Structure and Properties of Matter: Instructional Segment (part 1 of 3)

In our day to day life we depend on our understandings of the nature of energy and matter to preserve, cook, and prepare our foods. This instructional segment makes connections to this big idea while focusing on cooking as means for understanding the structure and properties of matter.

Student Science Performance

Grade level **8**	**Title:**
Topic: **Energy & Matter: Structure and Properties**	Dinner Is Ready

S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter.

a. Develop and use a model to compare and contrast pure substances (elements and compounds) and mixtures. (*Clarification statement*: Include heterogeneous and homogeneous mixtures. Types of bonds and compounds will be addressed in high school physical science.)
b. Develop and use models to describe the movement of particles in solids, liquids, gases, and plasma states when thermal energy is added or removed.
c. Plan and carry out investigations to compare and contrast chemical (i.e., reactivity, combustibility) and physical (i.e., density, melting point, boiling point) properties of matter.
d. Construct an argument based on observational evidence to support the claim that when a change in a substance occurs, it can be classified as either chemical or physical. (*Clarification statement:* Evidence could include ability to separate mixtures, development of a gas, formation of a precipitate, change in energy, color, and/or form.)
e. Construct an explanation based on evidence to describe conservation of matter in a chemical reaction including the resulting differences between products and reactants. (*Clarification statement:* Evidence could include models such as balanced chemical equations.)

S8P2. Obtain, evaluate, and communicate information about the law of conservation of energy to develop arguments that energy can transform from one form to another within a system.

c. Construct an argument to support a claim about the type of energy transformations within a system [e.g., lighting a match (light to heat), turning on a light (electrical to light)].
d. Plan and carry out investigations on the effects of heat transfer on molecular motion as it relates to the collision of atoms (conduction), through space (radiation), or in currents in a liquid or a gas (convection).

Lesson Performance Expectations

- Plan and carry out an investigation to develop evidence about pure substances and mixtures.
- Develop and communicate explanations for pure substances and mixtures.
- Develop and use models that support explanations of pure substances and mixtures.
- Develop and communicate connections to cooking processes and outcomes to physical or chemical changes for the substances involved.

Additional notes on student supports

Engaging Learners	Phenomenon: **Dinner Is Ready** 
	Communicate*:** Students share their own cooking experiences. *Teacher Hint: Talk to students about how they help prepare meals for their families. Ask students about some of their most delicious recipes, most disastrous experiences, etc.* ***Obtain: Students obtain information about tonight's dinner menu. For example, students identify ingredients involved with each, taste, etc. ***Evaluate:*** Students analyze the recipes/instructions for preparing each part of the meal. Students make an initial prediction about several things: • Are the ingredients pure substances or mixtures? • Are the ingredients solid, liquid, gas, or plasma? • When you follow the recipe (step) did the ingredients change phases? • Was heat involved? Was mixing involved? • Does following the recipe result in a physical change, chemical change, or both? *Teacher Hint: Consider supporting students by providing a graphic organizer (Organizer for Recipe) with the recipe instructions numbered. See sample below.*

(insert your recipe here)					
List the ingredients:					
Is this ingredient a solid, liquid, gas, or plasma?					
Is this ingredient a pure substance or mixture?					

	Read the recipe carefully.	Step 1	Step 2	Step 3	Step 4	Step 5
	When you follow this step in the recipe, did the ingredients change phases?					
	Was thermal energy (heat) involved?					
	Was mechanical energy (mixing) involved?					
	Was this a physical or chemical change?					

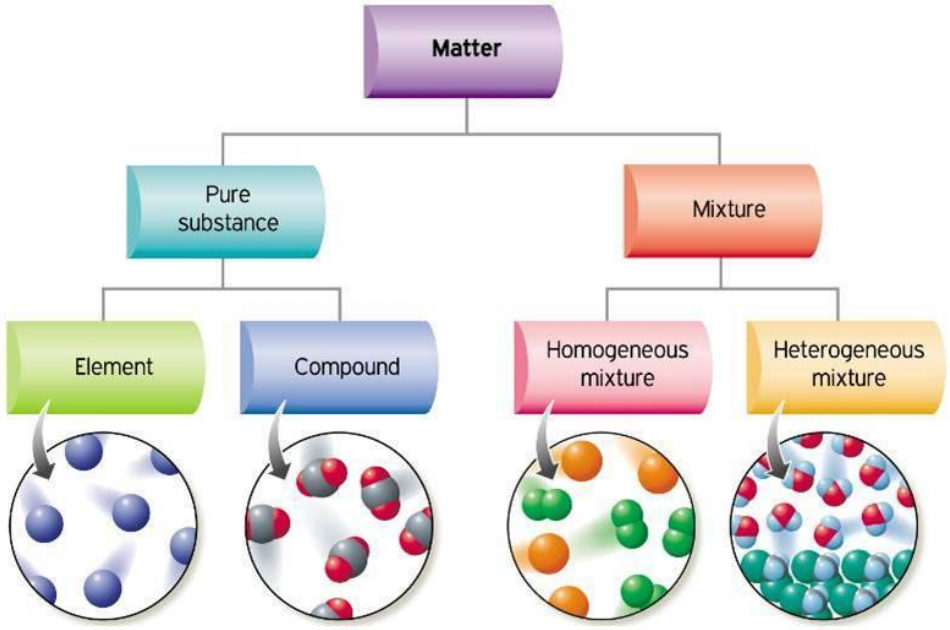
Communicate: Students share their initial predictions about each ingredient and step of the recipe with their initial reasoning behind their decisions.

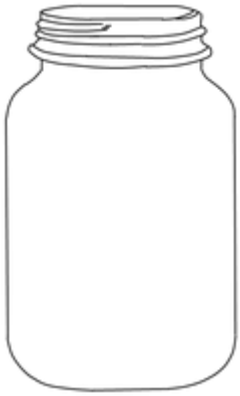
Teacher Hint: As students provide reasons, informally assess student prior knowledge about each concept. Listen for student use of language. Encourage students to think out loud, making note (to use formatively in your planning) but not correcting their thinking if they are inaccurate or not at this time.

Important Instructional Sequencing Note*: In order to explore the concepts more in-depth, students now separately explore-explain pure substances/mixtures, phases of matter, properties/changes of matter, and conservation. The sequence that follows* ***concentrates on pure substances/mixtures****, with concepts of atomic structure bundled within.*

Exploring Pure Substances and Mixtures	***Obtain*** Students obtain information about the observable properties of various pure substances and mixtures that are part of an average meal. *Teacher Hint: Consider putting a plate of food wrapped in aluminum foil (element) on display for the students. Be specific about including substances that are exemplar models of elements, compounds, heterogeneous mixtures, and homogeneous mixtures. For example, have a carton/glass of milk (heterogeneous), glass of ice water (compound) or powdered soft drink or sports drink (homogeneous), salt (compound), a roll/piece of bread (homogeneous),*

	salad (heterogeneous), and spaghetti (heterogeneous). ***Communicate*** In small groups, students communicate and compile the observed properties. Students continue small group conversation by making predictions about the structure of the particles making up these substances. Students should draw what they think these particles look like. *Teacher Hint: Ask guiding questions as you listen to student conversations in their small groups. Guiding Questions – What do you know makes up bread? What do you know makes up spaghetti noodles? What all goes into the sauce? Do you ever pick stuff out of a salad? Do you know what is in water? Do you think the particles of water look the same as the particles in milk? Have you ever noticed that ice will float in water? Do you think the particles in the solid water look the same as the liquid water? As you listen to student conversations provide scientific language for the descriptions students are using. For example, if a student says spaghetti is 'twisty' then you provide them the term malleable.* *Teacher Hint: Provide students a graphic (see below for sample) to support whole group communication of their thoughts.* ***Evaluate*** Guide students in their evaluation to now categorize the different substances as either pure substances or mixtures. Provide students time in their small groups to complete this evaluation. ***Communicate*** Students share as a whole group their decisions and rationales. *Teacher Hints: Guiding questions – Why did you all think the milk would be a pure substance? How do you think the milk and water are the same? What differences made you decide to categorize the salt as a pure substance? What was it about the salad that made you decide it was a mixture? Do all of the things you categorized as mixtures follow this rule?*

Explaining Pure Substances/ Mixtures	*Obtain* Students obtain information about the distinguishing structures and functions of pure substances and mixtures via informational text, video, visual representations, kinesthetic modeling, separation technique labs, and role play. Suggestions for **video**: Science Bits-Pure Substances and Mixtures TED-Ed- Macaroni Salad: What's in a Mixture  Suggestion for **kinesthetic modeling**: Use a teacher led demonstration coupled with a predict-observe-explain strategy to facilitate student understandings. Prepare 4 jars: 1) tea 2) powdered soft drink 3) sugar water 4) beans, paper clips, sugar, water. As each jar is presented students predict whether a mixture or pure substance will result. Students make predictions on the provided particle models in their own jar (see below) to represent their thoughts. For example: Shapes/Particles provided to students: (Paper) Jar provided to students:



Students observe outcomes with both the naked eye and a light microscope (if available). Teacher facilitates discussion leading students toward accurate understandings. Students refine explanations based on new/refined understandings. Refined explanations are checked as teacher walks around looking at students' jar representations.

Suggestions for **role play**:
Actors: 5 water molecules, 3 salt particles
Act 1: A Life Apart
Act 2: A "Mixer" Social
Final Act: Filtering out Friends

Teacher Hint: Facilitate student decision making about how to role play based on the actors and titles of each act. Allow students to think through as much of the decision making as possible. Encourage students to consider what kinds of props (e.g. a stirring utensil, a paper/cloth filter) number of actors (e.g. 15 for water, 9 for salt), and how these actors should interact (e.g. each water molecule should represent their inner bonds by linking arms and stay close to the other water molecules while each salt particle should also link to show their bond but tend to stay on the outside edges of water until act 2).

Formative Evaluation Students re-evaluate their initial decisions about the meal used in the explore phase. In small groups they revise their initial particulate drawings and add to/take away from their initial rationales as needed for accuracy.

Communicate Students share their revised thinking with the whole group.

Evaluate/Communicate Students are now shown a new meal and then given a paper plate that has been divided into four categories: element, compound, homogeneous, heterogenous. Individually students evaluate the meal, where they then draw and label each part of the meal within its accurate category.

<table>
<tr><td>Elaborate</td><td>

Obtain Students obtain information about making hot cocoa. Students record observational evidence that will help support whether making hot cocoa results in a new pure substance or a mixture.

Teacher Hint: Adjust the food based on the time of year for instruction. For example, consider lemonade if it is warmer weather.
Teacher Hint: Ask guiding questions such as those outlined in the engage/explore phase.

Evaluate Students evaluate their evidence and record their claims with reasoning.

Teacher Hint: Consider the use of a Claims-Evidence-Reasoning graphic Classifying Hot Chocolate such as the one below.

<table>
<tr><td colspan="4">Question: Does making hot cocoa result in a new pure substance or mixture?
Sub question: Therefore, would this be a physical or chemical change?</td></tr>
<tr><td colspan="4">Evidence</td></tr>
<tr><td colspan="2">of a new Pure Substance</td><td colspan="2">of a Mixture</td></tr>
<tr><td>Definitely Supports there is a new Pure Substance.</td><td>Might Support there is a new Pure Substance.</td><td>Definitely Supports there is a Mixture.</td><td>Might Support there is a Mixture</td></tr>
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<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="4">Claim:
_____
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_____</td></tr>
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<tr><td>Final Evaluation</td><td>

Communicate Students construct a written argument that communicates their final decisions from the elaborate phase. Exemplary arguments should include all applicable scientific language, particulate drawings, additional examples, and potential rebuttals.

Teacher Hint: Consider the use of a writing rubric that includes Claims-Evidence-Reasoning-Rebuttal specific to this context.

</td></tr>
<tr><td>SEP, CCC, DCI</td><td>Science Essentials</td></tr>
<tr><td>Science and Engineering Practices</td><td>

- Developing and using models
- Planning and carrying out investigations
- Constructing explanations and designing solutions
- Engaging in arguments from evidence

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<tr><td>Crosscutting Concepts</td><td>

- Observe **patterns** of a substance's **structure** and **function** that guides

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	classification ● **Causes** (e.g. physical and chemical change) and **effects** (e.g. new pure substances, thermal energy release) ● Transfer of **energy** and **matter** within and outside a system that contributes to changes of the system(s)
Disciplinary Core Ideas	● **PS1.A: STRUCTURE AND PROPERTIES OF MATTER** ● **PS1.B: CHEMICAL REACTIONS** ● **PS3.D: ENERGY IN CHEMICAL PROCESSES AND EVERYDAY LIFE**

Additional Supports for struggling learners:

The following supports are suggestions for this lesson and are not the only options to support students in the classroom. These supports target students that struggle with science material, this lesson or a previous lesson. These are generalized supports and do not take the place of IEP accommodations as required by each student's Individualized Education Program.

General supports for the following categories:

Reading:	Writing:	Math:
1. Provide reading support by reading aloud or doing partner reads 2. Have the teacher model what they are thinking when reading the text 3. Annotate the text with students so that they may refer to it as they work through the lab	1. The teacher can provide a sentence starter for the students. 2. The teacher can give students an audience to write to (i.e. Write a letter to your sibling explaining this topic). 3. The teacher can provide constructive feedback during the writing process to help students understand the expectations.	1. Templates could be provided for the atom models.

Supports for this specific lesson if needed:

Performance expectations for instruction:

1. The teacher should provide information to students in various formats to reach as many students as possible.
2. The students should be given adequate time to complete each part of the lesson.
3. The students should be allowed to express their knowledge in various formats.
4. The teacher should be sure to provide multiple ways for the students to communicate their knowledge of the material.

Engage:

1. The students should be given the form to record their recipe on. It should include the questions that they need to answer.
2. Struggling students may benefit from a set of resources to find the information that they need for this lesson.
3. Give students a rubric to let the students self-assess their recipe, questions and research.

Exploring:

1. The teacher may want to provide some plates with meals on them to let students practice assessing each plate.
2. This could be used as a formative assessment to group the students in the next part of the lesson.
3. Once the students have had a chance to form some initial assessments then the class can discuss what makes up each meal.

4. The teacher should use intentional grouping to set up the small groups for this part of the lesson.
5. The students should be allowed to express their prediction in multiple formats. This could include drawing the atom, verbally explaining what they think the atom looks like or writing an explanation.
6. Students can record observations of foods that they could use as evidence for their predictions. The teacher should be sure to ask the students why.
7. The teacher should have clear guidelines or rules for class discussions and group sharing that make students feel safe and valued in the classroom.
8. The teacher should try to encourage everyone to be involved. The teacher could walk around and give struggling students a warning that they will be called on to share about a certain part of the lesson.
9. The teacher can provide the discussion questions to students in advance to allow the students to formulate answers in advance. This way struggling students feel more confident and able to participate in the discussion. This makes struggling students more likely to have input into the discussion.

Explaining:

1. The teacher may need to show any videos more than once for struggling students to be able to identify the most important parts.
2. The explain part of this lesson provides some good information about ways to present the information to students. It, also, shows some examples of ways that these ideas can be presented to students.
3. The teacher should be sure to provide clear directions and have guidelines in place for any of these activities that they decide to do.
4. The students may need additional time to re-evaluate and revise their initial decisions about the meal in the explore phase.
5. The teacher needs to have clear guidelines about sharing in class. The goal is to help students feel safe to share in the classroom environment.
6. The teacher should have an alternative way for students to share with the class for students that do not feel safe doing so. It could be a gradual process to get students to the point that they are willing to share with the entire class.

Elaborating:

1. The teacher can do a demo making hot chocolate (or other food) in the classroom. This is a visual that may help students see the connections between what the teacher is doing and the material.
2. The teacher can, also, find a video of a mixture being made that they can show the class.
3. The teacher should provide the claims-evidence-reasoning graphic for the students to record their observations and claim about making hot chocolate or other food.

Evaluating:

1. The students may need additional time to formulate their argument.
2. Students should be allowed to express their knowledge in various ways. This could include writing their argument, drawing a cartoon, designing a play or making a power point.

Return to Instructional Segment

Organizer for Recipe

(insert your recipe here)					
List the ingredients					
Is this ingredient a solid, liquid, gas, or plasma?					
Is this ingredient a pure substance or mixture?					
Read the recipe carefully.	Step 1	Step 2	Step 3	Step 4	Step 5
When you follow this step in the recipe, did the ingredients change phases?					
Was thermal energy (heat) involved?					
Was mechanical energy (mixing) involved?					
Was this a physical or chemical change?					

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Classifying Hot Chocolate

Question: Does making hot cocoa result in a new pure substance or mixture? **Sub question: Therefore, would this be a physical or chemical change?**			
Evidence			
of a new Pure Substance		of a Mixture	
Definitely Supports there is a new **Pure Substance**	*Might* Support there is a new **Pure Substance**	*Definitely* Supports there is a **Mixture**	*Might* Support there is a **Mixture**

Claim: _____
_____
_____

What is your reasoning? _____

_____

_____

Return to Instructional Segment