
Assessment
outcomes
systematic
results
measurement
programs
goals
actions
measurable
rubrics
mission
program
degree
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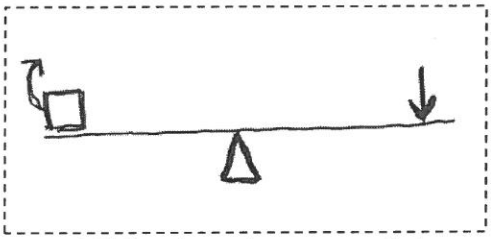
map
improve
collection
recommended
affective
development
specific
surveys
use
learning
objectives
behavioral
undertaken
student
educational
review

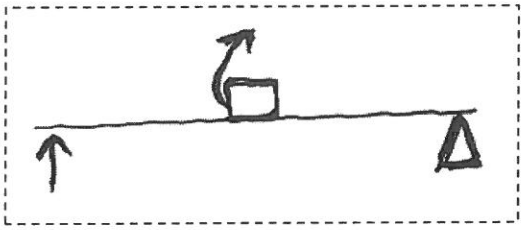
Sample Bell Ringer/Warm Up Questions

Levers

Below are two diagrams showing different set ups to lift the same object. Select the set up you think will be easier for you to use, and describe why. You may reference the effort you presume you will put into the set up, or the arrangement of the forces and how you will lift the item as reasons for one being easier than another:



A 1st Class Lever where your goal is to lift the box up. Example: seesaw



A 2nd Class Lever where your goal is to lift the box up. Example: wheelbarrow

Inclined Plane

You are tasked to place a ramp from the back of a moving van onto a driveway to make items easier to carry. You have a variety of boards to choose from; some are short in length, some are longer. Decide whether you would like to use a short board or a long board for your ramp, and explain why.

Now draw a diagram of your ramp. On the diagram, use a different color pen to outline any triangles that are created by the ramp.

Do you know any terminology to apply to these triangles? (For example: Right, Isosceles, etc). Do you know any formulas you could apply to these types of triangles? Add those below your diagrams.

Pulley

Pulley are frequently used outside apartments in Amsterdam to assist residents in lifting groceries, bulky items, heavy loads, and even bicycles up to a different floor of the building. The pulley often hangs from a hook above the top window of the building, and rope is kept inside the window to be taken out when the pulley is needed.

You are hoping to use a pulley to assist in lifting a box up to the 2nd floor of a 4-story apartment building. Each floor of this building is 10 feet high, with the window in the middle, meaning the pulley is 40 feet above the ground and the 4th floor windowsill is 32.5 feet above the ground. How much rope will you need to string the fixed pulley (diameter = 1 foot), reach an item on the ground, hold the end of the rope in your hands, and lift the bicycle up to the 4th floor?

Simple Machines Practice Problems

Show all work!

Your little brother gets a new seesaw for your backyard playground for his birthday. The sides of this seesaw are not equal & because he is younger, you always let your brother sit on the longer side. His side of the seesaw has an effort arm length of 5 meters & a Mechanical Advantage of 10.

1. Determine the length of the resistance arm. 1._____

2. Draw a diagram of the see saw below, label the effort arm, resistance arm & place the fulcrum.

You gather the following data from an inclined plane:

Distance Input = 2.2 m
Force Input = 4.25 N
Distance Output = 0.25 m
Force Output = 12 N

3. Calculate Work Output 3._____

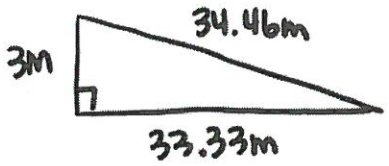
4. Calculate Work Input 4._____

5. Calculate AMA 5._____

6. Calculate IMA 6._____

7. Calculate ME 7._____

You have plans to help build a ramp at Hawken School this spring. Using the engineers' drawings below:



8. Determine the slope of the ramp 8._____

9. Does this designed ramp meet ADA requirements? Why or why not?

A pulley used to bring holiday decorations to the top of the cupola on the Lyndhurst campus has a Mechanical Advantage of 4. The 500 N load is lifted 40 meters.

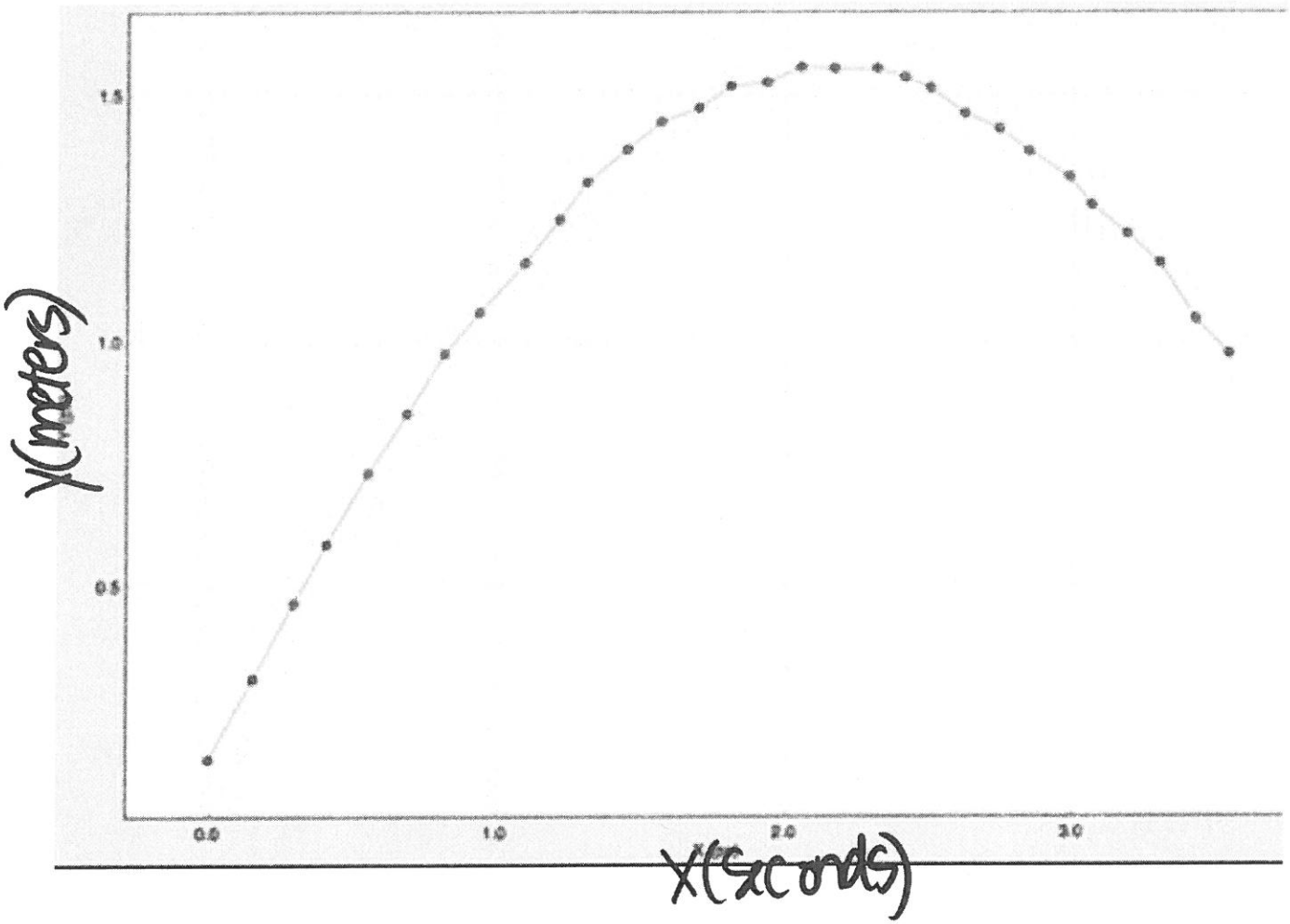
10. Calculate the Distance Input 10._____

11. Calculate the Force needed to Lift the Load 11._____

You record your friend shooting free throws at basketball practice. The graph of one shot is below.

12. What is the maximum height of the basketball? 11._____

13. After how many seconds does the ball reach the maximum height? 12._____



Sample Check-In Questions

Levers

How do you calculate the mechanical advantage of a 2nd class lever? Find the formula and explain it to us. Draw an example of a 2nd class lever that provides the most advantage to the user. Where should the resistance be located relative to the fulcrum and effort?

How do you calculate the mechanical advantage of a 3rd class lever? Find the formula and explain it to us. Draw an example of a 3rd class lever that provides the most advantage to the user. Where should the effort be located relative to the fulcrum and the load?

Inclined Planes

You are designing a wheelchair ramp to go in a new apartment building. Between the 1st and 2nd floor, there are 20 steps, and each step is 12 inches high. The average wheelchair weighs 5 kg, and the average person using wheelchairs weighs 75 kg. Your task is to design a ramp compliant with ADA requirements (the slope of your ramp must be 0.08 or less).

Below, draw a diagram of your ramp. Include labels for the following:

a	b	c	Di	Do	Fo
Fi	Δx	Δy			

Length of side a: Length of side b: Length of side c:

IMA of the ramp:

Given the average weight of a renter and their wheelchair, what is the WORK OUTPUT of your ramp?

Pulley 1

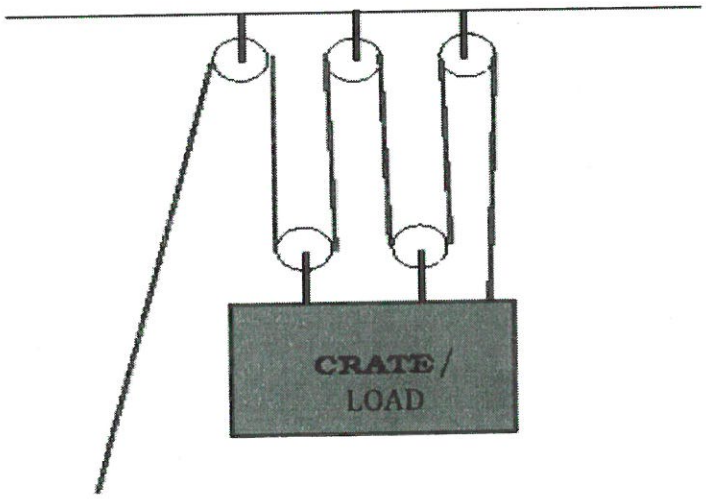
Use the below websites to create virtual pulley systems. You can observe the relationship between Force Input, Force Output, Distance Input, and Distance Output by "playing" the various games. Below each question, snip screenshots of at least 2 different pulley systems you create.

Select 1, 2, 3, or 4 pulleys in a game. The game will show force of each lift and distance rope was moved:
http://aspire.cosmic-ray.org/Labs/Machines/act2a/lab5.html

Pulley simulation where you can set up multiple pulleys, change the load, distance to lift, force applied, etc:
http://www.compassproject.net/sims/pulley.html

Pulley 2

Below is a diagram of a pulley. Please take a look at the organization of this pulley, then use this information to answer the questions.



What is the IMA of this pulley?

How do you know?

If the Distance Output (Do) of this pulley is 5m, what is the Distance Input (Di)? Show your set up/work, with units.

Sample Take Home Simple Machines Test

Mrs. Delia has a New Year's resolution to run 1000 miles in just one year. However, she has some conditions about completing this goal:

- She only wants to run 4 days a week (52 weeks = 1 year)
- On days where she runs, she plans to use only 1 hour to do so
- She will run the same amount every day she exercises

In order to achieve this goal, what does her average speed need to be, in meters per second?

A seesaw is perfectly balanced. On one side is Tanner. Tanner sits 1m away from the fulcrum and weighs 50kg. On the other side is Annalise. Annalise sits 4m away from the fulcrum and weighs 25 lbs. In order to perfectly balance the seesaw, one of them had to hold a bag of stones. Which person, Tanner or Annalise, has to hold the stones, and how much do those stones weigh, in kilograms?

Imagine finding yourself unemployed in ancient Egypt in the year 2551 BC. You learn of a job being offered to design a method of placing the final 2.5 ton stone block on the very top of the great Pyramid of Giza, the world's tallest structure (at the time) at 480 feet high. Though you're no superhero, you have a great education and know a bit about basic physics. So you decide to apply for the job.

a) Who would have most likely hired you and been your boss at the construction site?

b) What is the <u>minimum</u> amount of work (in Joules) required to accomplish this task?

c) In the space below, clearly design and diagram a simple machine capable of accomplishing this task. Your diagram should show accurate measurements and detail of all important parts.

d) What is the ideal mechanical advantage of your simple machine?

e) Would the actual mechanical advantage be different from the ideal mechanical advantage? Explain.

Mrs. Brandt and Mrs. Delia would like to use a pulley system to lift a dog, Pearl, 720 inches up to their tree house. Though Pearl weighs 54 lbs, they only needed 80N of force to lift her up.

a) If there was no friction in your system, how much Work (in Joules) is required to lift Pearl up to the treehouse?

b) What is the IMA of this simple machine?

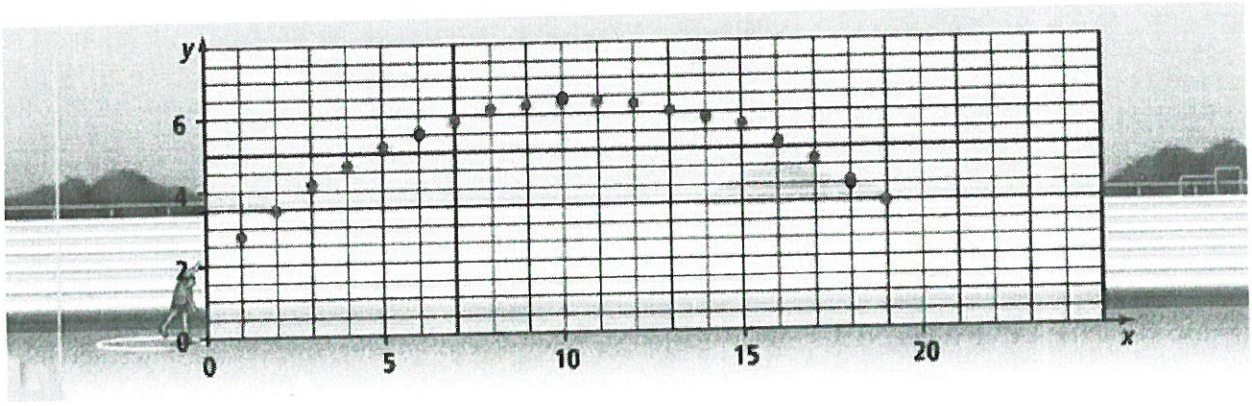
c) What is the minimum length of rope they used (the entire length, from start to finish)?

d) In the box below, draw a clear diagram of what the pulley system might have looked like, including labels.

(Pre-Algebra) Using the steps learned during our Trajectory Scavenger Hunt and graphing parabolas with Nspire (the day before spring break), we would like for you to graph the parabola of one additional picture. It can be any true parabola you wish, but you must take the picture (this means you cannot use part of a sphere or circle for your parabola – it must be an item that is the shape of a parabola, like an arch).

- Give your parabola a caption indicating the place and date you took the picture.
- Use Nspire to add the parabola graph and equation
- Make sure the equation for your parabola is clearly visible on your picture
- Copy this graphed picture below with your caption

(Algebra) In the shot put, an athlete throws a heavy metal ball through the air. The arc of the ball is modeled below, where x is the horizontal distance, in meters, from the athlete and y is the height, in meters, of the ball.



Show your steps to solve each of the below questions regarding the shotput's arc.

A) What is the maximum height that the ball reaches?

B) How far from the athlete is the ball when it reaches its maximum height?

C) What is the equation representing this relationship?

D) How far from the athlete will the ball land?

DESIGN CHALLENGE

PART 2

SIMPLE MACHINE DESIGN CHALLENGE

THE OVERALL DESIGN PROCESS

Engineers' initial ideas rarely solve a problem. Instead, they try different ideas, learn from their mistakes, and then try again. The steps that engineers use to arrive at a solution are called the DESIGN PROCESS. As a group, you are going to design a solution to a given problem. The design, drawings, instructions & materials will then be given to a different group for them to build & test.

Each group will need to complete a Design Process for their Simple Machine. The specifics of each section are listed below. Make sure that your process is clear, concise & detailed. Good Luck!

PART 1: DESIGN SPECIFICS

WHAT IS THE TASK TO BE SOLVED?

BRAINSTORM IDEAS

- What are some different ways to tackle the challenge?
- Off the wall suggestions often spark GREAT ideas. How creative can you be?

DESIGN SPECIFICS

- Which brainstorm ideas are really possible, given your time, tools, materials & budget?
- What are some problems that you need to solve as you build your project?
- How will a sketch help clarify your design?
- How will you relay the steps to be followed to another group? How specific should you be?

PART 2: TEACH & EXPLAIN

RESEARCH THE HISTORIC & CLEVELAND CONTEXT OF THIS MACHINE

TEACH & EXPLAIN YOUR DESIGN

- What information do you need to make sure you tell the Construction Group?
- What tips should be shared?
- How will they know if the design is successful?

PART 3: CONSTRUCTION & FEEDBACK

CONSTRUCTION & TEST DAY!

FEEDBACK FOR THE DESIGN TEAM

- Your group will be providing specific feedback to the Design Team.

PART 4: GROUP SHARE

PART 5: SELF-REFLECTION

PART 6: PHOTO TIMELINE & CONFERENCE

SIMPLE MACHINE DESIGN CHALLENGE

PART 1: THE DESIGN

WHAT IS THE TASK TO BE COMPLETED ~

BRAINSTORMING OF IDEAS ~

DETAILED DIAGRAM OF MACHINE ~

DETAILED STEPS TO CONSTRUCTION ~

DATA TABLE ~

SIMPLE MACHINE DESIGN CHALLENGE

SUPPLY LIST & BUDGET

GROUP MEMBERS ~

Your group has a budget of $10 to create your Simple Machine. Please use www.acehardware.com to find your supplies. Please be specific with what is needed (size, quantity, price, etc). Your group is welcome to use items from the classroom or bring items from home.

DESCRIPTION OF ITEMS TO BE BOUGHT AT ACE	ACEHARDWARE.COM ITEM NUMBER	UNIT PRICE	QUANTITY	TOTAL COST
			TOTAL:	

SUPPLIES FROM CLASSROOM	AMOUNT NEEDED		SUPPLIES FROM CLASSROOM	AMOUNT NEEDED

SUPPLIES BROUGHT FROM HOME	WHO IS BRINGING IN		SUPPLIES BROUGHT FROM HOME	WHO IS BRINGING IN

SIMPLE MACHINE DESIGN CHALLENGE

PART 2: TEACH & EXPLAIN

WHAT IS THE HISTORICAL USE OF THIS MACHINE ~

WHERE IS THIS MACHINE USED IN CLEVELAND ~

PLAN FOR GIVING ALL OF THE INFORMATION TO THE CONSTRUCTION GROUP (divide among all group members) ~

- Historical Use
- Cleveland Use
- Diagram/Sketch
- Specific Construction Steps
- Math Concepts
- Data Table

SIMPLE MACHINE DESIGN CHALLENGE
PART 3: CONSTRUCTION & DATA COLLECTION

Type of machine constructed ~

Task to complete ~

Data Collection ~

Modifications ~

SIMPLE MACHINE DESIGN CHALLENGE

PART 4: FEEDBACK TO DESIGN TEAM

PROVIDE THE FOLLOWING FEEDBACK TO THE DESIGN TEAM ~

		EXPLAIN
Did you feel that you got all of the information needed during the presentation?	YES NO	
Did you feel that the diagram/sketch was helpful & had all of the information needed?	YES NO	
Did you have all of the materials needed to build your machine?	YES NO	What materials did you need to add?
Were all the materials that needed to be cut ahead of time cut for you?	YES NO	
If your machine needed holes drilled, were all of those marked for you?	YES NO	
Was your group able to build the machine based on the steps provided?	YES NO	
Was there a design element that you wish was included that would have made building the machine easier?	YES NO	
Did you change any of the design features?	YES NO	
Was this machine able to solve the task that it was intended to solve?	YES NO	
What is the best feature of this design?		Why?

SIMPLE MACHINE DESIGN CHALLENGE

PART 5: SELF-REFLECTION

REFLECTING ON YOUR EXPERIENCE DURING THE SIMPLE MACHINE CHALLENGE, FILL IN THE PROMPTS BELOW.

For each of the items in the tables below, please make a selection based on your perception of your skill level.

1. "Not Evident" – This is a skill or content area you feel you did not develop during the project.
2. "Emerging" – You are starting to develop this skill and see more growth to come.
3. "Accomplished" – You saw significant growth in your abilities in this skill during the project and could apply your understanding to more work in the future.
4. "Mastery" – During this project you led, or on a future project, you feel ready to lead a group in this particular skill area – for example, you could present this information to an adult audience

Design Skills	1 – Not Evident	2 – Emerging	3 – Accomplished	4- Mastery
Understanding and articulating the "problem" addressed by my group				
Thinking of possible ways to solve the problem				
Writing down and sketching ideas for our machine				
Organizing all ideas into one set of construction diagrams				
Organizing all ideas into one set of construction instructions				
Researching materials and filling out a budget				

Collaboration Skills

	1 – Not Evident	2 – Emerging	3 – Accomplished	4- Mastery
Listening to the ideas of my team members				
Sharing my ideas in a clear, concise, and friendly way				
Working with team members in and out of class in order to meet deadlines and project requirements				
Feeling open to feedback and new ideas from others and my teachers				
Meeting deadlines (both my own and my group's)				

Understanding of Concepts

	1 – Not Evident	2 – Emerging	3 – Accomplished	4- Mastery
Levers				
Inclined Planes				
Pulleys				
Trajectory Motion				

Wrap Up Questions:

Describe two NEW pieces of information you gained from completing this Design Challenge. You may focus on "soft" skills (like teamwork, collaboration, creativity, resilience) or you may focus on specific content. Just describe it to us in detail.

What part of this project suited you best? Did one piece suit your learning style better than others? Do you feel more naturally aligned as a thinker, designer, builder, manager of materials, etc?

If you could build anything else, what would it be?

After completing the above tables and questions, please share this form in a conversation with your parents. Ask them to list one thing they learned from you discussing this project with them, here:

... and then sign this sheet here: _____

DESIGN CHALLENGE PHOTO TIMELINE

As part of your Final Design Challenge Conference, your group will need to create 2 1-Page Photo Timelines & 1 Video documenting your work & creations during the Simple Machine Design Challenge.

#1 – DESIGN PHASE PHOTO TIMELINE

This should be a 1-Page, printed document which walks an audience through the Design Process that your group went through. Be sure to have photo evidence of the various phases arranged in a creative & organized timeline.

#2 – CONSTRUCTION PHOTO TIMELINE

This should be a 1-Page, printed document which walks an audience through the Construction Phase of the Challenge that your group went through. Be sure to have photo evidence of the various phases arranged in a creative & organized timeline.

#3 – CONSTRUCTION VIDEO

Your group should record the Machine that you constructed completing the assigned task. If the Machine is successful, great! If the Machine does not work, that is ok – just record an attempt at the task. The video will be played during the Final Conference of the Challenge.

SIMPLE MACHINE DESIGN CHALLENGE
OPTIONAL: SIMPLE MACHINE ARTICLE SUMMARY

Your Task
Your task is to search the internet for an article about the use and application of one of the simple machines that we have studied (lever, inclined plane, pulley, trajectory). The goal is to discover something new & interesting about that machine – discoveries from history, a unique application, a new use of the machine. After reading the article, complete the summary below. Your information and findings should be in complete sentences, with correct grammar & punctuation.

Background Information
Title of article:

Author(s) of article:

Website link containing the article:

Date article was published:

Summary Information
Briefly state the main idea or thesis presented in this article:

Summarize the most important information, ideas, facts, etc. presented in this article (you can use a bulleted list):

Personal Reaction
What was the most surprising/interesting thing you found out by reading this article?

What question(s) do you have after reading this article? What would you like to learn more about?

DESIGN CHALLENGE CONFERENCE PREPARATION

Be sure to have the following materials gathered & ready to share during your Design Challenge Conference with Mrs. Brandt or Mrs. Delia. Items **in BOLD** should be printed and neatly organized in your folder. Other items should be organized neatly in your notebook. During the Conference, each group member should be prepared to talk about both phases of the Challenge - it would be a good idea to divide the parts in advance so you are prepared!

DESIGN PHASE:

	Group Member Who Completed	Check if Included	Teacher Comments	
Supply List & Budget				
Design Plans & Drawings				
Construction Instructions				
Math Concepts				
Data Table				
Historical Rationale				
Specific Cleveland Uses				
1 Page Photo Timeline				

CONSTRUCTION PHASE:

	Group Member Who Completed	Check if Included	Teacher Comments	
Data Collection				
Group Feedback				
Individual Self-Reflections				
1 Page Photo Timeline				
Video of Machine in Action **please note the team member's notebook where we can find the video				

SIMPLE MACHINE DESIGN CHALLENGE

GRADING CHECKLIST

Group Members:				
DESIGN				
Planning Effort (3 Points)				
Completed Components (8 Points)				
• Supply List				
• Design Plans/Drawings				
• Construction Steps				
• Math Concepts				
• Data Table				
• Historical Use				
• Cleveland Use				
Group Presentation (3 Points)				
CONSTRUCTION				
Effort (3 Points)				
Data Collection & Modifications (1 Point)				
Feedback (3 Points)				
REFLECTION				
Self-Reflection (1 Point)				
Parent Signature (1 Point)				
Photo Timelines (2 Points)				
Construction Video (1 Point)				
TOTAL (26 Points)				