Lesson Adaptation Activity:
Using Mathematics and Computational Thinking

Related MA STE Framework Standard:

5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [*Assessment Boundary: Assessment does not include distinguishing mass and weight.*]

Lesson Description and Introduction

Ms. Meyer's fifth grade class is in the middle of a unit on matter. In this lesson, students will investigate what happens to a substance when it is mixed with another substance. During this investigation, students will use mathematical skills (i.e., measuring, comparing, estimating) or concepts (i.e., ratios) to make sense of their results.

Ms. Meyer: Good morning, class! Last time we also learned about what "matter" is. Could someone remind us what "matter" is? Khalil?

Khalil: Matter is something that takes up space.

Ms. Meyer: Great, Khalil. Does anyone else want to add any comments?

Stephanie: Everything on earth is made of matter. Everything that takes up space.

Ms. Meyer: Thanks, Stephanie. Who can give us provide us with an example?

Caitlin: Matter is found in solids, liquids, and gases.

Ms. Meyer: Wonderful. Other examples? Mahlia?

Mahlia: Air is made of matter even though we can't see it.

Ms. Meyer: Great, Mahlia. Today we are going to conduct an investigation to explore what happens to the weight of a substance after it is mixed with another substance. We are going to be mixing water with either salt or Kool-Aid powder. Just like you all said earlier, everything is made of matter including water, salt, and Kool-Aid. What do you think will happen to the salt or Kool-Aid powder when we mix it with water? Sean?

Sean: It will dissolve in the water.

Ms. Meyer: Thanks, Sean. And we are going to see what happens to the weight of the water and salt or Kool-Aid after it is dissolved in the water.

Lesson Adaptation A

Ms. Meyer passes out a data table for students to record the results of the investigation (below) before addressing the class.

Substance	Weight (g)
water	
salt	
water + salt (mixed)	

Ms. Meyer: Let's measure the initial weight of the water by itself and the salt by itself. First, let's measure the water in the beaker. (*Pause*). Okay, that's 240.2 grams. (*Pause*). The beaker weighs 157.5 grams so we have to subtract that. (*Pauses to write calculation on board*). That's 82.7 grams. Make sure to record that in your table next to "water." Now let's measure the weight of the salt. The salt weighs 8.7 grams and the medicine cup we used to weigh the salt in is 1.7 grams. That means that the salt by itself weighs 7.0 grams. Please write that in your table next to "salt." Now we're going to mix them together really well. Could I get a volunteer? Stephanie? Okay, Stephanie is going to stir the salt into the water for a few minutes to make sure it dissolves. While she's stirring, let's make some predictions. What do you think will happen to the weight of the salt water once it dissolves? Here are some options. *She reads the following predictions out loud before asking students to share their predictions.*

1. The salt water will weigh less than the weights of the salt and water measured separately.
2. The salt water will weigh more than the weights of the salt and water measured separately.
3. The salt water will weigh the same as the weights of the salt and water measured separately.

Sean: I think number one is right. When you mix salt with water it disappears. So it will probably weigh less because it's broken down.

Ms. Meyer: Okay, I see. Great. Does anyone have another prediction to share?

Mahlia: I agree with number three. I think it will weigh the same.

Ms. Meyer: All right, let's see. The beaker with salt water weighs 247.2 grams. We still need to subtract the weight of the beaker, which is 157.5 grams. (*Pauses to perform calculation on the board*). So that means the salt-water weighs 89.7 grams. Now let's see how that compares to the salt and water that we weighed separately earlier. From our chart we had 7.0 grams for the salt and 82.7 grams for the water. That adds up to 89.7 grams, which is how much the saltwater mixture weighed! So what does this tell us?

Khalil: The salt water weighed the same as the salt and water when we weighed them separately. So that supports prediction number three.

Ms. Meyer: Great, Khalil. The initial weights of the salt and the water are the same as the final weight of the salt and water mixed together. This confirms the conservation of matter. Please write that new vocabulary term in your notebook: "conservation of matter." We will do the same investigation using Kool-Aid instead of salt tomorrow.

Lesson Adaptation B

Ms. Meyer: We are going to conduct an experiment to answer the question: *What will happen to the weight of water and salt after they are mixed together?* You all will be working in teams of four to investigate this question. Each group will have a beaker with water and a container with salt. If we want to see if the weight of your substance changes after mixing, what should we do? Please brainstorm ideas with your group and get started.

Stephanie: We should measure the water and the salt separately. Then we should mix the salt in the water and weigh it again.

Sean: Yeah, but we need to get the weight of the water by itself and the salt by itself, without the containers. So let's measure the weights of containers by themselves and then subtract them from the total weight.

Khalil: That makes sense. Okay, the weight of our beaker with water is 240.2 grams.

Caitlin: (*Pauses*). The weight of the beaker is 157.5 grams. So that's 82.7 grams for the weight of the water by itself.

Sean: Okay, now let's measure the weight of the salt. *(Pauses).* The container with salt weighs 8.7 grams. (Pauses). The container by itself weighs 1.7 grams.

Khalil: That means the weight of the salt by itself is (pauses) 7.0 grams.

Caitlin: Okay, now let's mix them. What do you think will happen to the weight? *She pours the salt into the water and starts stirring*.

Stephanie: I think that the weight of the water mixed with salt is going to be the same as the water by itself plus the salt by itself.

Sean: But when you mix salt with water it disappears. See! *(He points to the beaker with salt water that Caitlin is stirring).* So it will probably weigh less because it's broken down.

Caitlin: Okay, let's weigh it and see. (*Pauses*). The beaker with salt water weighs 247.2 grams. The weight of the beaker by itself is 157.5 grams so that means the saltwater mixture weighs 89.7 grams.

Sean: Okay, so earlier the water by itself was 82.7 grams and the salt by itself was 7.0 grams. That adds up to (pauses) 89.7 grams. So the weight didn't change! That's not what I expected.

Ms. Meyer: (*Addressing the class*) Great job, class. Now that everyone is finished recording their results, you are going to graph your data. Talk with your group about which graph is best to use to show your results.

Khalil: I think we should use a bar graph because we have different categories.

Stephanie: I agree. With a bar graph we could show the weight of the salt and water separately before we mix them. Then we could show the weight of the saltwater mixture with another bar. *Ms. Meyer passes out graph paper and students start to independently graph their results*

Lesson Adaptation C

After passing out a paper with problem sets, Ms. Meyer addresses the class.
Ms. Meyer: You all will investigate what happens to the weight of a substance after it is mixed with another substance. Let's look at the first example together. A student records the weight of water in a beaker to be 240.2 grams. (*Pause*). The beaker weighs 157.5 grams. How much does the water weigh by itself? (Pause). Stephanie?

Stephanie: 89.7 grams.

Ms. Meyer: Great, Stephanie. Let's continue. The student records the weight of salt in a container to be 8.7 grams. The container weighs 1.7 grams. How much does the salt weigh by itself? Khalil?

Khalil: 7.0 grams.

Ms. Meyer: Great. Next, the student mixes the salt and the water until the salt dissolves. She then measures the weight of the salt water in the beaker to be 247.2 grams. The beaker weighs 157.5 grams. How much does the salt water weigh by itself? Sean?

Sean: 89.7 grams.

Ms. Meyer: Great, now please complete the rest of the problems with your partner.
Pairs of students begin working on the next problem together. The following dialogue occurs between two students working together:

Stephanie: Okay, the next question has to do with dissolving Kool-Aid in water. A student records the weight of water in a beaker to be 385.2 grams. The beaker weighs 190.5 grams. So we need to figure out how much the water weighs by itself. *(Pauses to perform calculation).*

Mahlia: I got 194.7 grams.

Stephanie: Yeah, I got that too.

Mahlia: And the weight of the Kool-Aid powder in a container is 10.2 grams. The weight of the container is 2.2 grams. So that means the weight of the Kool-Aid powder by itself is 8.0 grams.

Stephanie: Yep, I got that too. Now it says that the Kool-Aid mixed in water weighs 293.2 grams. The beaker weighs 190.5 grams. So that means the Kool-Aid mixture by itself weighs 202.7 grams.

Mahlia: That's interesting. That's the same weight as the Kool-Aid powder and the water combined from earlier. 194.7 grams for the water and 8.0 for the Kool-Aid add up to 202.7 grams. *(Students continue working on questions. Ms. Meyer addresses the class after they are finished).*

Ms. Meyer: Great job, class. Now you all are going to create a bar graph to show the weights of substances before and after mixing.

After students have graphed their data, Ms. Meyer leads the class through data analysis and a discussion on conservation of matter.

Lesson Adaptation D

Ms. Meyer: We are going to conduct an experiment to answer the question: *What will happen to the weight of water and salt after they are mixed together?* You all will be working in teams of four to investigate this question. Each group will have a beaker with water and a container with salt. Your group will measure the weight of the water and salt separately and then again after dissolving the salt in the water. You will record your results in a table with your group. Please send one team member from your group up to the front of the room to get your materials.

Stephanie: Okay, the weight of our beaker with water is 240.2 grams. We should write that in our table.

Caitlin: The directions say that we need to subtract the weight of the beaker. (*Pauses*). The weight of the beaker is 157.5 grams. So that's 82.7 grams for the weight of the water by itself.

Sean: Okay, now let's measure the weight of the salt. *(Pauses).* The container with salt weighs 8.7 grams. (Pauses). The container by itself weighs 1.7 grams.

Khalil: That means the weight of the salt by itself is (*pauses*) 7.0 grams.

Caitlin: Okay, now let's mix them. What do you think will happen to the weight? *She pours the salt into the water and starts stirring*.

Stephanie: I think that the weight of the water mixed with salt is going to be the same as the water by itself plus the salt by itself.

Sean: But when you mix salt with water it disappears. See! *(He points to the beaker with salt water that Caitlin is stirring).* So it will probably weigh less because it's broken down.

Caitlin: Okay, let's weigh it and see. (*Pauses*). The beaker with salt water weighs 247.2 grams. The weight of the beaker by itself is 157.5 grams so that means the salt water mixture weighs 89.7 grams.

Sean: Okay, so earlier the water by itself was 82.7 grams and the salt by itself was 7.0 grams. That adds up to (*pauses*) 89.7 grams. So the weight didn't change! That's not what I expected.

Ms. Meyer: (*Addressing the class*) Great job, class. Now you all are going to create a bar graph to show the weights of substances before and after mixing.

After students have graphed their data, Ms. Meyer leads the class through data analysis and a discussion on conservation of matter.

Ordering of Adaptations

Directions: Order the four adaptations (A-D) along the Science Practice Continuum (Levels 1-4) for the Using Mathematics and Computational Thinking practice.

	Level 1	Level 2	Level 3	Level 4
Adaptations				