Data Sheet 2

Group member names:

____________________ ____________________

____________________ ____________________

	Length of Dowel (m)	Diameter of Dowel (m)
#1		
#2		
#3		
#4		

Dowel #1

Number of Oscillations Observed	Time (seconds)	Period, T Seconds/Oscillations
		Average Period, T Seconds/Oscillations

Dowel #2

Number of Oscillations Observed	Time (seconds)	Period, T Seconds/Oscillations
		Average Period, T Seconds/Oscillations

Dowel #3

Number of Oscillations Observed	Time (seconds)	Period, T Seconds/Oscillations
		Average Period, T Seconds/Oscillations

Dowel #4

Number of Oscillations Observed	Time (seconds)	Period, T Seconds/Oscillations
		Average Period, T Seconds/Oscillations

For each dowel, calculate the frequency.

	Frequency = $\frac{2\pi}{T}$
Dowel #1	
Dowel #2	
Dowel #3	
Dowel #4	

This spring-mass model replicates the natural frequency of a plant. There are two equations for the frequency of a plant.

Frequency = $\frac{2\pi}{T}$

Frequency = $\sqrt{\frac{k}{m}}$, where k is the stiffness of the dowel and m is the mass of the playdo and the dowel combined.

Can the stiffness, k, and the mass, m be related to the frequency that your group calculated? Write the new equation.

☆

To find stiffness of the dowel, k:

$$k = \frac{3EI}{L^3}$$

E – elastic modulus – measure of the stiffness of the dowel

For oak, E is 1.1×10^9 1.1 Pa $(\frac{kg}{m \cdot s^2})$

I – Second moment of area – property of a shape that describes the shapes resistance to bending

What shape is the dowel? ____

For a ______________________________________
(name of shape)

$I = \frac{\pi \times r^4}{4}$, where r is in meters

L – length of the beam (*m*)

Now that we know E, I, and L, we can find k. Once we know k, we can solve for m using the new equation that you wrote above (where the star is). For each dowel, calculate m.

	E $(\frac{kg}{m \cdot s^2})$	I $(meters^4)$	L $(meters)$	$k = \frac{3EI}{L^3}$	$\frac{2\pi}{T} = \sqrt{\frac{k}{m}}$	*mass* (*kilograms)*
Dowel #1						
Dowel #2						
Dowel #3						
Dowel #4						

Questions for Reflection:

1. What does m represent in real life? Remember you are modeling plants!

2. Agricultural researchers have genetically modified plants for larger fruit and vegetables. How do you think this increased mass affects the plant? Explain this in real life terms and in mathematical terms (what happens to the frequency as m becomes larger?).

3. Agricultural researchers have also modified plants for stronger stems. In mathematical terms, they are increasing the stiffness, k, of the plants. What three things could be changed about a plant to increase the stiffness, k?

4. Using dimensional analysis, show that $\frac{2\pi}{T} = \sqrt{\frac{k}{m}}$.

Note: Although we have been specifically modeling plants, building materials also have the same properties that affect frequency – length of beams, material of beams, shape of beams. When researching plant modifications and man-made constructions, it is important to consider the natural frequency of the plant or structure to prevent it from snapping, uprooting or falling down.