Properties of Matter
Lesson 7: Conserving Matter
Additional Support for NGSS Standards

Grade 2	**Length of lesson:** 60 minutes	**Placement of lesson in unit:** Extension lesson on properties of matter
Unit central questions: What is matter made of? How can matter change?		**Lesson focus questions:** Is matter created or destroyed when it changes? How do you know?
Main learning goal: When matter undergoes physical or chemical changes, atoms aren't created or destroyed. Comparing the mass of the matter before and after a physical or chemical change can provide evidence that the amount of matter is still the same.		
Science content storyline: Matter can change in physical ways, such as melting and freezing, or in chemical ways when atoms rearrange to form new substances. During these changes, the number of atoms remains the same. The movement and arrangement of the atoms or molecules may change, and the atoms may recombine to form new substances, but the matter itself always weighs the same, and the amount of matter (the number of atoms) doesn't change.		
Ideal student response to the focus questions: When matter goes through a change, it always has the same number of atoms. Atoms aren't created or destroyed. The molecules might be arranged and move differently (like in melting or freezing), or the atoms might recombine to form new molecules, but the same atoms are still there. One way I can tell is that even when matter changes, it always weighs the same.		

Preparation

Materials
- Science notebooks
- Chart paper and markers
- Physical-change bags and chemical-change bags from Conserving-Matter Setup (see handout 7.1 for materials and instructions) (per group of 4 students)
- Paper towels (to wipe off water bottles)
- Primary balance (two pans)

Student Handouts and Teacher Masters
- 7.1 Conserving-Matter Setup (Teacher Master)
- 7.2 Data Table and Explanation (1 per student)

Ahead of Time
- Review section 8 (Can Matter Be Created or Destroyed?) in the content background document.
- Assemble Legos based on the instructions in handout 7.1 (Conserving-Matter Setup). Make sure each group has enough Legos to compare before and after a physical change and a chemical change.
- Prepare 14 vinegar and baking-soda experiments (2 setups per group of 4 students):
  - Place 1 teaspoon of baking soda in a sealable freezer bag. Then place 2 tablespoons of vinegar in a clear plastic vial and secure the snap-on cap. Wipe any vinegar off the outside of the vial. Then place the vial in the freezer bag with the baking soda. Remove as much air as possible before sealing the bag.
  - To mix the vinegar with the baking soda, students will pop the cap off the vial (without opening the freezer bag) and pour out the vinegar.
  - As needed, review the activity in lesson 1b.
- **Reminder:** In this unit, the term *weight* is used to denote the amount of "stuff" in matter, since this term is more familiar to 2nd graders. Scientifically, it's more accurate to use the term *mass*. As needed, refer to the content background document to refresh your understandings of the differences between mass and weight.

Lesson 7 General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
10 min	**Link to previous lesson:** The teacher engages students in reviewing the differences between physical changes and chemical changes.	• The molecules in solid and liquid matter are always in motion. In a solid, the molecules vibrate in place in a rigid structure, and in a liquid, the molecules move around more freely and slide past each other. When chemical changes occur, the atoms that make up the molecules of a substance separate and then recombine to form new substances.
5 min	**Lesson focus questions:** The teacher introduces the focus questions, *Is matter created or destroyed when it changes? How do you know?* Then students share ideas about how they could figure out whether matter is created or destroyed during a physical or chemical change.	
7 min	**Setup for activity:** Students describe how they would weigh matter before and after a physical or chemical change to help them figure out whether it's created or destroyed.	• The weight of an object is a measure of how much matter is there. If the amount of matter changes during a physical or chemical change, then its weight would change. If the weight is the same before and after a physical or chemical change, this could be used as evidence to show that the amount of matter (the number of atoms) doesn't change, and therefore, matter isn't created or destroyed.
20 min	**Activity:** In small groups, students demonstrate physical and chemical changes in different kinds of matter and record on a data table the weight (mass) of the material before and after the changes. Then they use their Lego models to show why the weight of the material is the same before and after a chemical or physical change.	• Matter can change in physical ways, such as melting and freezing, or in chemical ways when atoms rearrange to form new substances. During these changes, the number of atoms remains the same. The movement and arrangement of the atoms or molecules may change, or the atoms may recombine to form new substances, but the matter itself always weighs the same, and the amount of matter (the number of atoms) doesn't change. This evidence shows that matter is neither created nor destroyed when it changes.
10 min	**Follow-up to activity:** Students look for patterns in their data; then they answer the focus questions using the evidence they collected.	• We know that matter is neither created nor destroyed during physical and chemical changes because it weighs the same before and after the changes occur.
8 min	**Synthesize/summarize today's lesson:** Students summarize key ideas from the lesson and then write their best answers to the focus questions in their notebooks.	• Matter can change in physical ways, such as melting and freezing, or in chemical ways when atoms rearrange to form new substances. During these changes, the number of atoms remains the same. The movement and arrangement of the atoms or molecules may change, or the atoms may recombine to form new substances, but the matter itself always weighs the same, and the amount of matter (the number of atoms) doesn't change. This evidence shows that matter is neither created nor destroyed when it changes.

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10 min	**Link to Previous Lesson** **Synopsis:** The teacher engages students in reviewing the differences between physical changes and chemical changes. **Main science idea(s):** • The molecules in solid and liquid matter are always in motion. In a solid, the molecules vibrate in place in a rigid structure, and in a liquid, the molecules move around more freely and slide past each other. When chemical changes occur, the atoms that make up the molecules of a substance separate and then recombine to form new substances.	Engage students in making connections by synthesizing and summarizing key science ideas. Engage students in constructing explanations and arguments.	**Show slides 1 and 2.** Throughout this unit on matter, we've been thinking about our central unit questions, *What is matter made of? How can matter change?* **Think-Pair-Share:** Think about your best answer to the first question, *What is matter made of*? Then turn to your elbow partner and share your ideas. **Whole-class share-out:** Who would like to share your ideas for answering our first unit central question, *What is matter made of?*	Matter is made of stuff that takes up space and weighs something. Me, my desk, my water bottle. Matter is made of molecules, and molecules are made	Can you give me an example in the room of something that takes up space and weighs something? Who can answer that question using the words *atoms* or *molecules*?

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				of atoms.	Can you see the atoms and molecules?
				No. Atoms and molecules are too small to see, but we can use a model instead.	
			Now let's talk about our second unit central question, *How can matter change?* Who can summarize what we've learned about how matter can change?	Matter can change when it melts and becomes a liquid, or when it freezes and becomes a solid. It can also change by becoming something different from what it was at the beginning.	
				You need to add heat to make something melt.	Any other ideas?
				Heat makes the	That's right. Do you remember what heat does to make something melt?

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				molecules move faster.	And how do the molecules in a solid move before you add heat?
				They just vibrate in place.	
			Show slide 3. What happens to the molecules when a solid changes to a liquid?	The matter melts.	What happens to the molecules?
				The molecules move faster until they move so fast they start moving around more freely and sliding past each other.	
			Show slide 4. What happens to the molecules when a liquid becomes a solid?	It's just the opposite of melting.	What do you mean by "the opposite of melting"?

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				Well, to melt something, you have to add heat, and to freeze something, you need to make it cold. No. Different things get solid at different temperatures. A melted crayon can get hard again without freezing, but water has to freeze to become a solid. Like I said, it's the opposite of melting. If the matter cools off, the molecules move slower and vibrate in place.	Does everything that turns from a liquid to a solid have to be cold like ice? So what happens to the molecules when you take away some of the heat?
			Show slide 5. We've also learned that some changes in		

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			matter don't involve melting and freezing. What happens during a chemical change when matter fizzes or burns?	When something burns or fizzes, the matter changes from one thing into something new and different. I mean like the vinegar and baking soda changing into something fizzy. Well, you start with certain kinds of molecules that are made up of a bunch of pieces called *atoms*. When the matter changes, the atoms break apart	Can you give me an example of what you mean by "something new and different"? Can you use our science terms *atoms* and *molecules* to describe this kind of change?

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				and mix around and connect differently so you have different molecules. The atoms in the molecules that made up the original stuff—like paper—change partners so they're grouped differently—like when you tell us to change desks so we're sitting with different kids in our group.	What do you mean by "the atoms break apart?" Can you say this a different way? That's a good comparison!
5 min	**Lesson Focus Questions** **Synopsis:** The teacher introduces the focus questions, *Is matter created or destroyed when it changes? How do you know?* Then students share ideas about how	Set the purpose with a focus question or goal statement.	**Show slide 6.** Now that we have a pretty good understanding of different ways matter can change, let's think about some new focus questions: *Is matter created or destroyed when it changes? How do you know?*		

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	they could figure out whether matter is created or destroyed during a physical or chemical change.	Ask questions to elicit student ideas and predictions.	Open your science notebooks to a new page and write down these questions. Then draw a box around them as a reminder that this is the focus of today's lesson. **Show slide 7.** Since atoms are way too small for us to see, how could we figure out whether matter is created or destroyed during a physical or chemical change? What kind of data could we collect that might tell us whether there's more or less matter, or "stuff," after a change than there was before? **Turn and Talk (2 min):** Talk about these questions with an elbow partner and share ideas about how you might figure out whether matter is created or destroyed during physical or chemical changes. **Whole-class share-out:** Who would like to share your ideas? How could we figure out whether matter is created or destroyed during a physical or chemical change? What kind of data could we collect to help us figure this out? **NOTE TO TEACHER:** *As students share their ideas, record them on chart paper.*	Maybe we could put the matter in a measuring cup and see if there's the same amount of	

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			Those are great ideas!	stuff. Maybe we could weigh it to see if there's more or less stuff.	Any other ideas? How would we figure out if there's more or less of something after a change?
7 min	**Setup for Activity** **Synopsis:** Students describe how they would weigh matter before and after a physical or chemical change to help them figure out whether it's created or destroyed. **Main science idea(s):** • The weight of an object is a measure of how much matter is there. If the amount of matter changes during a physical or chemical change, then its weight would change. If the weight is the same before and after a physical or chemical	Make explicit links between science ideas and activities **before** the activity.	**Show slide 8.** Weighing matter before and after a physical or chemical change is exactly what we're going to do in today's investigation. Weighing the matter will help us figure out whether there's more or less "stuff" after a change, or if the amount of matter is the same. **NOTE TO TEACHER:** *The term* weight *is used in this investigation to denote the amount of "stuff" in matter. The term* mass *is scientifically accurate, but 2nd-grade students are more familiar with the term* weight. We'll use a balance to weigh our matter. *[Show students the balance with two pans.]*		

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	change, this could be used as evidence to show that the amount of matter (the number of atoms) doesn't change, and therefore, matter isn't created or destroyed.	Ask questions to elicit student ideas and predictions.	On one side of the balance, we'll place the matter before the change, and on the other side of the balance, we'll place the matter after the change. **Show slide 9.** How will we know whether the amount of matter is the same before and after a change? What will the balance look like? How will we know whether there's a different amount of matter after a change than before? What will the balance look like?	The balance will be even. Both sides will be equal. OK. Here's two crayons that haven't been used. If they weigh the same, the balance won't move, and both sides will be even. The balance won't be even. One side will go down more.	Can you come up and demonstrate that? Put two equal things on two sides of the balance. Can you come up and show us how this would

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				We'd have to put different amounts of matter on the two sides of the balance, like a crayon on one side and half a crayon on the other side. If I put 10 Legos on one side of the balance to represent the matter before the change and 12 Legos on the other side for the matter after the change, that would show there's more matter after than before. Or if I put eight Legos on the other side to represent the matter after the change, it would show there's less matter than before.	happen? Well, let's not break the crayon. Can you think of a different example? What about using our Lego model? Can you show us

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		Highlight key science ideas and the focus question throughout.	So today we'll investigate whether matter is created or destroyed during a physical or chemical change. We'll try to figure this out by weighing matter before and after a change and seeing whether we end up with more or less matter than we had before. If the both sides of the balance are equal or even, we'll know that the amount of matter after the change is the same as it was before. This will also tell us that the number of atoms is the same. If one side of the balance is higher or lower than the other side, we'll know that the amount of matter is different after the change than before, and that the number of atoms is different. Are you ready to weigh some matter?		what that looks like?
20 min	**Activity** **Synopsis:** In small groups, students demonstrate physical and chemical changes in different kinds of matter and record on a data table the mass (weight) of the material before and after the changes. Then they	Select activities that are matched to the learning	**Show slide 10.** **NOTE TO TEACHER:** *Distribute handout 7.2 (Data Table and Explanation) and orient students to the investigation. The divide the class into groups of four students.* First, let's talk about the materials you'll be using in this investigation. Each group will have one small bottle of solid water, or ice, and one small bottle of liquid water. Both		

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	use their Lego models to show why the weight of the material is the same before and after a chemical or physical change. **Main science idea(s):** • Matter can change in physical ways, such as melting and freezing, or in chemical ways when atoms rearrange to form new substances. During these changes, the number of atoms remains the same. The movement and arrangement of the atoms or molecules may change, or the atoms may recombine to form new substances, but the matter itself always weighs the same, and the amount of matter (the number of atoms) doesn't change. This evidence shows that matter is neither created nor destroyed when it changes.	goal. Ask questions to elicit student ideas and predictions.	bottles have exactly the same amount of water in them. Last night, I put half of the bottles of liquid water in the freezer so they would change to ice. Each group will also have two plastic freezer bags containing baking soda and vinegar. Along with these supplies, you'll have two plastic bags containing Lego molecules. You'll find out what to do with all of these supplies as we walk through the handout. **NOTE TO TEACHER:** *Ask one member of each group to come to the supply table and gather the necessary materials for part 1 of the investigation (two water bottles and two bags of Legos). Wait until groups are ready to begin part 2 of the investigation to have them retrieve the vinegar and baking soda and the bags of Legos.* Before you do anything with the water bottles, I want everyone to write a prediction on your handout for step 2. Do you think the weight of the liquid water bottle and the frozen water bottle will be the same or different? Why do you think so? Do you think both bottles contain the same amount of matter? **NOTE TO TEACHER:** *Give students 1*		

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			minute to write their predictions on their handouts. When you've finished writing your predictions, put a check mark in the box next to step 2 to show that you've completed this step. Now let's move on to step 3 and go over the instructions together. **NOTE TO TEACHER:** *Read through the instructions for part 1 on the handout before groups begin the investigation. You may want to complete step 3 together as a class and then have students complete the rest of the steps in their groups.* Before you put the frozen water bottle on the balance, you may need to wipe it off with a paper towel. We only want to measure the water *inside* the sealed bottles, not outside too. First, you'll place the liquid water bottle on one side of the balance and the frozen bottle on the other side. Then you'll record your results on the data table by writing in the last column either "Same" if both sides of the balance are equal or "Different" if the sides aren't equal or even. When you finish this step, put a check mark		

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			in the box next to step 3 and move on to step 4. Work through this step as a group. If you don't understand something, be sure to ask me about it. For step 4, leave the Lego water molecules in the bags when you weigh them. *Don't take them out of the bags!* One bag of molecules represents liquid water before a change in matter, and one bag represents solid water after the change. You won't be able to move the liquid water molecules around like we did in an earlier lesson, but they're the same. After weighing the bags, write either "Same" or "Different" on your data tables. When you've completed step 4, make sure to place a check mark in the box. Then move on to step 5 and write your best answer to our focus questions, *Is matter created or destroyed when it changes? How do you know?* Use evidence from your data tables and Lego models to support your explanations.		

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			Show slide 11. You'll follow the same procedure for part 2 of the handout, but the bags you'll weigh contain baking soda and vinegar before and after a chemical change. **NOTE TO TEACHER:** *Ask one member of each group to come to the supply table and gather the necessary materials for part 2 of the investigation (two bags of vinegar and baking soda and two bags of Legos). Read through the instructions for part 2 on the handout before groups begin the investigation.* Make sure that everyone in your group writes a prediction for step 6 on the handout and puts a check mark in the box before moving on to step 7. For step 7, you'll very carefully place one plastic bag containing baking soda and vinegar on one side of the balance. Don't pop the cap off this vial or let any of the vinegar spill out. We need the vinegar and baking soda to stay separate in this bag. On the other side of the balance you'll put the second plastic bag, but this time you'll pop off the cap of the vial and mix the vinegar with the baking soda. Remember: *Do not open the bag!*		

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			Watch carefully as the vinegar and baking soda combine. Then record your results on the data table on your handout. Make sure everyone in your group has finished step 7 and checked off the box before moving on to step 8. For this step, you'll place the bag containing two Lego molecules on one side of the balance. One of the molecules is baking soda, and the other is vinegar. These are the molecules we started off with. On the other side of the balance, place the bag containing the three new Lego molecules created after the chemical change. Record the results on the data table and then check off the box for step 8 before moving on to step 9. For this final step, write your best answer to the focus question, *Is matter created or destroyed when it changes? How do you know?* Use evidence from your data tables and Lego models to support your explanations. Any questions before we begin? **NOTE TO TEACHER:** *Circulate among the groups as they work through the*		

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			investigation and make sure they're following the directions on the handout. Also ask questions to see how students are making sense of what they see when they weigh the matter before and after each type of change. What connections are they making between the actual substances and the Lego models? Do they predict the weight of the matter will be different after the physical or chemical change occurs? Ask students to explain their thinking and compare their ideas with the data. Are they surprised that the gas molecules that formed when the vinegar and baking soda combined weigh the same as the materials before this chemical change?  Listen to students' ideas. What's visible about student thinking?		
10 min	**Follow-Up to Activity** **Synopsis:** Students look for patterns in their data; then they answer the focus questions using the evidence they collected. **Main science idea(s):** • We know that matter is neither created nor destroyed during physical and chemical	Make explicit links between science ideas and activities **after** the activity. Ask questions to probe student ideas	**Show slide 12.** Who would like to share the data you recorded on your data table after you weighed the liquid and solid water in step 3? What did you observe when you weighed the water bottles?	When we put the liquid water bottle and the frozen water bottle on opposite sides of the balance, they were just about	

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	changes because it weighs the same before and after the changes occur.	and predictions. Ask questions to challenge student thinking. Engage students in communicating in scientific ways. Engage students in analyzing and interpreting data and observations.	What did you observe when you weighed the two bags of Lego water molecules?	the same. The weighed about the same. I thought they would be different because solids seem heavier than liquids. Well, we put the same amount of Legos on both sides of the balance, so of course they were the same. Yes, both of the Lego molecules were water molecules, even	What do you mean by "about the same"? How were they the same? How did that compare to your prediction? You said you put the same amount of Legos on both sides of the balance. Did you also put the same kind of Lego molecules on both sides?

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				though one molecule was a liquid and one was a solid. Yes. I thought maybe the liquid and solid molecules would be different weights because the liquid molecules are moving around more. I thought those molecules might weigh less, but we couldn't get the molecules to move like we did in the other lesson. It makes sense to me that the same number of molecules would weigh the same whether they move or not.	Any other ideas? Does anyone agree or disagree? So you think one molecule of water would weigh the same as another

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					molecule of water. Is that what you're saying? What about one molecule of water and one molecule of vinegar?
				Those would be different weights.	Why do you think that?
				Because water and vinegar molecules have different numbers of atoms and different kinds of atoms.	
			What did you observe when you weighed the bags of vinegar and baking soda before and after the chemical change?		Are there other ideas?
				The two bags weighed the same before and after the change. They were balanced evenly.	
			What did you predict would happen? Did you think the amount of matter before and after the chemical change would be the same or different?		
				I didn't think a gas would weigh the same as a solid and	

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			What do you think the results would have been if we had opened the bag while the stuff inside was fizzing? Do you think the balance would have been even? **NOTE TO TEACHER:** *If you decide to try this, you'll need to use a more precise balance. A primary balance might not be sensitive enough to show this accurately.*	a liquid. I didn't think the gas would weigh anything at all because it's a gas. I thought the puffy bag filled with gas might be lighter than the bag of vinegar and baking soda. I don't think so, because then you would have taken some of the molecules away. They wouldn't be in the plastic bag anymore. I guess the gas would go out into the air, and the balance wouldn't measure it anymore.	Do you think the gas has weight? Why do you think that?

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			What did you observe when you weighed the two bags of Lego molecules? Great discussion, everyone!	Maybe the gas would just disappear into the atmosphere. Oh, the gas would be somewhere all right. We might breathe them in! Well, we put the same number of Lego molecules on one both sides of the balance, so they weighed the same. The molecules were just combined in different ways.	
8 min	**Synthesize/Summarize Today's Lesson** **Synopsis:** Students summarize key ideas from the lesson and then write their best answers to the focus questions in their notebooks. **Main science idea(s):** • Matter can change in physical ways, such as	Highlight key science ideas and the focus question throughout. Engage students in making connections by synthesizing	**Show slide 13.** In this lesson, we've been thinking about two important focus questions: *Is matter created or destroyed when it changes? How do you know?* From our investigation, what did we discover about matter in physical and chemical changes that might help us answer these questions?	We found out that in both chemical and	

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	melting and freezing, or in chemical ways when atoms rearrange to form new substances. During these changes, the number of atoms remains the same. The movement and arrangement of the atoms or molecules may change, or the atoms may recombine to form new substances, but the matter itself always weighs the same, and the amount of matter (the number of atoms) doesn't change. This evidence shows that matter is neither created nor destroyed when it changes.	and summarizing key ideas. Highlight key science ideas and the focus question throughout.	**NOTE TO TEACHER:** *Students' responses should be similar to the sample responses in column 5. If they aren't, challenge student thinking and summarize key ideas to correct any inaccuracies or misconceptions.* **Show slide 14.** So based on our data and observations, how would you answer our focus questions, *Is matter created or destroyed when it changes? How do you know?* Write your best answers to these questions in your science notebooks and make sure to include evidence from your data tables and Lego models. **Whole-class share-out:** Who would like to share your answer to our focus questions?	physical changes, the stuff before the change weighs the same as the stuff after the change. The number of atoms before the change is the same as the number of atoms after the change. I don't think matter	What does this tell you about the atoms when the stuff before the change weighs the same as the stuff after the change?

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				is created or destroyed when it changes. When we weighed the matter before and after physical and chemical changes, it was exactly the same. The number of atoms didn't change even when the number of molecules did. The molecules just changed from a liquid to a solid or from one kind of matter to a new kind of matter, but no matter was created or destroyed.	What evidence do you have to support that answer?