Name:

**Materials needed (per group):**

STEMinAR Cube

Augmented Reality app downloaded

Writing utensil

***Observing the Effects:***

1. Take a few minutes to explore and play with the simulation. Write down all your observations. What do you notice? What do you wonder?

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***Understanding Relationships:***

1. Create two different scenarios for the spaceship that do not involve any forces (Make sure Force (N) is set to zero). Describe what you did to create the scenarios.

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1. Describe the object’s motion in both cases. What motion do you initially observe? What motion do you observe after a few, or even several, seconds have elapsed?

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1. Create a scenario where the object moves at a constant velocity. Draw the three different types of graphs.

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What is the relationship between these 3 graphs? What is similar, what is different?

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1. Reset the parameters. Then turn on a force in one direction of motion for at least 3 seconds. What happens to the motion of the space-ship? How is the motion similar to or different from the previous scenario?

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1. Draw the three different types of graphs. Explain the relationship between them.

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1. Create three different scenarios where the spaceship moves with a constant force. For each of the three scenarios, observe the different graphs produced. What do you notice is similar between the three graphs, what is different? Describe any relationship between the graphs that you observe.

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***Developing Our Model:***

1. Based on your observations, is it possible for an object to remain at rest if it is acted on by **only** one force? Explain your response including what observations it is based on.

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1. If you double the force on the ship (with only using the one force), how does that affect the ship’s acceleration? (Be specific with writing your observations.)

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1. Reset your parameters. For the first 2 seconds, make the object move at a constant speed in one direction. If you apply a force in the same direction, what happens to the ship after the first 2 seconds?

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1. If you wanted the ship to slow down after 2 s, what would you need to do? Run the experiment and describe the results below:

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1. Based on the above scenarios, what relationship can you devise, if any, between the direction of the net force and the direction of motion? Does this relationship hold for all scenarios? If it does not, revise your relationship.

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1. Based on your observations, what is the direction of the net force **directly** related to in all scenarios? Our model is the relationship with force that is consistent with each observation. Write the model that you have devised as clearly and simply as possible.

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***Testing Our Model:***

1. Task: You must create a scenario where the spaceship speeds up from 1 s to 2 s and then slows down from 2 s to 3 s. If this is possible, predict how you will make it happen? What parameters will you set in the app? If it is not possible, explain why it is not.

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1. Reset your parameters again. Your next task is to exert a force in one direction (either *x*, *y* or *z*) for the first three seconds. In the next 3 seconds, exert a force in one of the other directions that has the same magnitude. Run the simulation and describe what you observe. Use the graphs to help you out with your description.

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1. Does this observation violate our model? If it does, how can you fix the model. If it does not, explain how the observations fit the model.

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***Applications:***

1. Where can you relate this activity to everyday life?

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1. What was one surprising or interesting thing you learned from this lab?

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