Robotics Engineering

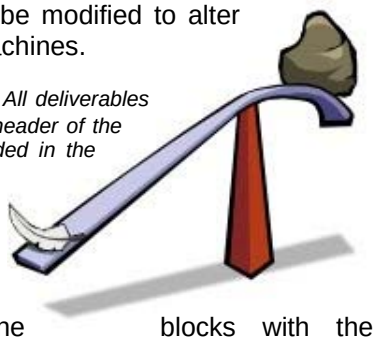
DoDEA – Career and Technical Education

Simple and Compound Machines

Exercise 1b – Levers

Objective:

At the completion of this exercise, you will demonstrate how lever systems can be modified to alter mechanical advantage and you will be able to apply the use of levers in complex machines.



Deliverables:

Copy and paste the required deliverables to another document for submission. All deliverables must be word processed with the required student ID information in the footer of the document. The header of the document should contain the title of the assignment. Both the question and answer must be included in the deliverable with the answers highlighted. All work must be complete and accurate to receive credit.

1. Detailed definitions for each of the terms found in the Nomenclature section.
2. Detailed answers to the queries listed in the Questions section.
3. Completed table from the Levers Activity below.

Information: The Great Pyramid of Giza is built of approximately 2.3 million stone blocks with the largest among them weighing between 20 and 80 metric tons. How was it possible to move these massive boulders over 5000 years ago? The answer lies in simple machines. One example of a simple machine is a lever. Levers use significantly less effort to move large weights by placing the weight on one side and applying pressure to the other while a fulcrum is positioned underneath to act as a pivoting point. See-saws, wheelbarrows bicycle hand-brakes are examples of levers.

Research Resources:

The WWW changes all the time. If the listed links do not work, first inform your instructor then use a search engine to research information regarding the described subject.

Web Site	Description
http://www.technologystudent.com/forcmom/lever1.htm	Website showing classification of levers
http://ocw.mit.edu/index.htm	M.I.T. Open Courseware -Search engine for high school level physics/engineering information.

Nomenclature:

Research and develop a detailed (two to three sentences) definition for each of these terms. It's important to realize that many words have multiple definitions. Some of which may have nothing to do with this course of study. Make sure your definitions fall within the context of this lesson.

- *Lever*
- *Effort*
- *Fulcrum*
- *Force*
- *Load*
- *Work*

Questions:

1. Research and develop a detailed definition for each of the terms found in the Nomenclature section.
2. Explain how levers allow people to lift heavy objects that they would normally be unable to lift.
3. Classify the three types of levers drawing a simple diagram of how they work.
4. List several practical examples of levers in everyday life.
5. From the data you collected in web based activity below:
   a. How does a lever produce a mechanical advantage for moving the obelisk?
   b. How did moving the fulcrum affect the mechanical advantage?
   c. How did moving the object affect the mechanical advantage?
   d. How did changing the length of the bar affect the mechanical advantage?

Procedure:

In this activity, you'll conduct a virtual experiment regarding the simple machine known as the lever. You'll closely examine the relationship between the fulcrum and bar, as well as the position of the fulcrum in relation to the effort and load. Follow the instructions carefully.

Required Materials and Equipment: *Get these materials and tools from your instructor.*

- *Computer with Internet Access*
- *Shockware Software Installed*

Steps:

1. Link to http://www.pbs.org/wgbh/nova/egypt/raising/ and navigate through the Nile Site Map showing how scientists attempted to lever an obelisk. Use your Learning Log to record notes.
2. Now, go to www.pbs.org/wgbh/nova/egypt/raising/leverwave.html and launch the lever simulation.
3. Before you begin, complete Table 1 below describing how you plan to raise the obelisk.

4. Put your plan into action and record the results in the cells provided, paying careful attention to the calculations provided in the simulation. The goal of this activity is to understand the mechanical advantage which levers provide.
5. Improve your plan in Table 2 and compare the results between the two tables.

Table 1: Plan for Raising the Obelisk

Step	Object Used	Location	Mechanical Advantage Data Work = Force x Distance			Result
			Lever Side W=FxD	*=, <, >*	*Obelisk Side W=FxD*	*How did obelisk move?*
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Table 2: Improved Plan for Raising the Obelisk

Step	Object Used	Location	Mechanical Advantage Data Work = Force x Distance			Result
			Lever Side W=FxD	*=, <, >*	*Obelisk Side W=FxD*	*How did obelisk move?*
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Conclusion: Were you able to lift the obelisk? This is a virtual simulation to what the Egyptians had to deal with but they had to incorporate gravity into their solution as well. Used properly, levers can change the amount of effort needed to a fraction or what would be required without using this simple machine. The amount of force applied times the distance an object moves is equal the amount of work performed. In completing this exercise you can now understand how levers used to build huge structures like the pyramids at Giza can be also be applied to the miniature mechanism found in robot design.