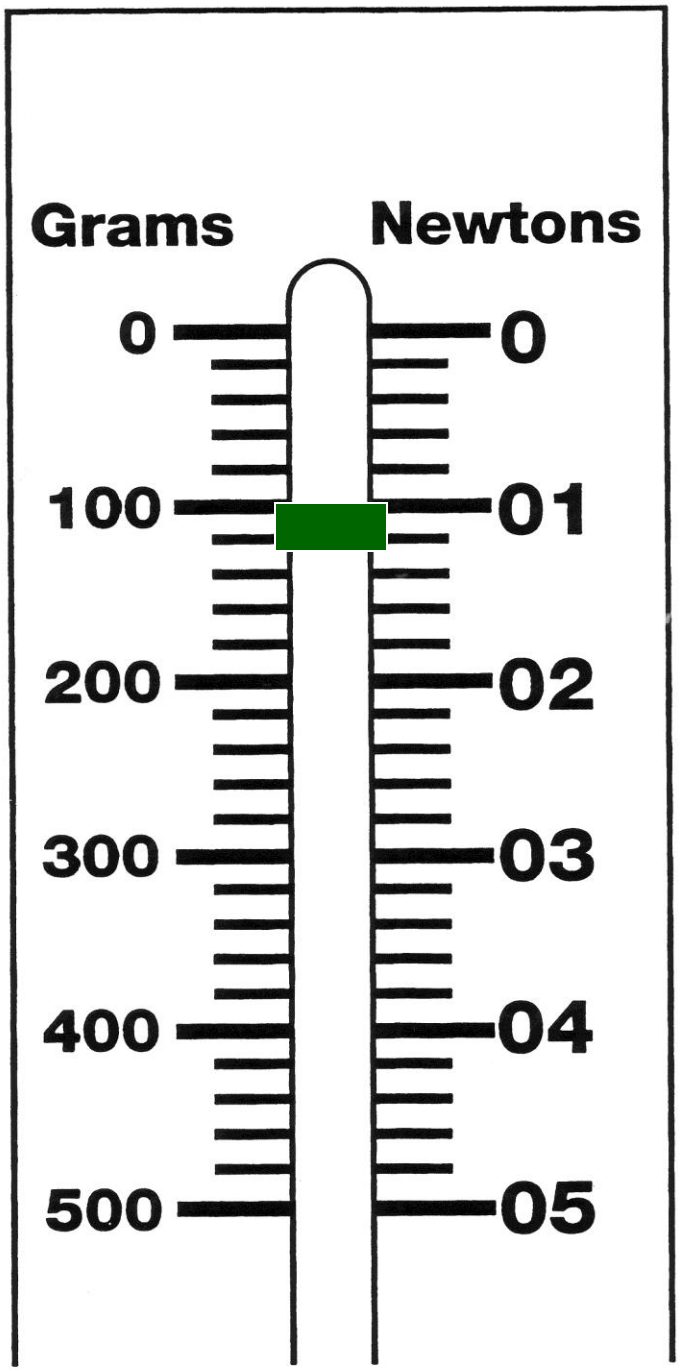
_____

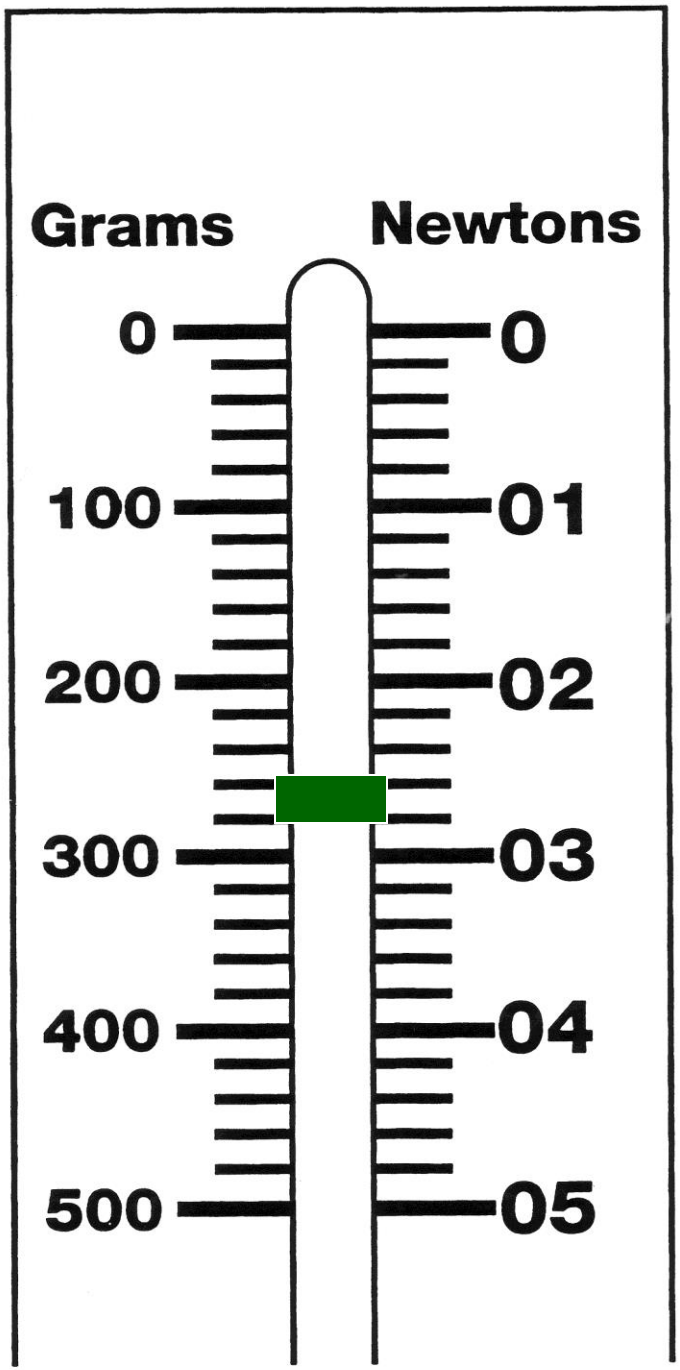
_____

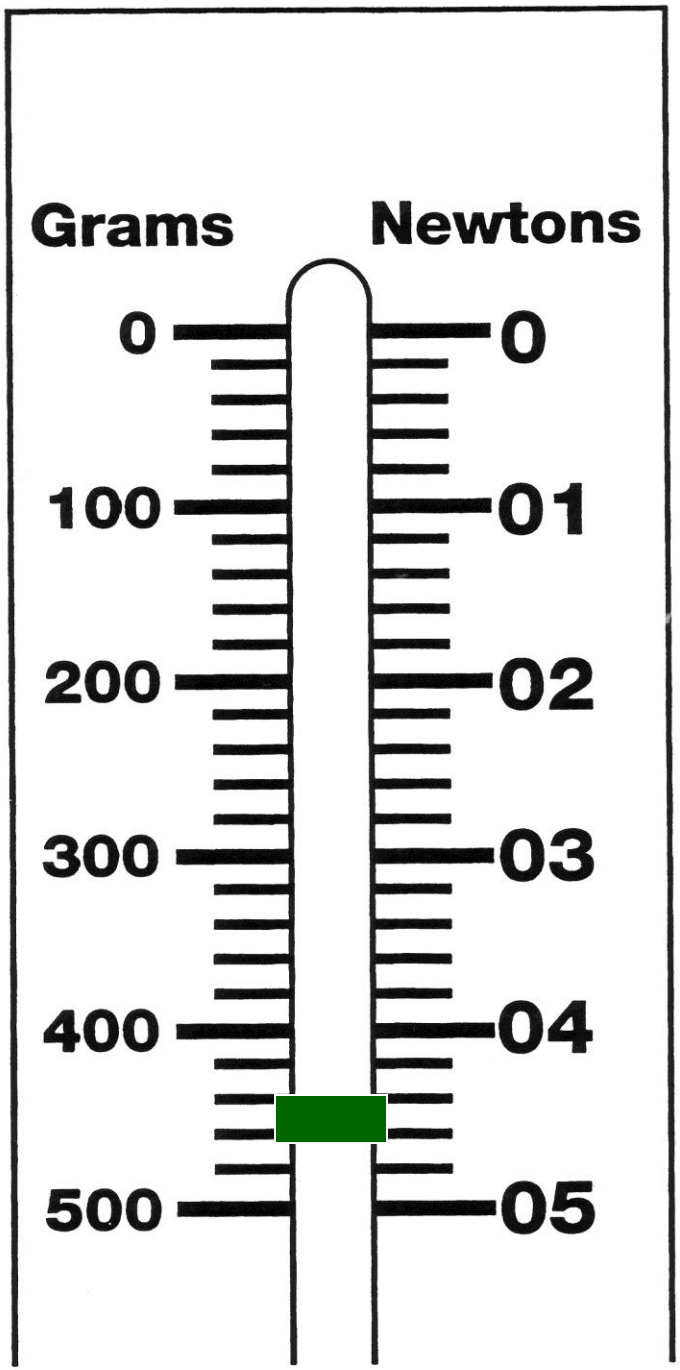
_____

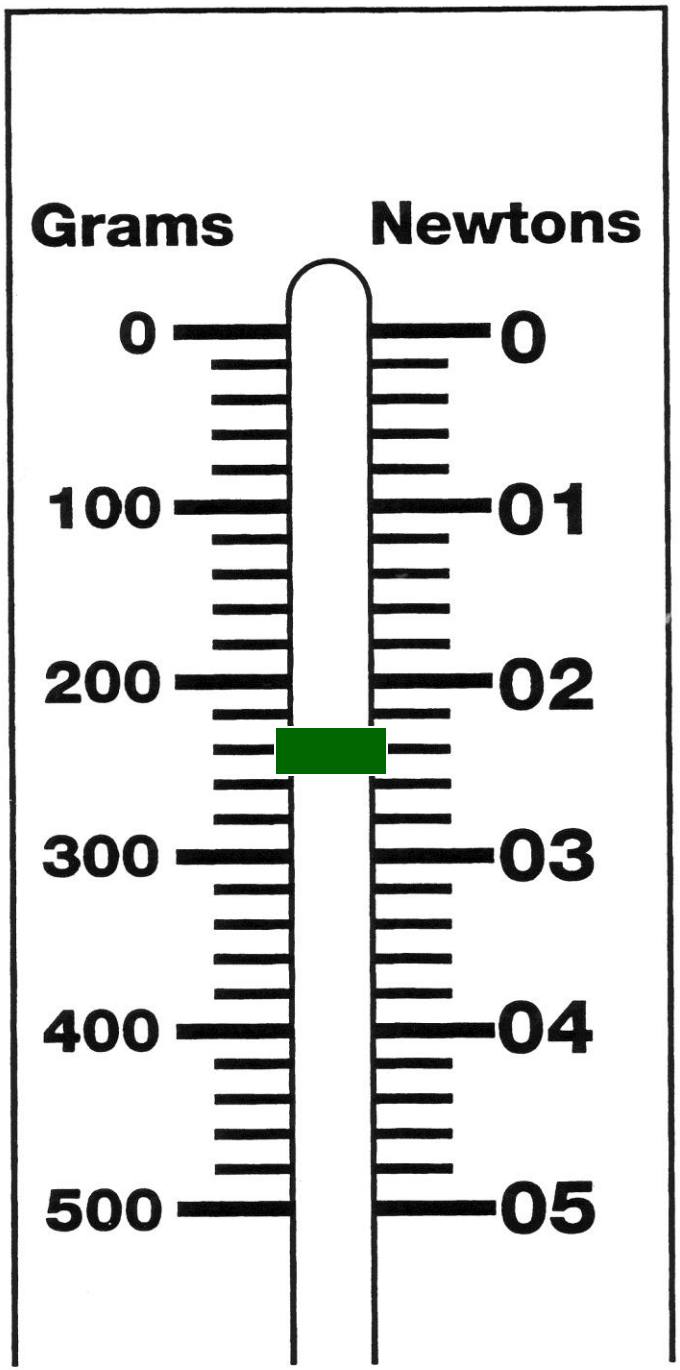
_____


Grams
Newtons
0
100
200
300
400
500
0
01
02
03
04
05


Grams
Newtons
0
100
200
300
400
500
0
01
02
03
04
05


Grams
Newtons
0
100
200
300
400
500
0
01
02
03
04
05


Grams
Newtons
0
100
200
300
400
500
0
01
02
03
04
05


Grams
Newtons
0
100
200
300
400
500
0
01
02
03
04
05

Levers and Pulleys

Bibliography

Dylan, William. *Embedded Formative Assessment.* Bloomington, IN: Solution Tree, 2011. Print.

Keeley, Page. *Science Formative Assessment: 75 Practical Strategies for Linking Assessment, Instruction, and Learning*. Thousand Oaks, CA: Corwin, 2008. Print.

Popham, W. James. *Transformative Assessment*. Alexandria, VA: Association for Supervision and Curriculum Development, 2008. Print.

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

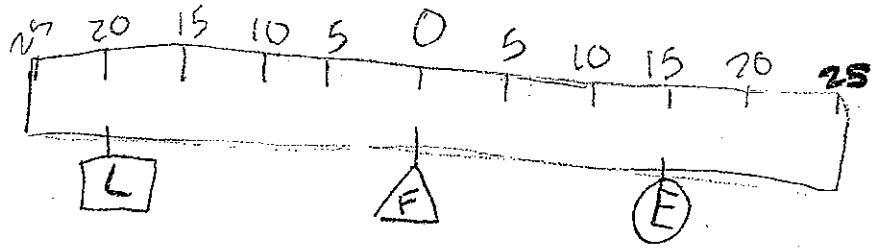
Name [redacted] Date

Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

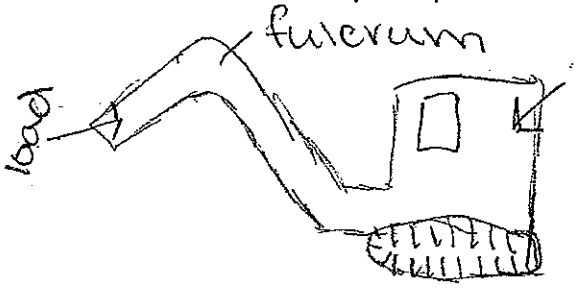
THINK...Reflect on these ideas.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



The fulcrum is in the middle so it will be a Class 1 the Load the Effort. The advantage is if the fulcrum is further from the load then it will be easier to lift.

APPLY...Describe an example of your chosen system from the real world.



a crane would be a class 1 because the fulcrum is in the middle.

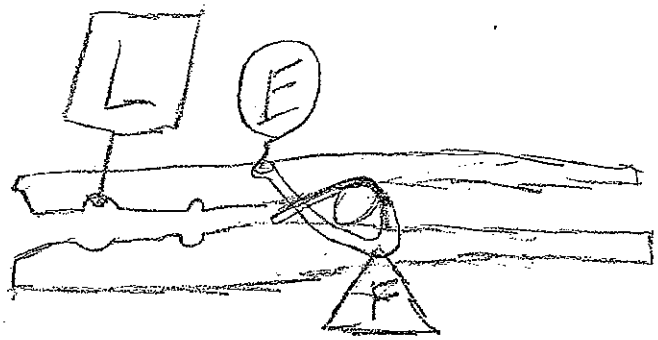
Name [redacted] Date

Levers and Pulleys Reflection

Systems have inputs and outputs. We can predict what will happen if input is changed. We have also learned that we can change the advantage in a machine by changing how the system is set up.

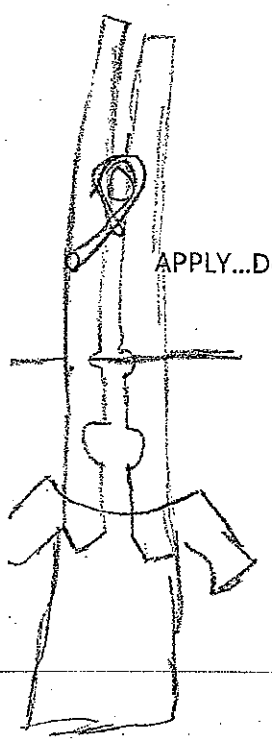
THINK...Reflect on these ideas. This reflection should have had a pulley system.

EXAMPLE...Draw a system from one of our investigations. Show and describe how you can change the advantage in the system.



This is a class 3 Lever it could also be a class 1 because when you are just opening and closing it it is a class 1 but when you are hanging Somthing up it is a class 3.

APPLY...Describe an example of your chosen system from the real world.



if the paper clip is hanging Somthing up on a close line its a class 3 because you have your Load at the end because your have a shirt at the end and the effort in the middle here

up the shirt and the fulcrum is at the other end because that's the base that's where it meets altogether thats what makes a class 3 lever