**Putting It All Together** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***(A summary of what we have learned about Forces & Motion)***

If a book is on your desk, there are two forces acting upon it. One of these forces wants to pull this book to the floor.

What do you call that force? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Another thing is acting upon this book to keep it in place. What is pushing up on the book just by being there?

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When two forces acting on an object equal out, they are **in balance**. When forces are in balance, Newton said that an object that is resting in one place will stay resting in that same place. If forces are in balance on a moving object out in space, it will keep moving forever in a straight line at the same speed.

When forces are **unbalanced**, they may cause objects to speed up, slow down, or change direction until the objects get to a state of balance once again.

On Earth, many forces act on objects to keep them from moving in a straight line forever. One of these forces is **gravity**. It's what keeps you from floating off the ground.

At the same time the Earth pulls on any object, that object is also pulling on Earth. Right now, you are pulling on Earth as the Earth pulls on you. Earth has a much stronger pull than you do because it is so \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

When you are standing on the ground, the forces between you and the Earth are balanced, so you can stand still.

If you were standing on a cliff a thousand feet up, the gravitational pull of Earth on you would still be balanced with the upward push of the cliff (because the cliff keeps you in place just by being there).

If you stepped off the cliff, there would be no upward push holding you in place so you would \_\_\_\_\_\_\_\_\_\_\_\_\_.

You would keep moving until you reached the ground below. The upward push of the ground below would stop you and the forces would be balanced again.

Unfortunately, as you fell off the cliff toward the ground, you would **accelerate**. Many people describe acceleration as "speeding up". Isaac Newton said that gravity causes objects to accelerate as they fall toward the Earth. Newton also came up with an equation to calculate the force that a moving object would generate:

**F = M x A**, which stands for "***Force equals mass times acceleration***."

Your mass is how much matter is in you. It's sort of like how heavy you are.

Since you will accelerate to a high speed by the time you hit the ground,

your Mass x Acceleration will create a lot of

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which might really damage your body!

We care about things like balanced forces and Newton's Laws of motion when we are on a cliff. We also care about balanced forces and Newton's Laws when we are driving around in our cars. Why do you think we care about forces?

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When we put balls on ramps, we observed the effects of letting go of an object from different points on a ramp. We also observed the effect of releasing a heavier and lighter ball from the same spot on the ramp? What happened in the experiment? Did it make a difference if a ball was released from higher up on the ramp? Did it make a difference if you increased the mass of the ball (that is, you increased the size & weight of the ball)? Describe what happened in the ramp experiments and what you learned:

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Here's another question: If a car has sped up to 60 miles per hour (freeway traffic speed), will it take longer to stop than if it is driving at 25 miles per hour (neighborhood traffic speed )? \_\_\_\_\_\_\_\_\_\_\_\_\_.

Why? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Why do you think there are speed limit signs on most streets that say how fast people can drive?

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Do the police and other people care about things like acceleration or the effect of the forces of cars in motion? \_\_\_\_\_\_\_\_\_\_\_ Why?

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Mass is how much matter is in something. A big truck has more matter than Mrs. Leroux's little red car, so it has more mass. If they are both driving the same speed (let's say, 30 miles per hour), which will do more damage if it smashes into something - a big truck or Mrs. Leroux's car?

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Why do you think so? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Do you think it would take longer for a big truck to stop suddenly than it would take for Mrs. Leroux in her car? \_\_\_\_\_\_\_\_\_\_ If you think so, why do you think this? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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There are rules on the roads leading down out of the mountains from Lake Tahoe that say that big trucks have to drive more slowly down big, steep hills than other cars do. There are even special places where trucks can run off the road if their brakes don't work well enough to stop them on these steep hills. What does this have to do with what we have learned about forces in motion? (You may use any of the following words in your answer if it is helpful: momentum, mass, speed/ velocity, acceleration, gravity, potential energy, kinetic energy, balanced forces, unbalanced forces, collision)

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In our ramp experiments, many of us learned about the effects of friction. Is friction a force that speeds a rolling ball up or slows it down? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What have you learned that can help you build a marble maze or raceway? If you are trying to have your marble roll for a long time without being pushed, what can you do to make a good track? What are some aspects of force that you need to consider? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Describe your teamwork so far in building your marble run. Who is in your group? What are some changes that you have had to make in your design? Why do you have to make these changes? What are you planning to try as you continue your engineering project?