Newton's 3rd Law

Name: _____ Date: _____

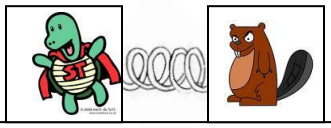
Newton's 3rd Law: Force every force there exists an equal and opposite reaction force. The force exerted on each body is equal in magnitude, but opposite in direction. The force acts on different bodies.

Activity

Consider the situation below. Two massless boxes are pushed together on a completely frictionless surface. There is a strong spring between the two of them. The spring when compressed exerts a **force of 12000 N**. For each situation, **calculate the acceleration** of each box when the spring is released. The spring acts on the boxes for **0.25 seconds**, also, determine the **final speeds of each box**. You must include **free body diagrams** of each object.

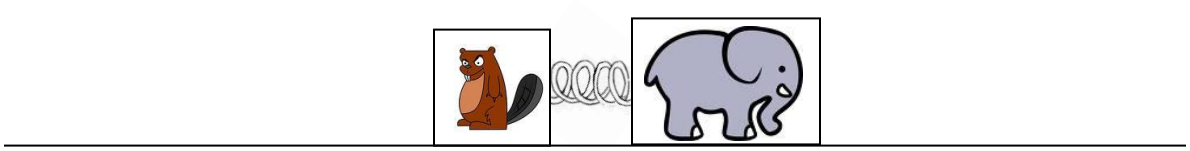
Situation 1:

Inside one box is *BigBang the Beaver (B^3)* (20 kg) and inside the other is *Super Turtle* (12 kg).



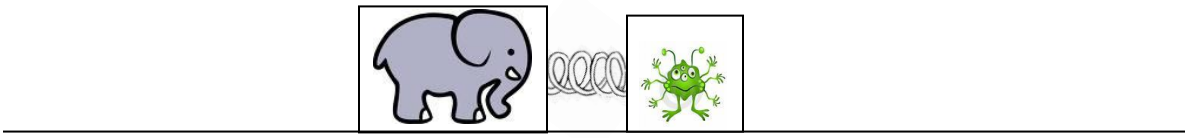
Situation 2:

Inside one box is B^3 and inside the other is *Vector the Elephant* (2000 kg).



Situation 3:

Inside one box is *Vector* (2000 kg) and inside the other is *Alcon the Alien* (*Double A*) (2000 kg)



1. In order to jump up in the air you must overcome gravity by pushing down on the Earth. If you push with enough force you will accelerate into the air. The Earth is floating in space and hence should it not also move and accelerate if Newton's third law is to be correct? Explain why the Earth does not seem to move when this happens. Suppose a 50 kg person pushes downward on the earth with a force of 1000N, calculate the acceleration of the person (you must use the net force acting on the person, i.e. they must overcome their weight) and the acceleration of the Earth (5.98×10^{24} kg)

2. In reference to question 1, explain why when you run forward along the ground you move forward and the Earth does not start spinning in the opposite direction (compare this to a logger running on a log in the water).

3. Explain why if you are standing on the skates with a friend that is much bigger than you and you push them that you accelerate more than they do.

4. Explain why when you jump off a skateboard you don't move forward much but the skateboard shoots out backwards a greater speed. In contrast, explain why if you are standing on the back of a flatbed train and jump off you move forward with a large speed, but the train barely moves.

5. Explain why a propeller on a plane is able to propel the plane forward.

6. Explain why the blades on a helicopter cause it to lift.

7. Explain why the wing of a plane causes lift. Tilting up causes you to rise and tilting down causes you to accelerate downward.

8. Explain how an astronaut that is stranded in space holding a bag of marbles can use those marbles to slowly propel himself back to his ship.

9. Explain why a rocket can thrust and propel its way through empty space.