Category III Life science examples

Providing variety of phenomena

Food, Energy, and Growth - Example 1
The module includes two phenomena for the idea that food provides the molecules that serve as building materials for organisms:

- Students are reminded that as they grow, their weight increases and their bones and muscles get longer even though the food they eat does not contain human muscle or bones (pp. **45–46s**).
- Then students are asked to consider several situations in which people gain weight from eating food but not from drinking water (pp. **49–50s**).

Both could help make the idea plausible to students and are explicitly linked to the idea, as indicated by highlights on the pages noted above.

GROWING

Lesson 12

Most people know that you need to eat well to grow well. But just what does this mean? And how does food help a person grow?

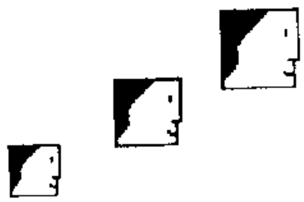
Throughout this unit we've said that food does two important things for living organisms (yes, not only humans, but dogs, cats, insects, bacteria, even plants!) It provides the energy they need for all of their body's activities, and it provides the raw materials needed for growing and repairing damaged body parts. But what does it mean to say that food provides raw materials for growing?

Key Question	How does food help a teenager get taller? How does food help a lizard regenerate a tail that gets torn off? How does food help a plant increase its size?

This key question, which will be examined as this lesson continues, assumes that students realize that when they grow, they actually have more material in their body than before—it's not a case of getting larger like a balloon expanding. The questions that follow the key questions are intended to help students recognize this.

The important idea for this lesson is that some material from food gets incorporated into bodies (cells) as we grow.

As you grow between the ages of 5 and 15,
you get much bigger and your weight increases.



Your bones get longer.
Your muscles get longer.
Do they just stretch?

As your bones and muscles get longer, you **need more skin to cover them**. Your body needs more blood to move food and oxygen to all of its cells.

Does your skin just stretch to cover your larger body? Does your blood just "thin out" to move over longer distances?

Let's think about one muscle as it grows:
As it gets longer, does it weigh more?
Is there more muscle material in it if it weighs more?
Do you think that your body adds more muscle material to the growing muscle?
Where do you think that extra muscle material comes from?

* * *

Yes, it comes from food. But the tricky problem is: **Since you don't eat human muscle material, how do you get it?** How do the animal and plant parts you eat become part of you? How can food materials that come from animals and

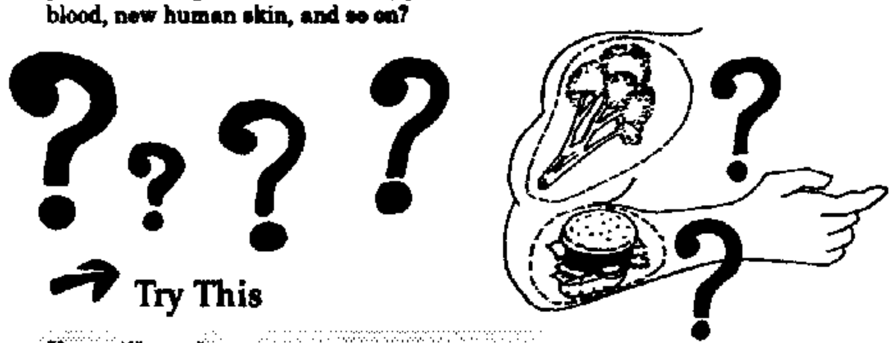
Lesson Statement: Students go back to the model of the digestive system they made in Cluster 2 and use the amino acids from digested fodds to make new protein. They make different arrangements of various numbers of objects to simulate they sythensis of proteins from amino acids.

Purpose: To understand how our bodies grow by adding new materials to cells.

Approximate Time: 1 or 2 class periods

Lesson 12

plants be changed into human body parts—human muscle material, new human blood, new human skin, and so on?



Try This

You will need:
- model from Cluster 2, Lesson 8
- "molecules" of protein, fat, and carbohydrate
- pins

Get out the model of the human digestive and circulatory systems you made in Cluster 2. Find the piece of different shaped paper that represent each of the basic components of food—the carbohydrates, the proteins, and the fats.

A. Place these pieces in the small intestine. They will represent, say, some broccoli and hamburger you just ate (plant and animal parts.)

B. Then pretend that the food is being digested: Separate the food particles into their digested products, showing that proteins are digested into _______, carbohydrates are digested into _____, and fats are digested into _______.

C. Move these digested particles through the wall of the small intestine into the blood stream, and give them a ride to, say, a muscle cell in your forearm.

What happens to them in the cell?

This is the big question. We already know what happens to glucose in the cell (what?) But what happens to amino acids?

Think this through for a minute. If your body needs new material to add to muscles as they grow, but you can't add the cow muscle materials in hamburger to your own muscles, where could this new material come from? From these amino acids? Yes. Just as proteins are broken down into amino acids, amino acids can be built back up into new proteins, the exact ones you need to make new muscle material! Your cells are tiny architects, building new muscle structures from the raw materials—the building blocks—of amino acids.

D. Use the amino acid pieces of paper in your model to build new proteins by taping them together in new ways. In your model, these new proteins can be thought of as new muscle material.

46 *Michigan Department of Education*

Lesson 12

The role of vitamins and minerals in growth: Vitamins and minerals are essential for making the chemical reactions occur that combine amino acids into new proteins. They are not incorporated into the new proteins, but are co-factors with enzymes to make these reactions occur. Vitamins cannot be produced by the body, so they have to be eaten; and some are not stored in the body for very long, so they have to be eaten every day. Certain minerals have other functions also, such as calcium in the production of bone matter, iron in the production of blood hemoglobin, and phosphorus for nerve firings.

WEIGHT GAIN AND WEIGHT LOSS

Lesson 13

↓↓ ↑↑

All living things undergo continuous change during their brief span of life on earth. Fish get bigger, trees add new branches, crayfish regenerate damaged or lost parts, and people increase in size. In this lesson, you will use what you learned earlier in this cluster to help you understand the balance in your body between what goes in and what comes out.

Key Questions	Why does the food you eat make you grow and gain weight sometimes but not other times? What role does exercise play in weight gain and weight loss?

Allow students to speculate about these key questions, without providing answers at this point in the lesson.

Imagine two identical twins, Emily and Felicia. Each weighs 120 pounds. Emily is thirsty and so she drinks a pound (about a pint) of water. Felicia is very hungry so she eats a pound of spaghetti. For the purposes of this activity, consider all other food, water and activities of Emily and Felicia to be exactly the same unless indicated otherwise. Here is what happens to the weights of the two girls:

	Weight before eating or drinking	*Weight right after eating or drinking*	*Weight after one day*
Emily (water)	120 lb.	121 lb.	120 lb.
Felicia (spaghetti)	120 lb.	121 lb.	120.2 lb.

In answering questions 1-4, students are asked to do more than compare the effects of eating and drinking. They should speculate about what actually happens to food and water inside the girls' bodies. Most answers will probably be incomplete at this point. Note where students difficulties are.

Do you notice any pattern here? Both girls gained weight right away but lost most of that weight within a day. Felicia, though, didn't lose quite *all* of the weight she had gained.

1. Why do you think Emily did not show any weight gain after one day? Explain what Emily's body did with the water.

2. Why do you think Felicia showed a slight weight gain after one day? Explain what Felicia's body did with the spaghetti.

1. Emily's body used the water to help remove waste products through urine and feces; she lost the water in these ways over the long term, and returned to her original weight.

2. Felicia's body used some of the spaghetti (the protein) to build new body cells, adding to her weight. Most of the spaghetti, however, was used for energy, and the products of cellular respiration (carbon dioxide and water) were exhaled and excreted.

On a different day, Emily and Felicia both decided that they want to lose weight. Emily sat in a sauna for half an hour. She perspired a lot. Felicia ran for half an hour. She perspired a lot too. Here is what happened to their weights:

Lesson Statement: Students analyze several hypothetical cases of weight gain and weight loss and decide what factors caused each effect. They make predictions for specific situations and write a plan by which they can attain their own goals. They explore the weight balance of all things that go into one's body and come out.

Purpose: To help students understand weight gain and weight loss both with regard to short term effects and long term effects.

Approximate Time: 2 class periods

Lesson 13

3. Mostly by drinking water to replenish what they lost through perspiration—our bodies demand this from us after we exercise!

4. She needed extra energy to make her body work faster than normal, so she used some of her stored body fat for that energy. It was changed to carbon dioxide and water, and exhaled. She actually lost weight by exhaling CO_2!

5. (see table)

6. Long term weight gain: eating food that helps build new cells (proteins) or that can be stored as body fat. This food intake has to be beyond what the body requires for energy.

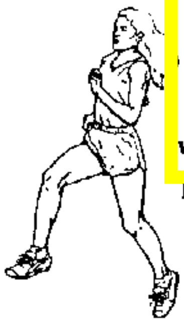
Long term weight loss: exercise that uses stored body fat for its energy content, changing it into carbon dioxide and water. The carbon dioxide is exhaled, losing its weight.

b. ones that only involve water intake or loss

	Weight before sauna or running	*Weight right after sauna or runnng*	*Weight after one day*
Emily (sauna)	120 lb.	118 lb.	120 lb.
Felicia (running)	120 lb.	118 lb.	119.9 lb.

3. How did the two girls gain back the weight they had lost?

4. Notice that Felicia didn't quite gain all her weight back. Why? What happened to that weight?



Both girls lost weight shortly after their activities by losing mostly water due to perspiration. They gained it back by drinking. Felicia, though, also used some *stored* food for energy needed for running. Through cellular respiration, it changed into water and carbon dioxide, and left her body, reducing her weight.

In general, you can do many different things that can cause you to gain or lose weight. Some of them make you gain or lose weight only in the short term. Others cause long term or permanent weight gain or loss. Let's try to sort out which activities have which sorts of effects.

5. Look at the activities listed in the table below. Think about what things cause only short-term weight gain or loss and what things cause long term weight gain or loss. Then copy the following table and fill in each space with one of the following: weight gain, weight loss, no effect or not sure.

Activity	*Short term effect*	*Long term effect*
Eating tuna fish	[weight gain]	[weight gain]
Eating french fries	[weight gain]	[weight gain]
Eating pasta	[weight gain]	[weight gain]
Drinking skim milk	[weight gain]	[weight gain]
Drinking water	[weight gain]	[no effect]
Playing basketball	[weight loss]	[weight loss]
Sitting in the sun (& perspiring)	[weight loss]	[no effect]
Sleeping	[weight loss]	[weight loss or no effect]
Going to the bathroom	[weight loss]	[no effect]

6. a) Study your answers and make a statement about what sorts of activities lead to long term weight gain or weight loss.

b) What sorts of activities have no long term effect?

Calories: We deliberately have not talked about calories in this lesson, allowing the idea of calories to come up as a question from students instead. Many students are familiar with the idea of "counting calories" for dieting, or have seen the caloric value of a serving of food on package labeling. "Calorie" (with a capital C) is a common unit of energy that refers to the amount of energy released from the food when it is oxidized in the body—one Calorie is equal to the amount of energy needed to raise one kilogram of water one degree Celsius. In dieting, people often try to restrict the amount of calories (Calories) they eat, which is not the same, of course, as restricting only the quantity of food eaten, since some foods have more calories per ounce (or

Lesson 13