Science Assessment Item Collaborative

Grade 5 Item Cluster Prototype

for assessment of the

Next Generation Science Standards

November 2015

Developed by WestEd in collaboration with CCSSO Science Assessment Item Collaborative state members and content experts.

Intended Use of this Prototype

1. To serve as an initial model for measuring the 3-dimensional science learning (NGSS).
2. To support states in guiding NGSS assessment development.
3. To promote ongoing dialogue.

Level:	Grade 5
Primary Target Domain:	Physical Sciences
Target PEs:	5-PS1-1, 5-PS1-2
Crosscutting Concept(s) Focus:	Scale, Proportion, and Quantity
Science and Engineering Practice(s) Focus:	Developing and Using Models, Using Mathematics and Computational Thinking
Reasoning for PE Groupings:	Mass (size micro to macro), and conservation of mass
Phenomenon:	Sugar is no longer visible when it dissolves in water, but the mass of the mixture stays the same
Allowable Item Types:	SR, TE, CR

	5-PS1-1	5-PS1-2
Performance Expectations:	Develop a model to describe that matter is made of particles too small to be seen.	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.
Target Clarifications:	Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.	Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.
Assessment Boundary:	Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.	Assessment does not include distinguishing mass and weight.

Disciplinary Core Idea(s):	**PS1.A: Structure and Properties of Matter** • Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.	**PS1.A: Structure and Properties of Matter** • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. **PS1.B: Chemical Reactions** • No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)
Science and Engineering Practice(s):	**Developing and Using Models** Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use models to describe phenomena.	**Using Mathematics and Computational Thinking** Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Measure and graph quantities such as weight to address scientific and engineering questions and problems.
Crosscutting Concept(s):	**Scale, Proportion, and Quantity** • Natural objects exist from the very small to the immensely large.	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes consistent patterns in natural systems.

5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen.

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.

ITEM CLUSTER

Stimulus

Item 1:
Text Entry /
Table Fill-In

5-PS1-2 | SEP | CCC

Item 2a:
Computation

Item 2b:
Graphing
(TEI)

5-PS1-2 | DCI | SEP | CCC

Item 2c:
Short Answer

Item 3(a–b):
Multiple Choice /
Multiple Select

5-PS1-2 | DCI | SEP | CCC

Item 4a:
Short Answer

Item 4b:
Building a Model
(Drag-and-Drop,
TEI)

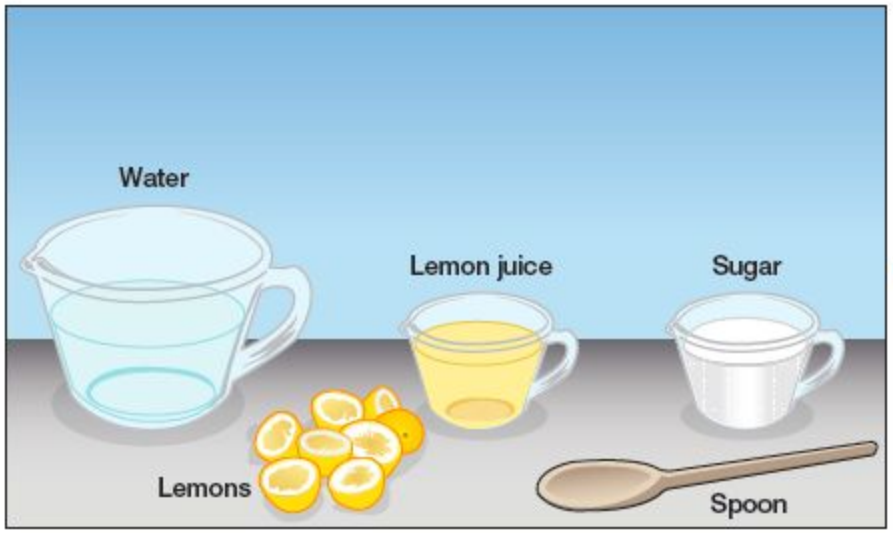
5-PS1-1 | DCI | SEP | CCC

Item 5(a–b):
Constructed
Response

5-PS1-1 | DCI | SEP | CCC

(Stimulus)

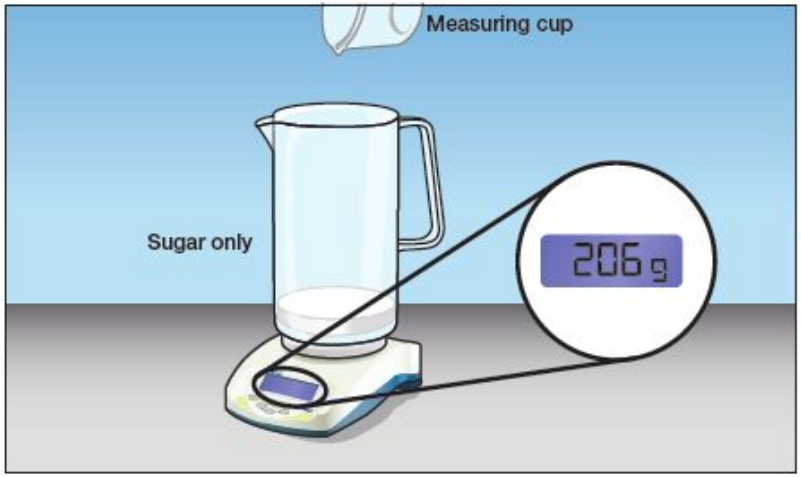
Students are making lemonade using three ingredients: water, lemon juice, and sugar. While making the lemonade, the students plan to investigate how the ingredients are affected by a physical change that happens when the ingredients are stirred together. The students measure out how much of each ingredient they need by following a recipe.



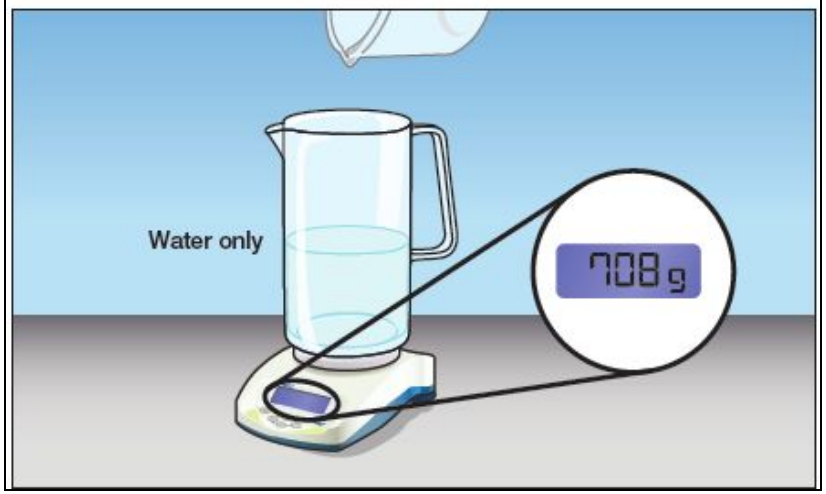
REPLAY Click REPLAY to watch the animation/video again.

Click NEXT to continue NEXT

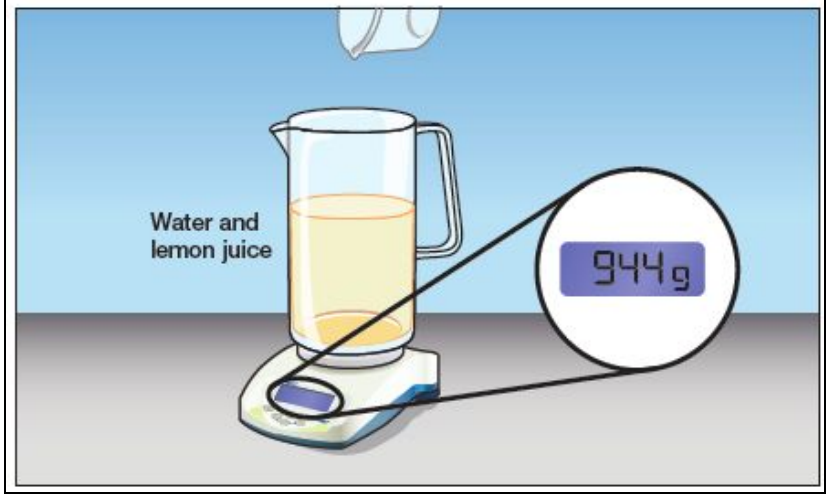
The students pour the sugar from the measuring cup into the pitcher and record the information shown on the scale.



Next, the students pour water into the empty pitcher on the scale.



Then, the students pour the lemon juice into the pitcher of water, as shown.

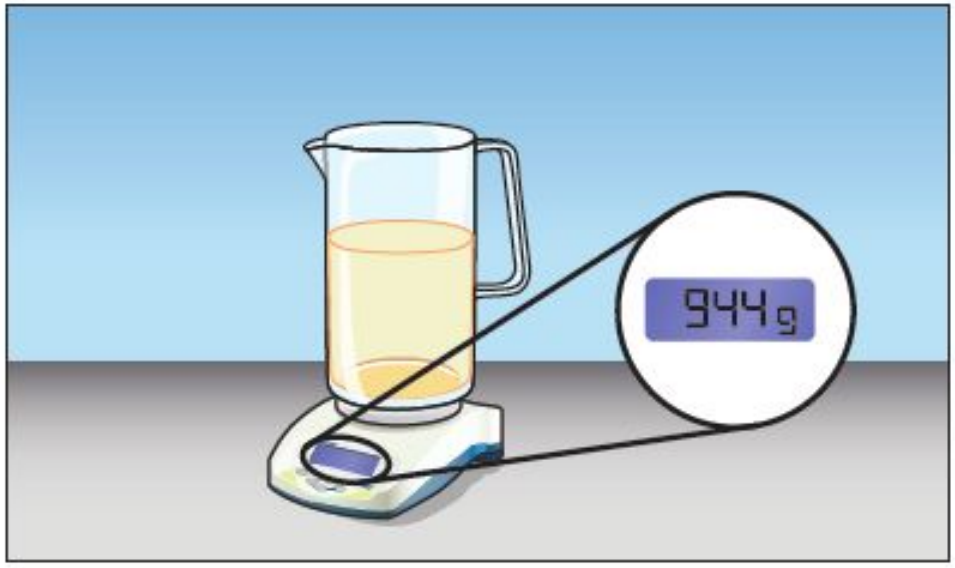


#1.

The students want to determine how much of each ingredient will be in the lemonade. Replay the animation by clicking the "REPLAY" button at the bottom of the screen. Type in the correct labels for the type of measurement you are collecting and then complete the table with the data you collect while replaying the animation.

Ingredients	Measurement: _____ Units: _____
Sugar only	
Water only	
Water + lemon juice	

ANIMATION / VIDEO:



REPLAY — Click REPLAY to watch the animation/video again.

Click NEXT to continue to the next question. — NEXT

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.

Full alignment to the PE and targeted dimensions is intended through the entirety of the item cluster. Partial to strong alignment to the dimensions for each item is achieved through alignment to the evidence statements, and is inclusive of all item parts for any given item.

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Measure and graph quantities such as weight to address scientific and engineering questions and problems.

Scale, Proportion, and Quantity

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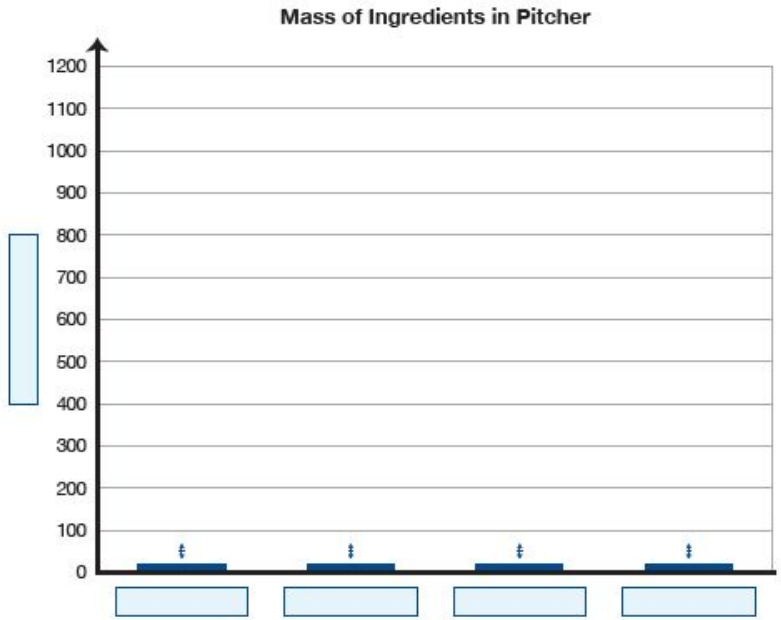
#2.

Part (a) The students add all the sugar in the cup to the pitcher with the water and lemon juice. **Determine the total mass of all the ingredients in the pitcher once the sugar is added. Enter your answer, including units, into the correct location in the table.**

Ingredients in Pitcher	Mass (grams)
Sugar only	206
Water only	708
Water + lemon juice	944
Water + lemon juice + sugar	

Part (b) Now you will graph the data you collected. **Complete the graph to show the mass of the ingredients in the pitcher after each ingredient is added. Click on the top of the bar to drag and change the height of each bar. Then, type in a label in the appropriate space below each bar. Type in the appropriate label along the vertical axis (be sure to include an appropriate unit).**



Part (c) After stirring, the students observe that none of the sugar could be seen in the lemonade mixture. **Explain how the mass of the ingredients in the pitcher right after the sugar is added compares to the mass of the ingredients after the sugar is stirred.**

#3.

Part (a) The sugar could not be seen after the mixture was stirred. Which statement **best** explains what happened to the sugar?

- ○ The sugar was destroyed by the liquids.
- ○ The sugar became liquid water when stirred.
- ○ The sugar separated into particles too small to be seen.
- ○ The sugar was changed into a new substance by the lemon juice.

Part (b) Based on both the experiment presented here and your knowledge, which statement(s) below provide strong evidence to support your answer to Part (a)? Select all that apply.

- ○ The mixture was stirred after the sugar was added.
- ○ The mass of the mixture did not change after stirring.
- ○ The ingredients added to the mixture were almost all liquids.
- ○ The mass of the mixture increased when the sugar was added.
- ○ The sugar looked the same before and after it was added to the mixture.

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.

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PS1.A: Structure and Properties of Matter

- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.

PS1.B: Chemical Reactions

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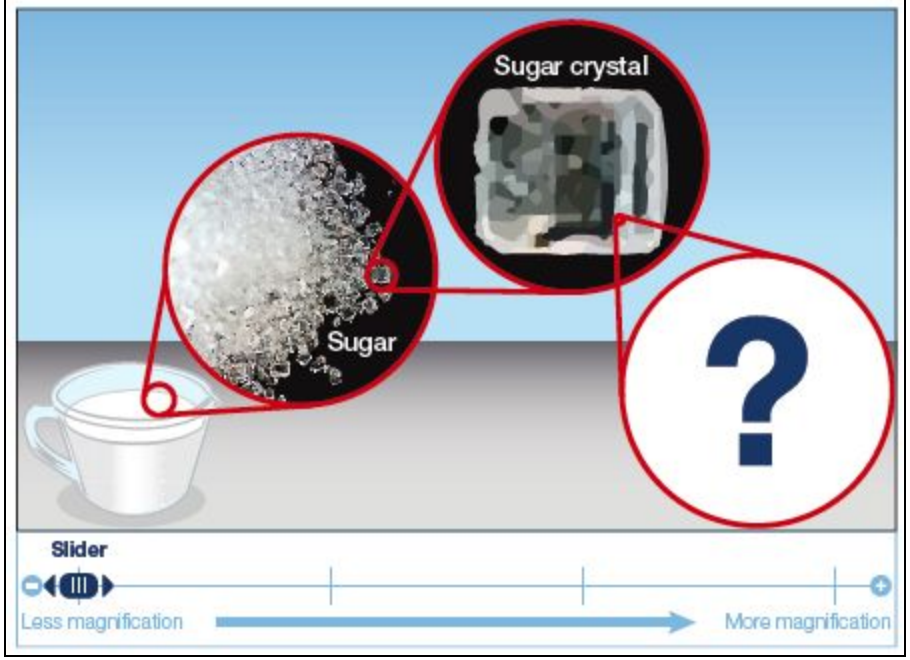
#4.

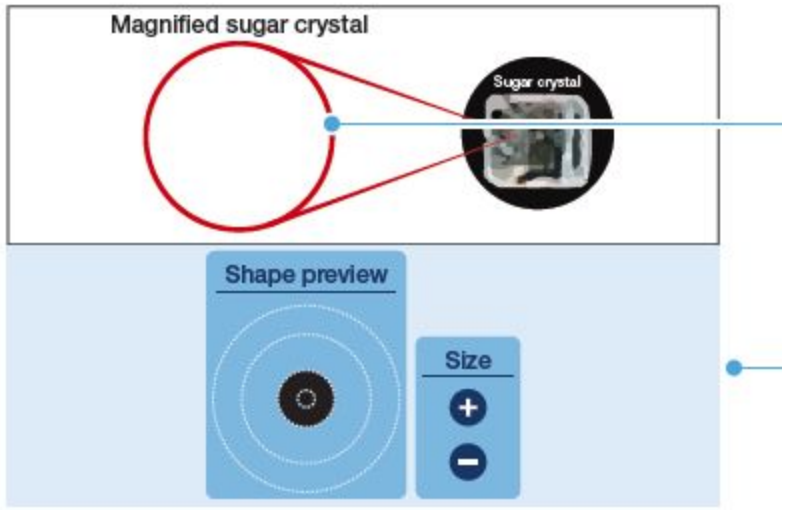
The students look closely at the sugar and water and then research to find images of what the ingredients look like when magnified using a powerful microscope.

Slide the slider to the right and left to observe what sugar looks like at different magnifications.



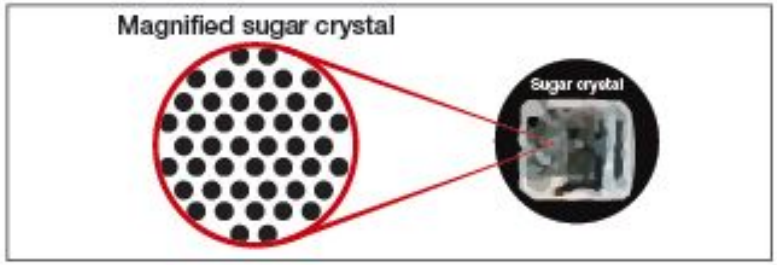
Part (a) Describe **one** way that the sugar and the water would look similar if they were both magnified under a powerful microscope.

Part (b) Develop a model to show what the sugar would look like when you slide the slider above to the greatest magnification. Change the size of the circle in the "Shape preview" box below to represent the matter that makes up the sugar, and drag one or more of the circles into the area for the magnified sugar crystal.



#5.

YOUR MODEL:



Part (a) Your model shows what the sugar would look like if you could magnify it using a powerful microscope. Describe what your model shows about the sugar crystals that your eyes are unable to see.

Part (b) Describe how your model helps explain why the sugar seemed to disappear after the lemonade mixture was stirred.

Click NEXT to continue to the next question. NEXT

5-PS1-1
Develop a model to describe that matter is made of particles too small to be seen.

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- Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
- Use models to describe phenomena.

Scale, Proportion, and Quantity
- Natural objects exist from the very small to the immensely large.

Item	Item Part	Brief Description	Item Type	PE	DCI	SEP	CCC	EV Level	EVs	Points	Estimated Time (min)	Hand or Automated Scoring
Stimulus		Preparing lemonade	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	N/A
1	1	Designing and populating a data table	Text Entry/ Table Fill-In	6-PS1-2	N/A	6	3	1	1.a.i 1.a.ii	2	2	A
2	2a	Calculate mass of ingredient	Computation	6-PS1-2	PS1.A PS1.B	6	3	1	1.a.i 1.a.ii	1	1	A
	2b	Graphing masses of ingredients	Graphing					2	2.a	2	2	A
	2c	Describe properties of individual ingredients	Short Answer					2	2.c	1	2	H
3	3a	Claim for conservation of mass	Multiple Choice	6-PS1-2	PS1.A PS1.B	6	3	2	2.d	1	1	A
	3b	Identify evidence of conservation of mass	Multiple Select					2	2.d	1	1	A
Stimulus		Investigating ingredients	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A
4	4a	Describe that both sugar and water are made up of particles	Short Answer	5-PS1-1	PS1.A	2	3	1	1.a.ii	1	2	H
	4b	Building a model to show particles of matter	Building a Model (Drag-and-Drop)					1	1.a.i 1.a.ii	1	3	A or H
5	5a–b	Describing the model and use of model in explaining science phenomenon	Constructed Response	5-PS1-1	PS1.A	2	3	2, 3	2.a.i 3.a	2	6	H
								Total:	**9 of 11**	**12**	**24**	