Name: ____________________________

Work and Power

CAN AIR DO WORK?

Terms to Know

energy - the capacity to do work

force - a push or a pull

horsepower - an English system unit used to measure power (1 Horsepower = 746 Watts)

Joule - a metric system unit used to measure energy or work (1 Joule = 1 Newton-meter = 1 kg-m^2/s^2)

mass - the measurement of the amount of matter an object contains (You have the same amount of mass while on the earth, the moon or in space.)

Newton - a metric system unit used to measure force (1 Newton = 1 kg-m/s^2)

power - the rate at which work is being done (It takes a certain amount of work to lift a box to a certain height. While the work is the same, it takes more power to lift the box quickly than it does to lift the box slowly.)

Watt - a metric system unit used to measure power (1 Watt = 1 Joule/second = 1 kg-m^2/s^3)

weight - a measurement of the gravitational force pulling objects to the earth, the moon or other object (The more mass a planet has, the greater its gravitational pull will be. An object weighs more on the earth that it does on the moon because the earth has more mass.)

work - applying a force through a distance (Pushing a book across a desk is work, pushing on a wall that doesn't move isn't.)

Directions

1. From the materials supplied, invent a machine that will lift dice off the ground using wind power.
2. Set your machine so that the dice that are being lifted start on the floor. Using only wind power, lift the dice as high as possible and as quickly as possible. Use a meter stick to measure how high the dice were lifted and a stopwatch to measure how fast the dice were lifted. Record how many dice were lifted, how high they were lifted and how quickly they were lifted on the **Work and Power Data Chart**.
3. Reset your machine and try again. Try lifting a different number of dice or changing the design of your machine. For each trial, record how many dice were lifted, how high they were lifted and how quickly they were lifted.
4. Use the data you collected to calculate the amount of **work** that your machine did in lifting the dice and the amount of **power** that your machine generated.

Data Collection and Analysis

Directions: For each trial you conduct, record the **number of dice used**, the **height the dice were lifted** and the **time it took to lift the dice**. For each trial, calculate the **work** your machine did in lifting the dice and the **power** your machine generated. Use the **Work and Power Calculation Worksheet** if you need help with the calculations.

Work and Power Data Chart

Trial	Number of Dice Lifted	Height Lifted (centimeters)	Time to Lift (seconds)	Work Performed (Joules)	Power Generated (Watts)
1					
2					
3					
4					

Questions to Think About

1. What was the most work your machine did? What was the most power your machine produced?

2. Does it take more work to lift a 5 gram mass a total of 10 centimeters or to lift a 10 gram mass a total of 5 centimeters?

3. Does it take more power to lift a 5 gram mass a total of 10 centimeters in 10 seconds or to lift a 5 gram mass a total of 10 centimeters in 1 second?

4. If your machine could produce electricity, how many of them would you need to power a 5 Watt night-light? How long would the night-light stay lit?

5. If your machine could produce electricity, how many of them would you need to power Jefferson Lab's accelerator? How long would the accelerator run? [It takes about 1 Megawatt (1,000,000 Watts) to power Jefferson Lab's accelerator.

Work and Power Calculation Worksheet

Number of dice used	How high did it go?	How long did it take?
	cm	s

How much mass was lifted?

$$\left(\underset{\text{Number of dice used}}{\boxed{}} \times \underset{\text{Mass of one die}}{5.5\ g} \right) + \underset{\text{Mass of the cup}}{2.5\ g} = \underset{\text{Total Mass Lifted}}{\boxed{\ g}}$$

Conversions!

Height Lifted [cm] = Height Lifted [m]

Total Mass Lifted [g] = Total Mass Lifted [kg]

How much work was done?

Total Mass Lifted [kg] x Height Lifted [m] x Gravity $10\ m/s^2$ = Work [J]

How much power was generated?

Work [J] ÷ Time [s] = Power [W]