# Sample Physical Science Learning Plan

## Big Idea/ Topic

Atomic structure, chemical and physical properties and changes, periodic table

## Standard Alignment

**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.

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. Develop models (e.g., atomic-level models, including drawings, and computer representations) by analyzing patterns within the periodic table that illustrate the structure, composition, and characteristics of atoms (protons, neutrons, and electrons) and simple molecules.

**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.**

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).

**Connections to other Contents:**

**ELAGSE8SL1:** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics and texts, building on others' ideas and expressing their own clearly.

**ELAGSE8SL1a.** Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.

**ELAGSE8SL4:** Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

# Instructional Design

## Part 1

## Engage

Phenomenon: What is the food we eat really made of? Students use food as a way to discuss and learn about matter and changes in matter.
***Communicate***: Students share their own cooking experiences through class discussion or another format.
*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 a 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.*

***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.*

**Unplugged:** Students can be given the same tasks and questions/prompts and still be able to share with limited access to technology. The student responses can be used as formative assessments.

## Explore

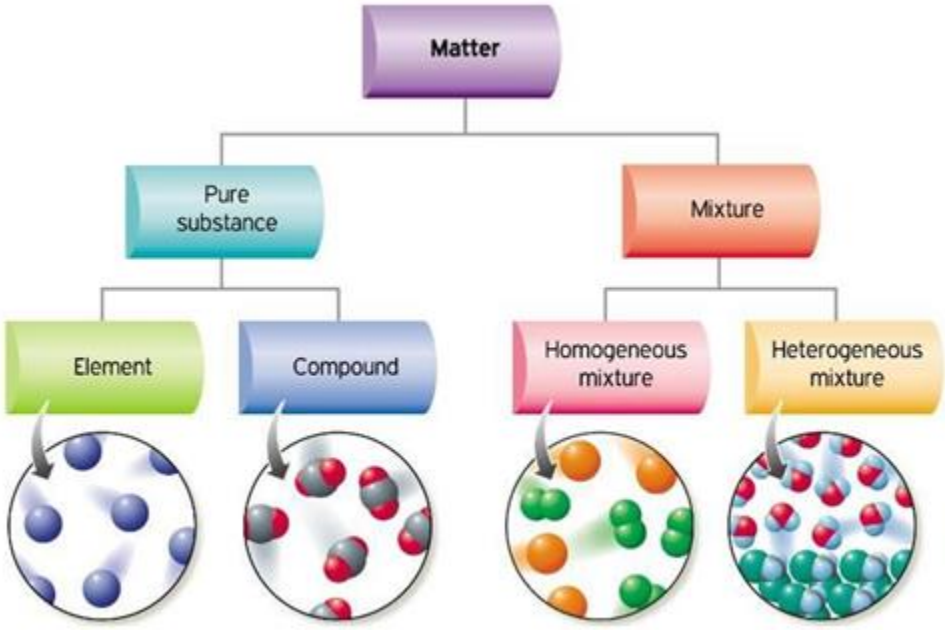
***Obtain*** Students obtain information about the observable properties of various pure substances and mixtures that are part of an average meal.
*Teacher Hint: Consider showing a plate of food wrapped in aluminum foil (element) on display for the students. Be specific about including substances that 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: 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.*

***Evaluate*** Guide students in their evaluation to now categorize the different substances as either pure substances or mixtures. Provide students time 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?*

**Unplugged:** Students can complete the guided questions with a family member as they think more about various foods that they eat.
**Explain**
*Obtain* Students obtain information about the distinguishing structures and functions of pure substances and mixtures via informational text, video, visual representations, kinesthetic modeling, and separation technique labs.
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 a blank jar (or another container) model.
Students observe outcomes with both the naked eye and see images of under microscope (if available). Teacher facilitates discussion leading students toward accurate understandings. Students refine explanations based on new/refined understandings and complete thoughts on jar representations.

***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 divide 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.

**Unplugged:** Students should have access to articles or sources that explain the organization of matter. In the same theme, students can make predictions about meals or foods they eat with a family member.

**Elaborate**
***Obtain*** Students obtain information about making lemonade (or another beverage). Students record observational evidence that will help support whether making lemonade results in a new pure substance or a mixture. Students can do this at home with a family member and share their predictions.
*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, such as Beverage Classification.*

**Unplugged:** The majority of the activities in this section can be done asynchronously and with limited technology access.

**Evaluate:**
***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. Students can use the lesson goals checklist to self-asses their learning as well.*

## Part 2 You are What you Eat

### Engage

Phenomenon: What is the food we eat really made of?

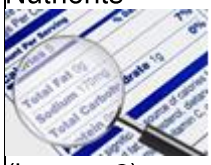
***Obtaining*** Students obtain information from nutritional labels associated with what is seen on the dinner plate. Students investigate the nutritional categories and breakdown for each food. Students then record the items from their last meal and similarly obtain information about the nutritional categories and breakdowns.

Resources for Obtaining Information:

Choose My Plate
Chicken and Turkey Nutrition Facts
Healthy Foods

***Communicating*** In small groups, students share what they have discovered. Students discuss and record what they know about the different nutrients.

*Teacher Hint: Some students would benefit from a discussion guide. A suggested organizer provided below:*

| Food Item  | Nutritional Category   | Least Abundant Nutrients  (bottom 3) | Most Abundant Nutrients (top 3) |
|---|---|---|---|
| Chicken | | | |
| Fries | | | |
| Spinach | | | |
| Water | | | |
| | | | |
| | | | |
| | | | |

***Communicating*** In whole group discussion students then share obtained information.

*Teacher Hint: As students engage in whole group discussion purposefully elicit prior knowledge about the history of the FDA recommendations (pyramid – my plate), current conceptions about healthy versus unhealthy, sources of different nutrients, and that all matter –including their food- is made of atoms.*

*(Prompts for Writing or Discussion: Why do you think the labels only list a few vitamins and minerals? What do these different nutrients do for you? What do all the proteins have in common? What about the vegetables? What kind of atoms make up Vitamin A?...Potassium? ...Carbohydrates?)*

***Obtaining/Evaluating/Communicating*** Students provided samples and/or images (infographics) about some of the elements (nutrients) identified from 'dinner.' In small groups, or class discussion, students generate a list of observable properties, surprising properties, and questions. *Teacher Hint: List student questions in a way that allows you to reference and mark through as they are answered. Some students may benefit from an organizer to help facilitate their discussions. A sample is provided below:*

| What did you observe? | What was the same as what you expected? | What was different than what you expected? | What questions do you have? |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**Unplugged:** This section of the learning segment can be done with little access to technology. Consider providing students with printed articles about certain foods and nutrition labels.

**Explore**

***Obtaining Information*** Students obtain information about the atomic/molecular structure of the different nutrients from 'dinner' and their last meal.

Suggested Resources for Obtaining Information:

Vitamin Structures

Vitamin Structures Graphic

Periodic Videos

As students are spending time in the kitchen analyzing meals and recipes, they will plan an investigation about heat transfer during the cooking that they are helping with. Under supervision, students will predict what is happening on a small scale to the food that students are cooking. Students could use a graphic organizer for planning their investigation, for examples, see: thewonderofscience.com. An optional investigation could involve other household materials, such as Hot Cans and Cold Cans.

***Evaluating*** From the obtained information, students use the modern periodic table to locate the most common elements that are part of the molecular/atomic structure of foods consumed at 'dinner' and encountered during their investigation.

***Communicating*** Students share identified patterns from obtained information. (For example, Mg and Ca are in the same group.) Students conjecture what each of the different columns, rows, numbers, and symbols represent.

***Obtaining/Evaluating/Communicating*** Students obtain information for how the modern periodic table is organized.

*Teacher Hint: Myriad instructional approaches allow students to obtain/reason/communicate an understanding of the organization of the modern periodic table.*
Suggestion for Virtual Simulation
Suggestion for History of Science approach
Ted-Ed: Solving the Puzzle of the Periodic Table

***Evaluating/Communicating*** Students construct an explanation for the organization of the periodic table and summarize all the data that can be acquired by knowing how to read it.
Options for Constructing an Explanation:
1. How to book/15 steps or less with pictures
2. Create a web page/infographic (Show the following as an example)
3. Student comparison of alternate tables, identifying strengths and weaknesses for each, with final claim (supported by evidence) as to why the modern periodic table is the better choice.

*Teacher Hint: Consider providing a checklist and rubric*

**Unplugged:** Consider providing students with printed resources to learn more about the organization of the periodic table. Students can complete the heat transfer investigation without technology but may need to be provided with written resources and organizers.

**Explain**
***Obtaining*** Specifically students obtain information from the Periodic Table and other resources to make sense of one common element found in their food. Students obtain information about the physical/chemical properties of the element, typical atomic structure, family information, bonding preferences, other uses, etc.
Potential Resource for Obtaining Information:
How to understand the periodic table
Periodic Table Interactive

***Evaluating/Communicating*** Students choose approach for presenting model of the Periodic table with focus on assigned element.
*Teacher Hint: Provide student choices with a rubric (e.g. singing, creating a new product made with the element, telling a sci-fictional narrative, dating profile, social media page, etc.*
*Teacher Hint: Group students with same elements together (3 or less students should be grouped together) and allow them to collaborate on their presentation but require each complete a model or visual representation of some sort.*

**Unplugged:** Consider providing students with printed resources to learn more about the organization of the periodic table. Students choose product for periodic table presentation.

**Elaborate**
***Obtaining*** Students choose one of the foods that were part of their last meal. Students obtain information about how that food is farmed, processed for the grocery, bought/consumed, digested, broken down to molecular/atomic states, used by the human body for life, and then returned back to Earth.

***Evaluating*** Students generalize the sequence of events and develop a model as evidence to construct an argument about the conservation of matter as it pertains to the food we eat.

*Teacher Hint: Provide students a guide and set of resources for obtaining/reasoning information.*

***Communicating*** Students generate a claim supported by evidence that proves conservation of one element/molecule found in one food (from farm to earth).
*Teacher Hint: Provide students a CER framework and writing rubric.*

**Unplugged:** Students should be provided articles or other printed resources as they develop models and construct arguments.

## Evaluate

### Assessment of Student Learning

***Evaluating*** Students use obtained information about a "new" element to determine its atomic structure, family, period, potential bonding preferences, etc.
*Teacher Hint: Develop descriptions that range from difficult to easy to categorize. Provide appropriate difficulty level based on student needs.*

***Communicating*** Students must write from a unique perspective (e.g. the scientist who discovered it, family or group member, another element from which it may be bonded with, etc.) to develop the main character (i.e. new element) to reflect its eventual placement in a family, properties, "friends," etc.
*Suggested mediums:*

1. Breaking News: Special TV Report
2. Personal Journal Entries
3. Science Peer Reviewed Journal
4. Graphic Novel/Short Story

### Lesson Goals Checklist

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

- Develop and use models to compare and contrast:
  - Pure substances and mixtures
  - Heterogeneous and homogeneous mixtures
- Develop and use models to describe particle movement when thermal energy is added or removed in:
  - Solids
  - Liquids
  - Gases
  - Plasmas
- Construct an argument from observational evidence to support a claim that a change in substance is either physical or chemical
- Develop models of atoms and simple molecules by analyzing periodic table patterns that illustrate:
  - Structure
  - Composition
  - Characteristics (protons, neutrons, and electrons)

**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.**

- Plan and carry out investigations of heat transfer on molecular motion as it relates to:
  - Conduction
  - Radiation
  - Convection

## Evidence of Student Success

Student mastery is assessed throughout this unit using formative and summative components. Student discussion, explanations and products should reflect the understanding indicated in the Evaluate section above. Each activity in the segment functions as an assessment opportunity as well to plan targeted supports or provide extension items. Formative options using the self-evaluation checklist and the sorting activity at various points during the segment.

## Distance Learning Supports

The goal for science education in the state of Georgia is as follows: All Students, over multiple years of school, actively engage in science and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields.
The learning experiences provided for students should engage them with fundamental questions about the world and with how scientists have investigated and found answers to those questions.
This lesson includes the disciplinary core ideas, science and engineering practices and crosscutting concepts to actively engage students in exploring science concepts with real world topics. As part of the vision we must support the inclusion of all students in science learning. Some **general** ideas to consider when designing things to support students that struggle are as follows:

- Be sure that students can access the information that you they are learning. Make sure that you can answer the following questions:
  - Do students have what they need to get the information? This is about them having the book or internet access to get to the information.
  - Once students obtain the information, are students able to determine what information is important? This is about the students having materials on the appropriate grade level and that is in a format that students can understand.
  - Is the material presented in multiple ways that allows all students to interact with information in a way that works for them? Such as video, audio, and articles.
  - Consider read aloud as a potential option for students that have reading deficits as an option to assist students in accessing the material. This could be done using video, read aloud or via phone.
- Students may need ideas about where to find information. Providing students with information about what a reliable source is and even where to find reliable sources may be beneficial for students.
- Some students may find it difficult to complete the entire lesson workload. Some students may benefit from a reduced workload (note: this should be used only when absolutely necessary). Be sure that the information that is removed will not negatively impact the student's understanding of the disciplinary core idea.
- Consider how students show their knowledge. Students need multiple ways and opportunities to show their knowledge. Things to consider:
  - Recording video or audio
  - Drawing

    - Writing
    - Typed
    - Verbal

- Provide students with a way to ask questions in a forum that does not cause anxiety. Frequently students do not want to ask questions in front of their peers because they are afraid of what their peers may think of them. So, be sure to provide students a way to ask questions that is private or anonymous.
- Consider materials that students need to complete the assignments.
    - Do students have needed materials?
    - What are some alternative materials that students may have available to them?
- Have a clear and consistent set of guidelines for providing consistent feedback to all students.
- Utilize graphic organizers such as those from the Wonderofscience.com
- Use high leverage and evidence-based practices to reach all students.

Some ideas for supporting **this lesson specifically** would be to make sure to consider the following:

- The teacher should have clear and consistent guidelines for student discussion.
- The teacher should consider providing students with a simple food menu that students can work with for this lesson.
    - The teacher should be sure that the food menu that they are providing is simple and does not contain extravagant food choices such as ice cream or cake. This is to provide empathy for students that are in food insecure environments.
- The teacher should be cognizant of food insecure students as they move through the lesson.
- The teacher should consider using pictures, articles and information about mixtures and pure substances.
- The teacher should consider reviewing solids, liquids, and gases.
- The teacher should consider providing students with graphic organizers to organize their thoughts and ideas as they move through the lesson.
- The teacher should have clear and consistent guidelines for students to share their ideas with their peers. This should include some way for students that are unplugged to share ideas with their peers. The teacher should be sure to follow district guidelines about student communication.
- The teacher should consider providing students with sources to use when obtaining information.
    - The teacher should consider teaching students to evaluate sources to find reliable sources. The teacher should consider modeling for students how they, as an adult, determine what sources are reliable.
    - The teacher should, also, consider teaching students to find important information that is contained in the text. This can be done by modeling the teachers thought process as they read through the text and think about what the text is saying. Annotate the text where students can see and verbalize what you are thinking as you move through the text.
- The teacher should consider providing students with an image of foods that students regularly eat.
- The teacher may need to review what a prediction is prior to students getting started.
- The teacher should consider using guiding questions to help students as they move through the lesson.
- The teacher should provide students with multiple formats to share their knowledge. These formats could include writing, drawing or verbally explaining.
- The teacher should provide students with multiple formats to access information. These formats could include videos, articles, or PowerPoints.
- The teacher may need to provide nutrition labels to students.
- The teacher may, also, need to discuss how to read nutrition labels and make clear what students should be looking for as they analyze the labels.

- The teacher should consider a graphic organizer for the planning an investigation piece of this lesson.
- The teacher should also consider guiding questions to help student plan their investigation.
- The teacher should consider providing students with a rubric for activities contained in the lesson. The rubric will allow students to understand expectations and self-evaluate prior to turning in their assignments.
- The teacher should consider providing students with resources to have articles or webpages read aloud. This could be doing using text-to-speech features, text-to-speech apps, or you reading aloud via video or phone. Be sure to follow district guidelines for student communication and technology.

## Engaging Families

- Additional resources to support this segment can be found at GPB: Georgia Home Classroom.
- Science Support for Families During School Closures

*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? | | | | | |

*Beverage Classification*

| Question: Does making lemonade result in a new pure substance or mixture?<br>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** |
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**Claim:** _____
_____
_____

What is your reasoning?