

This 5E model for instruction is used to connect the concepts of cell structure and function, levels of organization, and body systems to develop the understanding that organisms maintain their basic needs as a result of the interactions between and within subsystems (cell structures, cells, tissues, organs and organ systems). This lesson is part 1 of 2 of the instructional segments on Structure and Function in Living Systems.

Student Science Performance

Grade or course: 7th Grade Life Science

Title:

Topic: Structure and Function in Living Systems

“I can’t eat this food.”

Performance Expectation for GSE:

S7L2. Obtain, evaluate, and communicate information to describe how cell structures, cells, tissues, organs, and organ systems interact to maintain the basic needs of organisms.

- a. Develop a model and construct an explanation of how cell structures (specifically the nucleus, cytoplasm, cell membrane, cell wall, chloroplasts, lysosome, and mitochondria) contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste.

(Clarification statement: The intent is for students to demonstrate how the component structures of the cell interact and work together to allow the cell as a whole to carry out various processes. Additional structures, beyond those listed, will be addressed in high school Biology.)

- b. Develop and use a conceptual model of how cells are organized into tissues, tissues into organs, organs into systems, and systems into organisms.
- c. Construct an argument that systems of the body (Cardiovascular, Excretory, Digestive, Respiratory, Muscular, Nervous, and Immune) interact with one another to carry out life processes.

(Clarification statement: The emphasis is not on learning individual structures and functions associated with each system, but on how systems interact to support life processes.)

Performance Expectations for Instruction:

Students will:

- examine food packaging from various food items to obtain information on the types of nutrients in food.
- ask questions to obtain information about a nutrient and its importance to the body.
- develop a conceptual model representing the path of the nutrient through the subsystems of the body to reach a cell.
- develop a model and construct an explanation of how cell structures contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste.
- ask questions to obtain information about a food allergen and its effect on the body.
- construct an argument of how the systems of the body interact during the allergic response.
- develop and use a model to show how the allergic response at the cellular level (microscopic level) is transmitted through the levels of organization to the body system (macroscopic level).
- construct an argument of how the systems of the body, including cardiovascular, excretory, digestive, respiratory, muscular, nervous and immune, interact with one another to obtain nutrients for cells to carry out life processes.

Additional notes on student supports

Materials

Print or digital text resources for research purposes

Various food packaging (actual or images) with ingredients and nutritional facts label from products containing allergens identified by the [FDA](#) (soybeans, milk, egg, wheat, peanuts, tree nuts, fish, and/or crustacean shellfish)

Students will continuously obtain, evaluate, and communicate information. This is not a linear process. Students will communicate through writing and discussions to allow for formative assessment. This benefits the teacher, student, and whole group to guide instruction to clarify misconceptions or extend content.

Engaging Learners

Before introducing the phenomenon to students, open the lesson with a Think-Pair-Share about the question, “Have you ever been sick from something you ate?” Ask students to think about this experience, or that of someone close to them, and talk with a partner about the experience.

After students have had 1-2 minutes to share their experiences with one another, ask for volunteers to share the reason they became sick from the food. Post the responses on the board. Students may suspect food poisoning (bacteria), an allergic reaction, too much sugar, or other reasons as to why they became sick (or had a bad experience) from the food.

Use the students’ experiences to introduce the phenomenon that some foods may not be good for them.

Teacher Notes: Students may have indicated various suspected reasons why they became sick from the foods they ate. For the purpose of this instructional segment, students are going to investigate food allergens (during the Explore and Explain phases) and diabetes (during the Elaborate phase) as to why some foods may not be good for them. If you have students with other physiological responses to food, adapt the lesson to allow them to investigate the phenomenon from their perspectives to make the learning experience more relevant to them.

Phenomenon: Some foods may not be good for you.

- Teacher will share a story, news article or media report about someone who suffered from an allergic reaction to a food item.
- Sample articles can be found online.
- The report could include peanut, tree nuts, wheat, gluten, soybeans, egg, milk, fish, crustacean shellfish or other allergens in food. (Another option--Rather than using a story or news report, use an image of a safety sign with a warning about an allergy, such as one that designates a [peanut-free zone](#) in a school cafeteria or outside play area.)

Teacher Notes: The use of a story or sign may generate different responses from the students depending on how much information is provided in the story or on the sign. With the story, students may initially wonder what is in food that could cause someone to get sick or have a reaction. With the sign, students may wonder what it is about peanuts (or another food allergen) that causes someone to have a reaction.

After reading or viewing the media, ask students to write down what they notice and wonder about the situation depicted in the media.

In pairs, students will share what they noticed and wondered about food allergies.

Teacher will initiate a brief class discussion where selected students share with the class what they notice and wonder.

	<p>The teacher will post the students’ responses in a T-chart on chart paper or the board and refer back to these throughout the lesson. Post students’ “wonder statements’ as questions. Possible student questions:</p> <ul style="list-style-type: none"> ● What is in a food that could cause an allergic reaction? ● What is in food that our bodies need? ● What happens when someone who has allergies eats certain foods? ● Can the reaction be prevented? ● What are the symptoms of an allergic reaction? ● Can someone die from an allergic reaction? ● If someone can’t eat this food, then how does the person get the necessary nutrients to stay healthy? <p><i>Teacher Notes: During the discussion, some students may share knowledge of additional food allergens, such as milk, soybean, egg, gluten, wheat, tree nuts, fish, shellfish or others, that may not have been addressed by the initial phenomenon. Include these in the T-chart or on a separate list. Students will investigate these allergens throughout the lesson. After the discussion, transition the lesson to the next phase by explaining to students that they are going to explore food packaging for nutrient and food allergen information/warnings.</i></p> <p><i>At the end of the lesson for the day, ask students to talk with an adult at home to find out if anyone in the family is allergic to or cannot eat a type of food. This information could be shared or discussed at the beginning of the next day and serves as another relevant connection to the content.</i></p>
<p>Exploring</p>	<p><i>Teacher Notes: If this phase of the lesson is beginning on a different day than the Engage, then you can begin the lesson with the at home connection from the previous day. Before beginning this phase of the lesson, restate the phenomenon by explaining that organisms need nutrients from food and their environment to survive, and yet, some of these nutrients can cause harm to some individuals. The Explore phase is divided into two parts where students will investigate the nutrients in food and food allergy indicators.</i></p> <p>Teacher will provide students with food packaging from various food items to examine the nutrient and allergy information provided on the package. The allergy information could reference soybean, milk, egg, peanut, tree nuts, gluten, wheat, phenylketonurics, etc. Food packaging can be obtained from the school cafeteria or brought in from home. (Do not bring in actual food items.)</p> <p>In pairs, students will examine food packaging from various food items to obtain information on the types of nutrients and allergens in food. Students will make a list of the nutrients and allergens identified on the food packaging.</p> <p>In larger groups, students will share their information to identify commonalities in the nutrients and allergens listed on the food packaging. One student from each group will share 3-4 commonalities with the class during the class discussion.</p> <p>Teacher will initiate a brief class discussion where students will share the common nutrients and allergens indicated on the food packaging. List the nutrients and allergens in a T-chart on the board or chart paper.</p>

Teacher Notes: Part A of this phase focuses on the relationship between the cell structures and the nutrients needed by organisms to function and survive at the cellular level. This lesson focuses on the cell as a system with specific cell structures and identifies processes related to the function of the cell structures. It would be appropriate to include the nutrients used and/or needed by the cell structures to perform their functions for the benefit of the cell system. Part B of this phase focuses on the body as a system and how the systems interact in response to food allergens.

Part A

In pairs, students will select a nutrient from the list to investigate further. Nutrients such as carbohydrates (sugars), fats (lipids), fiber and proteins are listed on the nutrition facts labels. Other nutrients (matter) such as water and oxygen are necessary but not listed on food packaging and should be included in the investigation.

Students will ask questions to obtain information about the nutrient and its importance to the body. Possible student questions:

- Where do these nutrients come from? How do they get in the food?
- What other nutrients does the body need that are not obtained from food?
- How does the body use this nutrient?
- What happens to this nutrient as it enters and passes through the body?

Teacher will provide students with access to print or digital text resources from which students can obtain and evaluate information to answer their questions about the nutrient they selected to investigate.

- Possible nutrients to investigate sugar, water, oxygen, protein, fat (lipid) or cholesterol.
- This investigation will include how the body (organ systems, organs, and tissues) and cell structures use this nutrient.
- A school nutritionist or cafeteria manager could be invited to the classroom to speak with students about the nutritional needs of the body to maintain the basic needs of the organism.

Teacher Notes: As students investigate the answers to their questions, they will likely discover the body needs these nutrients because the cells (tissues and organs) that make up the body need these nutrients to perform life processes. The students may identify the body systems as well as cell structures that play a role in obtaining, transporting, and using this nutrient to carry out life processes.

Monitor students work during this part of the lesson to encourage them to ask more questions about the connection between the body and nutrients from the macroscopic to microscopic scale (body system → organ system → organ → tissue → cell → cell structures). Students will conclude that the nutrients in food come from the cells that make up the food. The students will obtain and evaluate the information from this part of the lesson to develop models and construct explanations. The students' models and explanations will be further developed throughout the lesson. The final completed model will be evaluated as part of the summative assessment at the end of the lesson.

Students, in pairs or individually, will develop a conceptual model representing the path of the nutrient through the subsystems of the body (levels of organization) to reach a

cell.

- The students' conceptual models (paper or digital formats could include a flow chart or other graphic organizer, animation, or schematic diagram) will communicate their understanding that the nutrient can pass through various subsystems before reaching the cell (from the macroscopic to microscopic scale: body → organ system → organs → tissues → cells).

Students will share the model with a partner or other group (depending on initial completion of work).

- Students will provide feedback and/or ask questions about the model. (This guidance will be used to further develop the model in the next performance task of the lesson.)

Students will obtain and evaluate information on the nutrient, from research the teacher provides as print and/or digital resources (such as textbooks), to communicate the relationship between the nutrient and specific cell structures.

- The students will focus their research on the nutrient they examined for the previous model.
- Students will evaluate the information to determine the function, or role, of the cell structure (cell wall, cell membrane, cytoplasm, nucleus, mitochondria, lysosome, and chloroplast) within the cell system.
- Students will evaluate this information to make connections between the cell structures and the nutrient obtained, transported and used by the cell to perform basic processes (growth, reproduction, making needed materials, and processing waste). For example, cells need oxygen because the mitochondria in cells need oxygen to make needed material (energy) for the cell through the processes of cellular respiration. (Students do not have to know the details of how the mitochondria use oxygen or the biochemical mechanisms of cellular respiration.)
- Students will evaluate this information to determine how the cell structures interact with one another contributing to the function of the cell as a system in obtaining nutrients to perform basic processes. For example, students would seek to determine the role of the other cell structures in obtaining or transporting oxygen for use by the mitochondria.

Teacher Notes: As students obtain and evaluate the information from the resources, ask questions ([sample questions](#)) and offer guidance ([sample organizer](#)) to help students focus on the cell as a system with interacting components that obtain the nutrient in order to grow, reproduce, make needed materials, and process waste. Students will use the information obtained from these resources to complete the next performance task.

Students, in pairs or individually, will develop a model and construct an explanation of how cell structures contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste.

- Students can further develop the previous model, making any needed adjustments or revisions based on the peer feedback and/or questions, to include the cell structures.
- The students' models (paper or digital formats could include a flow chart or other graphic organizer, animation, or schematic diagram) will include the nutrient they selected to investigate and each of the cell structures (cell membrane, cell wall, lysosome, nucleus, cytoplasm, mitochondrion or

chloroplast) that obtain, transport, or use the nutrient in maintaining the basic needs of the cell.

- The students' models and explanations will communicate their understanding that a cell is a system with interacting structures that use matter (nutrients) and energy to help the cell maintain its basic needs and/or that of the organism. These basic needs include growth, reproduction, making needed materials, and processing waste.
- The intent is for students to demonstrate how the component structures of the cell interact and work together to allow the cell as a whole to carry out various processes. Each of these processes is associated with one or more of the cell structures students are investigating. For example, cells must take in nutrients (matter) and use energy to make needed materials. The cell membrane contributes to the process of making needed materials by allowing nutrients to enter and exit the cell. These nutrients are then transported through the cytoplasm to other cell structures such as the nucleus, chloroplast, mitochondrion or lysosome, depending on the cell and the needed material being produced (matter or energy), where it is used to maintain the basic needs of the cell.
- The model and explanation should not focus on detailed steps or biochemical mechanisms associated with basic needs of the cell. For example, the cell membranes contribution to making needed materials should not include the details or biochemical mechanisms of cell transport (osmosis, diffusion, facilitated diffusion, or active transport) as these are part of high school biology.

Students will share their models and explanations with their peers, in small groups or a whole class gallery walk, to receive feedback and ask questions. The peer feedback and questions will be taken into account as the models and explanations are further developed later in the lesson.

Teacher will initiate a brief class discussion allowing student volunteers to share their models and explanations and answer or ask additional questions. Refer back to the initial list of students' questions posted on the board or chart paper to answer any questions (or ask new questions) related to nutrients cell structures use to help a cell grow, reproduce, make needed materials, and process waste.

Teacher Notes: Thus far, students have explored the organization of an organism, the nutrients cells need to perform their functions, and the interactions between cell structures in carrying out basic processes. In Part B, students will explore how one specific nutrient (in most, if not all cases, a protein) can initiate a response at the cellular level causing tissues, organs and organ systems to interact affecting the organism. To begin Part B, you will need to refer back to the T-chart completed earlier in the lesson for the students to select a food allergen.

Part B

In pairs, students will select a food allergen from the list to investigate further.

Students will ask questions to obtain information about the food allergen and its effect on the body. Ask students to think of a time when someone they know had an allergic reaction and what questions they might have about that experience. Possible student questions:

- What specific substance in the food causes the allergic reaction?
- How does a cell, tissue, organ, or organ system respond to the substance?
- What happens to this substance as it enters and passes through the body?
- Why does someone have a food allergy? (Is it inherited from their parents? Or is it acquired?)
- How do you know when someone is having an allergic reaction?
- What are the symptoms of an allergic reaction?
- Which body systems are involved in the allergic reaction?

Students will obtain information from teacher provided resources (print or [digital text resources](#)) about the food allergen they selected to investigate.

- School personnel, such as the cafeteria manager and/or school nurse, could be invited to the classroom to discuss precautions taken during food preparation and/or taken by the school to prevent students from having an allergic reaction to a known food allergen. The school nurse could also discuss the symptoms of an allergic reaction.

Teacher Notes: Students will conduct research to obtain information to answer their questions. Students will obtain information on how and why allergic reactions occur with specific foods. Students will evaluate this information to develop models and construct arguments to communicate how body systems interact in response to food allergens. As students find answers to their questions using research, ask probing questions to guide students to investigate at least one of the symptoms of the allergic response more closely to understand how the cell response causes responses at other levels (tissues, organs, and organ systems) due to the organization of the body of a multicellular organism.

In small groups, students will share the questions they investigated and the information they obtained on the substance in food that causes the allergic reaction including its effects on the body (i.e. symptoms of the reaction).

Students will communicate information during a brief class discussion on food allergens and symptoms of allergic reactions as well as share answers to their questions.

In pairs, students will develop and use a conceptual model of how the allergic response at the cellular level (microscopic level) causes responses in the subsystems of the body (tissues, organs, and organ systems) affecting the organism as a whole (macroscopic level).

- Students will represent one aspect of an allergic reaction (i.e. symptom or specific body system) in the model. For example, students may choose swelling as a part, or symptom, of an allergic reaction. Students will conduct additional research to investigate the cause and effects of the swelling including the cell(s), tissue(s), organ(s), and organ system(s) involved in this response. Sample Link: WebMD: [What is an Allergic Reaction?](#)
- Students will use the model to communicate the cause and effect relationship between the allergen and the subsystems of the organism (cells, tissues, organs, and organ systems).

Teacher Notes: As students develop their models, circulate the room to identify the body

system(s) addressed in the students' models, and ask students to share their ideas with you. Ask questions that may be necessary to guide students to further develop their ideas. Use this opportunity to formatively assess student learning and select students to share their ideas during the discussion.

Teacher will initiate a brief class discussion allowing student volunteers to share their models and answer or ask additional questions.

- The students will communicate the information they obtained related to each symptom and its corresponding body system(s).
- Guide and direct the class discussion to include all the necessary body systems related to the allergic response. Together this information will paint a picture of how the body systems interact during the allergic response.

Teacher Notes: Based on the information provided during the class discussion, it may be necessary to provide students with print and/or digital text resources from which they can obtain additional information about the body systems enabling them to better identify interactions between the systems of the body during an allergic reaction.

In pairs, students will construct an argument of how the systems of the body, including the cardiovascular, excretory, digestive, respiratory, muscular, nervous, and immune, work together in response to a food allergen.

- Students arguments will focus on the allergen and the aspect of the allergic reaction represented in their models.
- Students will obtain and evaluate information on the systems of the body from print and/or digital resources to construct their arguments.

Teacher Notes: As pairs of students construct an argument, ask students to share their ideas with you and ask questions to guide students to further develop their ideas. This is an opportunity to formatively assess student learning and select students to share their ideas during the discussion. This could be a claim, evidence, reasoning activity.

Students will post their model and argument for a gallery walk allowing their peers to provide feedback and ask questions.

- Teacher will provide the students with two sticky notes on which to provide feedback or ask questions about the model and argument. Teacher will offer guidance on how to provide appropriate feedback or ask questions before students begin the gallery walk. (Guidance is teacher discretion.)
- Each student will provide feedback on two different models and arguments using the sticky notes, one note per model. (Anonymity is teacher discretion.)
- Each model should be reviewed at least twice. (Teacher discretion--the goal is to ensure all students receive feedback on and have questions asked about their model and argument.)
- At the conclusion of the gallery walk, students will retrieve their model and argument with attached sticky notes.
- Students will use the feedback and questions to further develop their model and argument later in the lesson.

Class Discussion:

- Engage in a brief class discussion where selected students share their models, explanations and/or arguments with the class.

	<ul style="list-style-type: none"> ● Refer to the T-chart depicting what the students initially noticed and wondered about nutrients and food allergies. ● Ask students if they have anything new to add to the notice column. ● Ask students if they can provide any information to address, or answer, what they wondered about. ● Ask students what new things they wonder about now that they have learned more about food allergies.
--	---

<i>Formative Assessment of Student Learning</i>	
--	--

<i>Explaining</i>	<p><i>Teacher Notes: In the Explore phase, students learned cells, and other subsystems of an organism, interact in obtaining nutrients to perform basic process to maintain the needs of the organism. Students also learned the cells of the immune system perceive certain nutrients (proteins) in food as a threat initiating various interactions between the subsystems of the organism.</i></p> <p><i>In this phase of the lesson, students will work individually to obtain and evaluate information to further develop their models, explanations and arguments with opportunities to receive peer and teacher feedback. During the peer review process, formatively assess student learning. The information students communicate in their work will be the basis for deeper discussions, explanations of specific content and/or explicit teaching points during class discussions.</i></p> <p><u>Part A: Interacting Cell Structures within the Cell System</u></p> <p>Students will develop a model and construct an explanation of how cell structures contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials and process waste.</p> <ul style="list-style-type: none"> ● Students’ models will depict interactions between cell structures in obtaining nutrients in order to perform basic processes (growing, reproducing, making needed materials, and processing waste). Each of the processes involves interactions between multiple cell structures. ● Students models can focus on specific nutrients or nutrients in general. ● Students explanations will include the interactions between cell structures as they perform their functions within the cell system. <p>Students will participate in a gallery walk, using the same guidelines as the previous gallery walk, to offer feedback and/or ask questions about each other’s models and explanations. Students will retrieve their models and explanations to review the feedback posted by peers.</p> <p><i>Teacher Notes: As students participate in the gallery walk, formatively assess student learning by evaluating students’ models and explanations to identify any further clarifications, explanations, or specific content that should be addressed to help students revise their models and explanations. These can be addressed with individual students, small focus groups, or whole class based on students’ needs.</i></p> <p>Teacher will engage the students in a brief class discussion allowing students to share helpful feedback and/or questions they received and/or provided to guide their revisions. Teacher will provide any additional content, explanations, and/or clarifications related to the core ideas to help students make further connections before revising their models and explanations.</p>
--------------------------	---

Students will revise their models and explanations.

Part B: Interacting Subsystems (Levels of Organization)

Students will develop and use a conceptual model of how the allergic response at the cellular level (microscopic level) affects the tissues, organs, organ system and organism (macroscopic level).

- Students' models will focus on one system to show how the allergic response at the cellular level initiates responses that affect the tissues, organs, organ system, and body.
- This model could be added to, or combined with, the previous model from Part A.

Teacher Notes: As students develop this conceptual model related to the levels of organization, ask students probing questions to formatively assess the students' levels of understanding that cells are organized into tissues, tissues into organs, organs into systems, and systems into organisms. Students' models should be used in discussions of this concept. Based on students' levels of understanding, teacher will provide any additional content, explanations, and/or clarifications related to the core ideas to help students make further connections before revising their models and explanations.

Students will revise their models and explanations.

Part C: Interacting Organ Systems

Students will construct an argument of how the systems of the body, including cardiovascular, excretory, digestive, respiratory, muscular, nervous and immune, work together during the allergic response.

- Students' arguments will address each of the body systems and will likely include responses, or symptoms, associated with each system. The arguments may include an explanation about how the response in one system causes, or initiates, a response in another system or how two or more systems work together during the response.
- Students can develop a model to accompany their arguments.

Students will participate in a gallery walk, using the same procedures as before, in order to offer feedback and/or ask questions to guide the revisions of their arguments.

Teacher Notes: As students participate in the gallery walk, formatively assess students' arguments to identify any clarifications, explanations, or specific content that should be addressed with individual students, small groups, or whole group to help students make the necessary connections before revising their arguments. The [Signs and Symptoms of Anaphylaxis](#) resource may be useful to help students identify the body system associated with specific symptoms of the allergic response.

Students will revise their arguments.

Class Discussion:

- Engage in a brief class discussion where selected students share their models, explanations and/or arguments with the class
- Use the students' work to review and/or summarize the core ideas

	<ul style="list-style-type: none"> ● Make connections between students’ ideas presented in their work and accepted scientific explanations and terminology ● Refer back to the students’ initial questions and address any remaining unanswered questions
<p>Elaborating</p>	<p><i>Teacher Notes: This phase of the lesson continues with the phenomenon that some foods may not be good for you with a secondary phenomenon of diabetes. In this case, sugar is the nutrient the body needs that may also be harmful. The focus is on the sugar the cells and cell structures need to perform their functions for the benefit of the system. This phase of the lesson is organized so that students will first focus on a specific nutrient (sugar) and the interactions between cell structures in obtaining nutrients in order to make this needed material. Students will then examine how sugar is obtained by an organism (through consumption), the systems involved in this process, and the levels of organization the sugar passes through to reach a cell. Students will develop a model and construct an explanation of how the cell structures interact in obtaining and using this nutrient to perform basic processes. Lastly, students will focus on how the body systems interact when there is too much sugar in a cell.</i></p> <p>Phenomenon: Diabetes Sugar is one of the nutrients cells need to keep tissues, organs, and organ systems functioning properly. People with diabetes must monitor the amount of sugar they consume because too much sugar can be harmful.</p> <p>Teacher will introduce this phenomenon to students by reading the statement above, sharing an informational text about diabetes, or a personal narrative about someone’s experience with too much sugar.</p> <p>Students will ask questions related to sugar and diabetes. Possible student questions:</p> <ul style="list-style-type: none"> ● What is diabetes? ● How can a nutrient the body needs also be harmful? ● What happens to someone who consumes too much sugar? ● Where does sugar come from? ● How do you know someone has diabetes? ● Why does someone have diabetes? ● How does the body respond to sugar? ● Why does the body need sugar? ● Which cell structures need sugar? ● What would someone do if he/she could not eat certain foods but still needed those nutrients? <p>Students will use teacher provided print and/or digital text resources to obtain information to answer their questions about sugar and diabetes. Students will also use these resources as they complete the performance tasks in Parts A-C.</p> <p><i>Teacher Notes: Each of the following models, explanation, and argument will likely be similar to previous work developed in the Explore phase of the lesson. Previous student work depicting sugar as the nutrient could be posted or discussed to offer guidance or insight as the students develop their new models. Each part of this phase is connected to possible questions the students may have about sugar and diabetes.</i></p> <p><i>Part A allows students to examine specific cell structures (chloroplast and cell wall)</i></p>

that otherwise would not be part of the cells in the body systems under investigation. Students are able to investigate where sugar comes from--the cell structures that play a role in obtaining nutrients in order to make this needed material.

Part A: How does sugar get into the food we eat? (Where does sugar come from?)

Students will develop a model and construct an explanation of how cell structures (nucleus, cytoplasm, cell membrane, cell wall, chloroplast, lysosome, and mitochondria) contribute to the function of the cell as a system in obtaining sugar in order to grow, reproduce, make needed material, and process waste.

- Models will represent the interactions between cell structures to obtain sugar to perform basic processes (growing, reproducing, making needed materials, and processing waste) in the cell. [Cells use sugar (carbohydrate) as a structural component in cell structures (during growth, reproduction, and making needed materials) as well as the main energy source to maintain the needs of the cell (growing, reproducing, making needed materials, and processing waste).]
 - The model can depict the cell obtaining nutrients (i.e. matter) and energy to make needed materials (in this case sugar) and include information on the role of the cell structures in this process.
 - The model can depict the path of sugar within the cell. This would involve the cell structures and could include information on how the cell structures perform their role in relation to sugar.
- The explanation will describe the cell as a system of interacting structures working together to obtain nutrients and energy in order to make needed material, in this case sugar, and the interactions between cell structures in this process. Explanations could include why a cell needs sugar and the cell structures' roles in obtaining, transporting, and/or using sugar to meet the cell's needs.

Teacher Notes: The students' models and explanations should not include the detailed steps or biochemical mechanisms of photosynthesis or cellular respiration. These concepts are addressed in high school biology.

Part B: How does the body obtain sugar? Which cell structures need sugar?

Teacher Notes: Students will develop two models in this part of the Elaborate phase. These models can be combined with the model from Part A. Students can use their previous models, including the peer and/or teacher feedback, from the Explore and/or Explain phases to guide the development of the models for this phase of the lesson.

Students will develop a conceptual model representing the path of sugar through the subsystems of the body (organ systems, organs, and tissues) to reach a cell.

- Students will obtain and evaluate information, from teacher provided resources as well as peer and/or teacher feedback on previous models, to develop a conceptual model representing the path of sugar through the body to the cell system.

Students will develop a model and construct an explanation of how cell structures (nucleus, cytoplasm, cell membrane, cell wall, chloroplast, lysosome, and mitochondria) contribute to the function of the cell as a system in obtaining sugar in order to grow, reproduce, make needed material, and process waste.

- Models could depict the path of sugar within the cell. This would involve the cell

	<p>structures and could include information on how the cell structures perform their role in relation to sugar.</p> <ul style="list-style-type: none"> • This model will depict the interactions between the cell structures in obtaining sugar. <p><i>Teacher Notes: Depending on the students' thought processes and the perspective they are trying to represent, this specific model may or may not include the chloroplast and cell wall since these cell structures are not present with the cells of the body systems under investigation.</i></p> <p><u>Part C: What happens to someone who consumes too much sugar?</u> Students will construct an argument that systems of the body (cardiovascular, excretory, digestive, respiratory, muscular, nervous, and immune) interact with one another in response to too much sugar in the cells.</p> <p>Class Discussion:</p> <ul style="list-style-type: none"> • Engage in a brief class discussion where selected students share their models, explanations and/or arguments with the class • Use the students' work to review and/or summarize the core ideas • Make connections between students' ideas presented in their work and accepted scientific explanations and terminology • Refer back to the students' initial questions and address any remaining unanswered questions
<p>Evaluating</p>	<p style="text-align: center;"><i>Assessment of Student Learning</i></p> <p>Students will develop models and construct an explanation and argument to describe how cell structures, cells, tissues, organs and organ systems interact to maintain the basic needs of organisms. Student work will answer each of the following questions:</p> <p><u>Question 1</u> How would a cell respond to a nutrient it needs to perform basic processes (growing, reproducing, making needed materials, or processing waste)? <i>[The cell structures are going to perform their functions and interact in order for the cell to obtain the nutrient it needs to grow, reproduce, make needed materials and process waste.]</i></p> <ul style="list-style-type: none"> • Students will develop and use a model to construct an explanation of how cell structures (nucleus, cytoplasm, cell membrane, cell wall, chloroplast, lysosome, and mitochondria) contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste. <p><u>Question 2</u> In multicellular organisms, the body is a system of multiple interacting subsystems used by the body to perform various life processes including obtaining nutrients for use by cells. How are these subsystems organized in the body of a multicellular organism?</p> <ul style="list-style-type: none"> • Students will develop a conceptual model of how cells are organized into tissues, tissues into organs, organs into systems, and systems into organisms. <p><u>Question 3 (choose one)</u> How do the systems of the body interact with one another during the response to a nutrient perceived as being harmful?</p> <ul style="list-style-type: none"> • Students will construct an argument of how the systems of the body, including

	<p>cardiovascular, excretory, digestive, respiratory, muscular, nervous and immune, interact with one another to carry out life processes.</p> <p>How do the body systems interact with one another to obtain nutrients for a cell to perform life processes?</p> <ul style="list-style-type: none"> ● Students will construct an argument of how the systems of the body, including cardiovascular, excretory, digestive, respiratory, muscular, nervous and immune, interact with one another to obtain nutrients for cells to carry out life processes.
<i>SEP, CCC, DCI</i>	Science Essentials
Science and Engineering Practices	<ul style="list-style-type: none"> ● Asking questions and defining problems ● Developing and using models ● Engaging in argument from evidence ● Constructing an explanation
Crosscutting Concepts	<ul style="list-style-type: none"> ● Structure and function ● Systems and system models ● Cause and effect ● Scale, proportion and quantity
Disciplinary Core Ideas	<p>From <u>A Framework for K-12 Science Education</u>:</p> <ul style="list-style-type: none"> ● LS1.A: Structure and Function ● LS1.C: Organization for Matter and Energy Flow and Organisms

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:

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 activities.

Writing:

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.

Math:

1. Provide calculators as needed.
2. Provide graph paper as needed.

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 teacher should have clear and consistent guidelines for students working together. These guidelines should help students feel more comfortable working with other students in the class.
2. The teacher can then have students discuss as a class.
3. The teacher should have clear and consistent guidelines for class discussions. These guidelines should help students feel more comfortable participating in the discussion.
4. The teacher should post the list of reasons for people to get sick from food that they eat. Then the teacher can help students narrow it down to the food allergy portion of the lesson.
5. The teacher can use a video, article or story to introduce how people can get sick from food allergies.
6. The teacher should use intentional and flexible grouping to pair students. Best practice is to use data to drive student grouping.
7. The teacher should provide students with an organizer to assist in generating questions.

8. The teacher should consider giving students question stems to help them get started with generating questions.
9. The teacher can have students discuss actual food allergies. Have they experienced it or do they know someone with a food allergy?

Exploring:

1. The teacher should have clear and consistent guidelines for class discussions. These guidelines should help students feel more confident and be more likely to participate in the discussion.
2. The teacher should consider modeling reading a food label to the students.
3. The teacher should use intentional and flexible grouping to partner students. Best practice is to use data to group students.
4. The teacher should consider providing students with an organizer to record questions, research and ideas.
5. The teacher may need to assist students in narrowing down the questions that they have. This can help students focus their research and stay on topic of the lesson and standard.
6. The teacher should consider providing sources for students to use in their research.
7. The teacher should consider having some options for students to share their work in class. These options could include a gallery walk, presentations or using technology to share.
8. The teacher should consider providing an organizer to help students construct their model.
9. The teacher should provide a rubric that students can use to self-evaluate their assignment. This will increase student ownership.
10. The teacher should be sure to provide multiple ways for the students to communicate their knowledge of the material. These formats could include writing, drawing or designing a presentation.
11. The teacher should make sure that students do not get too in depth with their model. This can be determined based on student abilities and needs.
12. Students may need additional time to complete their models.
13. The teacher should consider a formative assessment. Then the teacher can review, re-teach or enrich as needed.
14. The teacher should consider giving sentence starters for the student argument.
15. The teacher should consider reminding students of the definition of a scientific argument and make sure that students know what constitutes evidence.

Explaining:

1. The teacher should consider providing an organizer for students to use in planning their models.
2. The teacher should use intentional and flexible grouping. Best practice is to use data to drive student grouping.
3. The teacher should provide students with a rubric to self-evaluate. This increases student ownership of their work.
4. The teacher should consider having some options for students to share their work in class. These options could include a gallery walk, presentations or using technology to share.
5. The teacher should consider a formative assessment. Then the teacher can use the data to review, re-teach or enrich as needed based on data.
6. The teacher should have clear and consistent guidelines for class discussions. This should help students feel more comfortable participating in the class discussion.
7. Students may need additional time to complete their model.

8. The teacher can use guiding questions to assist students in making their models.
9. The teacher should be sure to provide multiple ways for the students to communicate their knowledge of the material. These formats could include writing, drawing or designing a presentation.
10. The teacher should remind students of what a scientific argument is and what constitutes evidence.

Elaborating:

1. The teacher should consider using a video, story or article to engage students with the material.
2. The teacher could ask students if they have experience with someone with diabetes.
3. The teacher should consider providing an organizer and questions stems to guide student research.
4. The teacher should consider providing an organizer for students to use in planning their models.
5. The teacher should use intentional and flexible grouping. Best practice is to use data to drive student grouping.
6. The teacher should provide students with a rubric to self-evaluate. This increases student ownership of their work.
7. The teacher should consider having some options for students to share their work in class. These options could include a gallery walk, presentations or using technology to share.
8. The teacher should consider a formative assessment. Then the teacher can use the data to review, re-teach or enrich as needed based on data.
9. The teacher should have clear and consistent guidelines for class discussions. This should help students feel more comfortable participating in the class discussion.
10. Students may need additional time to complete their model.
11. The teacher can use guiding questions to assist students in making their models.
12. The teacher should be sure to provide multiple ways for the students to communicate their knowledge of the material. These formats could include writing, drawing or designing a presentation.
13. The teacher should remind students of what a scientific argument is and what constitutes evidence.
14. The teacher should consider providing sentence stems to students to guide the writing of their scientific argument.

Evaluating:

1. The teacher should consider giving students multiple options to express their knowledge. These options could include writing, drawing or designing a presentation.
2. The teacher should consider having students explain their models, data and reasoning as they move through the lesson.
3. The teacher should complete a formative assessment several times throughout the lesson and re-teach, review and enrich as needed.

Peanut Signs



Function and Nutrients Questions

Possible questions to guide students in obtaining, evaluating and communicating information to describe how cell structures interact to maintain the basic needs of cells and/or organisms.

Cell Membrane

1. What nutrients, or matter, enter and exit a cell through the cell membrane?
2. This structure is semi permeable (selectively permeable). How does this characteristic help the cell maintain the basic needs of the cell and organism?
3. How does the cell membrane interact with other cell structures to maintain the basic needs of the cell?
4. How does the cell membrane contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste?

Nucleus

1. How does the nucleus interact with other cell structures to maintain the basic needs of the cell and/or organism?
2. What nutrients, or matter, are used by the cell using the instructions provided in the genetic information stored in the nucleus?
3. How does the nucleus contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste?

Mitochondrion

1. How does the mitochondrion use nutrients, or matter, to help a cell grow, reproduce, make needed materials, and process waste?
2. How do other cell structures help the mitochondrion obtain the necessary nutrients it needs to perform its function within the cell?
3. How does the mitochondrion contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste?

Cytoplasm

1. What is the function of the cytoplasm in a cell system?
2. What nutrients, or matter, must pass through the cytoplasm to reach the cell structures that make up a cell?
3. How does the cytoplasm contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste?

Lysosome

1. What is the function of the lysosome in a cell system?
2. What is the role of the lysosome in making nutrients available to the cell?
3. How does the lysosome interact with other cell structures to maintain the basic needs of the cell and/or organism?
4. How does the lysosome contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste?

Chloroplast

1. How does the chloroplast use nutrients, or matter, to help a cell grow, reproduce, make needed materials, and process waste?
2. How do other cell structures help the chloroplast obtain the necessary nutrients it needs to perform its function within the system?
3. What needed material, or nutrient, is produced by the chloroplast that is used by the cell and/or other cell structures?
4. How does the chloroplast contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste?

Cell Wall

1. What is the function of the cell wall in a cell system?
2. How does the cell wall help to maintain the basic needs of a cell?
3. How does the cell wall contribute to the function of the cell as a system in obtaining nutrients in order to grow, reproduce, make needed materials, and process waste?

Function and Nutrient Graphic Organizer

Cell Structure	What is the function of the cell structure?	How does the structure help the cell function as a system in obtaining nutrients to grow, reproduce, make needed materials and process waste?
nucleus		
cell membrane		
cell wall		
cytoplasm		
mitochondrion		
chloroplast		
lysosome		

Possible Digital Resources:

- U.S. Department of Agriculture, Food and Nutrition Services--[The Food Allergy Book: What School Employees Need to Know](#)
- Kids with Food Allergies.Org--[So What's the Big Deal About Food Allergies](#)
- Nutrition.gov
 - [What's In Food](#)
 - [Food Allergies and Intolerances](#)
- MedlinePlus
 - [Diabetes](#)
 - [PKU](#)
- National Institute of Health: Genetics Home Reference
 - [PKU](#)
- U.S. Department of Health and Human Services/National Institute of Health: National Institute of Diabetes and Digestive and Kidney Diseases
 - [The Digestive System & How it Works](#)
 - [Celiac Disease](#)
 - [Lactose Intolerance](#)
 - [Diabetes](#)

[Return to Instructional Segment](#)