14.4 Simple Machines
Honors Integrated **Science**

Name:_____ Date:_____ Per._____
Directions: Answer the following questions in complete sentences and thoughts, using the information from the video to support your learning. For all math questions, show your work and your final answer should include appropriate units and significant figures.

1. How are the lever and the wheel and axle related to each other?

2. What is the ideal mechanical advantage of a rampo if its length is 4.0 m and its higher end is 0.5 m above its lower end?

3. Tightening a screw with a large spacing between its threads requires fewer turns of a screwdriver than tightening a screw with smaller thread spacing. What is a disadvantage of the screw with larger thread spacing?

4. What class or classes of lever always have a mechanical advantage greater than 1?

5. If you want to pry the lid off a paint can, will it require less force to use a long screwdriver or a short screwdriver? Explain your answer.

6. When the pedals of a bicycle move through a distance of 0.25 m, the rear wheel of the bicycle moves 1.0 m. What is the ideal mechanical advantage of the bicycle?

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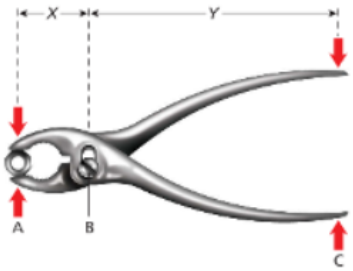
7. Explain why it could be useful for the mechanical advantage of a bicycle to be less than 1.

8. Write a paragraph describing the series of events that occur in the operation of a complex machine that you have used today.

9. a. Identify the position of the fulcrum.



b. If X = 3.0 cm and Y = 15.0 cm, what is the ideal mechanical advantage of the pliers?

10. A machine you designed has input and output arms that pivot around a fulcrum. When the input arm is pushed down through a short distance, the output arm moves down through a longer distance. Is the output force less than, equal to, or greater than the input force? Explain your answer.

11. Identify the simple machines in a pair of scissors.

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12. Why would you use a single fixed pulley to lift a box if the pulley's mechanical advantage is 1?

13. What determines the class of a lever?

14. Is a screw with fewer or more threads per centimeter easier to drive into a piece of wood? Explain.

15. Give an example of a useful machine you have seen that has a mechanical advantage less than 1. State how the machine is useful in terms of changing forces, distances, or directions.

16. A ramp 20 m long and 4 m high is used to lift a heavy box. A pulley system with 4 rope sections supporting the load is used to lift an identical box to a height of 4 m. Assume that friction can be ignored. Compare and contrast the input force and input distance needed to lift each box.

17. In a pulley system, where is there likely to be friction that reduces the efficiency?

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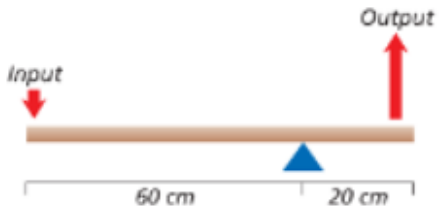
18. Classify each of these items as a type of simple machine;

    a. a steel bolt

    b. an iron nail

    c. a screwdriver.



19. The figure above shows the distances from the fulcrum to the input and output forces of a lever. Use these distances to calculate the ideal mechanical advantage of the lever.

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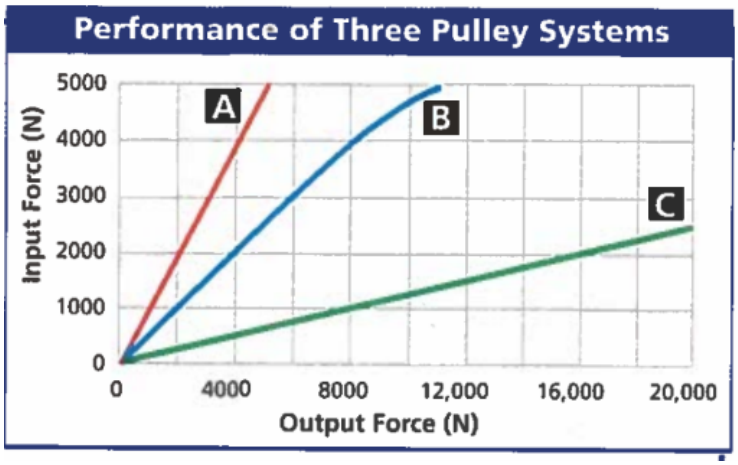

Data Analysis: A shipyard has many different pulleys and pulley systems in use. The pulleys are used to move large, heavy, fabricated ship sections through the manufacturing process. During an annual safety and performance inspection of three of the company's systems, a facility engineer collected the data shown in the graph. The data give the measured output forces for a range of given input forces.

1. What system requires the smallest input force to lift a 2500 N load?

2. Determine the actual mechanical advantage for each of the systems for a 2000 N input force. Show your work.

3. Which of the three systems shown in the graph consists of a single fixed pulley? Explain how you know.

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4. Describe what happens to system B's output force as the input force increases above 4000 N.
    a. How does this affect the mechanical advantage of the system at higher loads?

    b. Offer a possible cause for the performance shown in the graph.

5. Using the mechanical advantage value form question #2, determine the output force of system A for an input force of 8000 N.