Skype A Scientist - Mallory Gaspard, Cornell University
Spring 2020
Spring Into Action!

Name: _____

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1 Bouncing Back and Forth: Exploring Springs and Oscillations

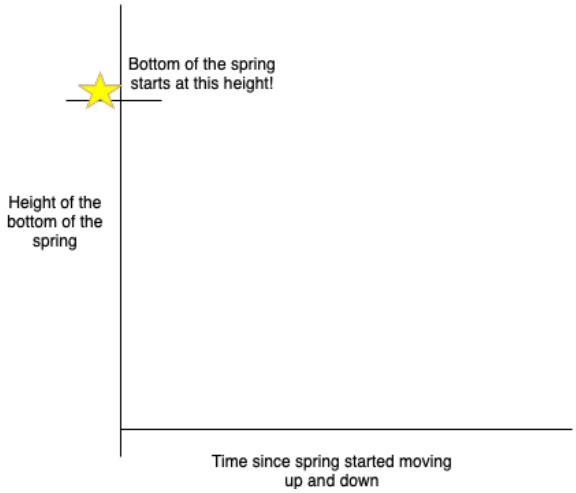
To understand the behavior of springs, we will observe a spring in motion by following the steps below. For this exploration, you will need one slinky to follow along with the guided instructions.

1. Hold the spring above the ground and make sure that it is bunched up, or *fully compressed*. Do not let the spring go just yet!

   Question 1. How fast is the spring moving *before* it is dropped? What is the potential and kinetic energy like at this step? Discuss with your group and write your thoughts here.

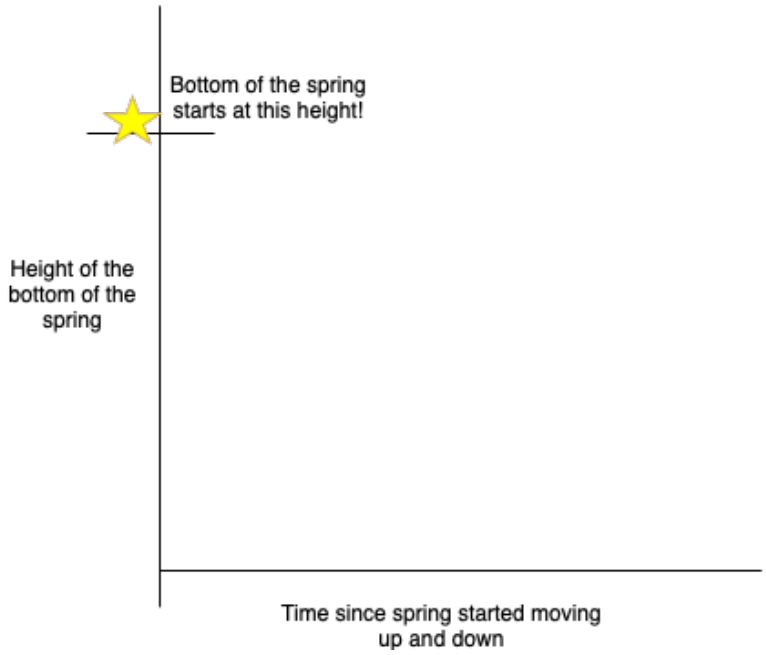
2. Next, keep the hand that was holding the spring in the same position above the ground (do not move your hand up and down - keep it still and keep it at the same height!) and let the bunched up part of the spring go! Carefully watch the spring move up and down.

   Question 2. How does the spring move up and down? Does its speed get faster or slower as it goes down and moves back up? Write down and talk about your ideas with your group and draw the spring's movement in the space below.



3. Repeat step two but this time, allow the spring to bounce up and down until it stops on its own. This bouncing up and down movement is called *oscillation*.

Question 3. What do you notice about the spring's movement? Each time the spring goes down and comes back up, does it always travel all the way back up to the starting height or position? Why or why not? Discuss your ideas with your group and use the space below to write or draw.



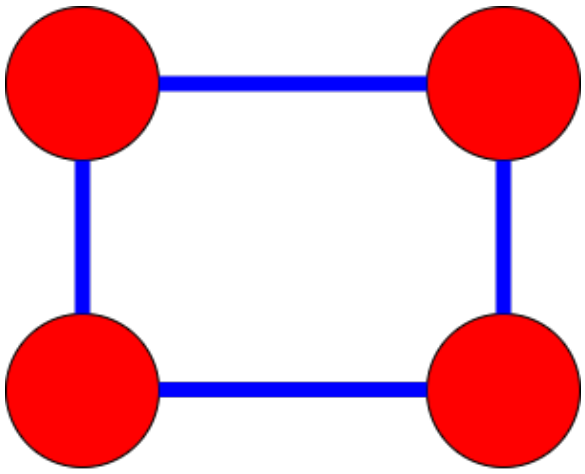
2 Spring Into Action! Springs in the Real World:

As you've seen from the demo above, slinkys are excellent examples of springs!

Question 4. Are there any other springs or objects that move like springs that you can think of in your daily life? Be creative, discuss your ideas with your group, and write them here!

2.1 Atoms and Molecules - Nature's Legos:

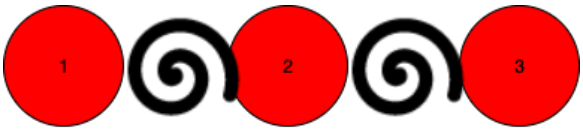
Now, we will briefly touch on *what* things are made of. Every object you interact with, from your school itself to the tiniest piece of dust is made of *matter*. You are also made of *matter*! Matter is made up of little particles called *atoms* that are held together by links called *bonds*.



Four red atoms connected by blue bonds

There are many different types of atoms that make up all kinds of different objects! Every object is made of a *material* which is a very very large group of atoms that are all bonded together. Some materials are hard, others are soft, some are stretchy, and some don't stretch at all! Over many years, scientists have studied different types of these materials in the lab. Through lots of lab experiments, especially on materials where all of the atoms are close together, scientists have found that bonds between all of these atoms are actually like springs!

Question 5. Suppose that we have atoms connected by two springs as in the picture below. Now, what if these atoms in the material get nudged or bumped so that they can move right or left. Will the atoms in the chain start to move? Will some of the springs be compressed while others are stretched? Describe some of the ways that the atoms and bonds (springs) can move side to side. Think about ideas related to kinetic energy, potential energy, friction. Discuss your ideas with your group and write them below!



Three atoms connected by bonds (springs)

2.2 Movin' and Groovin': Vibrations in Materials and Phonons

Many scientists are interested in how these atoms move back and forth from their starting positions in materials and what the energy is like when they move. Sometimes when a material absorbs energy of a certain type, the atoms that make up the material will start to move side to side.

If we think of the bonds between atoms as springs, when the atoms move side to side, the springs that connect them will stretch or compress depending on which way the atoms are moving. A moment when these atoms in the material are all moving the same way is called a *phonon*.

From the phonons in a material, scientists have been able to determine how the material behaves with heat, temperature changes, and other energy-related properties. This has also allowed scientists and engineers to come up with new materials to use in all sorts of devices that lots of people use in their daily lives!