Category III Life science examples

Providing variety of phenomena

Food, Energy, and Growth - Example 2
For the idea that food provides fuel for all organisms, the module includes two other phenomena, but they are linked to only part of the idea. Students observe that both a burning marshmallow (p. **2s**) and a butter “candle” (pp. **40–41s**) give off light and heat, but their observations are not extrapolated to *all* organisms, only to humans (as indicated by highlighted parts of the pages noted above).

FOOD STORES ENERGY — *Lesson 1*

We eat for many reasons. The most important is energy.

All living things require energy for life activities. People need energy to run, to talk, to lift, to smile, to wink—any time we move our muscles and bones. We need energy to pump blood through our body (the heart is a muscle, too!) We need energy to send nerve signals around our bodies, and to repair parts of our body when we're injured or sick. Food stores the energy we need for all of these life activities.

Can you think of something you could do to show that food stores energy?

Allow students time to puzzle about this. You might want to write their ideas on the board. If students come up with a good approach, let them try it.

Try This

If you have roasted marshmallows before, you know how quickly they will catch on fire. Would burning a marshmallow show that the marshmallow stores energy? What do you think? You might want to try burning a marshmallow again, just to remind yourself of the experience.

To try it, you will need a marshmallow, a shish-ke-bob stick or something else to hold the marshmallow, and matches. ***Be very careful to keep the flaming marshmallow away from everyone's hair and face.***

A. Light the marshmallow and watch what happens. Record observations from all of your senses (sight, smell, hearing, touch, and taste.)

Think, write, and discuss

1. What evidence do you have that marshmallows store energy?
2. a) When the marshmallow burned, did it give off more energy (more light and heat) than the match did that was used to light it?

   b) Where do you think all that energy came from?

1. More light and heat are given off when the marshmallow burns than the match gave off. This energy must have come from the marshmallow.

2. There is extra energy that did not come from the match, since the marshmallow burns longer. This energy comes from the marshmallow itself, not the match. It is not *produced* by the marshmallow, but is *released* during the chemical change of burning.

Lesson 1

Lesson Statement: Students will observe energy released from a burning marshmallow and relate this to their body's need for energy.

Purpose: To introduce the concept that food provides all the energy needed for all "life activities."

Approximate Time: 1 class period

See Advance Preparation for this lesson, in blue pages prior to this cluster.

HOW YOUR BODY ACTUALLY GETS ENERGY OUT OF FOOD

Lesson 11

Have you ever heard the statement: "Your body burns food to get energy?" Have you ever thought about what this means? Take some time to think about it now: What connections can you see between burning paper or wood and what your body does when you exercise? Share your thoughts with your classmates.

Key Question	How does the energy in food become energy that your body can use?

Since it is difficult to investigate in our own bodies how we might really "burn food," we will investigate it by first burning a sample of food *outside* of our bodies, and then making a few comparisons with what happens to food *inside* our bodies.

Try This: Build a *butter* candle

You will need:

- butter
- cotton string
- Petri dish
- 250 ml Pyrex beaker
- scissors
- matches
- BTB solution

A. Cut about one inch off from the end of a stick of butter and place it in a Petri dish. Shape the butter into a small mound.

B. Using a pencil or other sharp object, poke a hole into the top of the mound of butter. The hole should go about halfway through the mound from top to bottom.

C. Insert a 1" to 2" piece of cotton string into the hole and secure the string by gently pushing and then pinching the butter around it. Only the very end should be exposed, like a candle wick.

D. Light the wick and observe your candle. Record your observations.

You can burn a peanut or walnut as well as this butter — all produce carbon dioxide. But using the butter candle rather than a flaming peanut sets up question #3 on p. 41, which is important to help establish the idea that this is a chemical change. (Margarine does not work well as a substitute for butter.)

The butter candle also produces water, which can be seen easily by placing a cold plastic plate over the candle and noticing the noisture that condenses. This is not done in this activity, nor is the production of water discussed at length, because it is difficult to establish some evidence for students of water production in the cells. The water we breathe out, for example, is not necessarily produced in cells during cellular respiration; we are constantly drinking water and there is water all over our bodies, so there is naturally water vapor in our lungs.

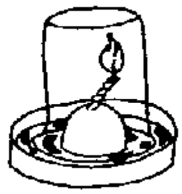
Lesson 11

Lesson Statement: Students make and observe a burning butter candle. They compare the reactants and products of this energy-producing process to the same process in their own body.

Purpose: To develop an understanding of the process of cellular respiration by comparing it to burning butter.

Approximate Time: 2 class periods

E. While the candle is still burning, test the air around it by pouring a little BTB into the Petri dish around the base of the butter candle. Cover the candle and Petri dish with a 250 ml beaker, so the spout on the beaker is under the BTB. Let it continue **until the flame goes out. Then swirl** the Petri dish, candle and beaker slightly and **look for any color change in the** BTB. Record your observations.



Think, write, and discuss

1. What evidence do you have that the burning butter candle is like whatever is going on inside your body when you use food. Think about Lesson 1. Describe your evidence in terms of *energy* and *substances*.

2. When the butter candle burned, it released light and heat—both forms of energy. Where do you think that energy was before the butter burned?

3. a) When you watched the butter candle, you saw it *burn* and *melt*. Which of these changes do you think caused the carbon dioxide to form?

   b) Do you think that what happens to the butter you eat is a chemical or physical change? Why?

4. What do you think would happen if you let the butter candle continue to burn with the beaker over the Petri dish? Do you know what substance in the air is needed for paper, wood, or even butter to burn?

Summarizing what you know

So what might be going on inside your cells when you need energy? What do we know so far? From Clusters 1 and 2, we know that

- Digested food goes to your cells.
- Oxygen goes to your cells.

So far in Cluster 3, we know that more carbon dioxide comes out of our body when we exercise, so can we conclude that

- Carbon dioxide is produced in cells when food is used for energy.

Also, from the difference between burning and melting, we know that

- Whatever is happening in your cells is a chemical process.

1. releases energy; produces carbon dioxide.

2. stored in the butter. Some students may suggest that the energy was in the flame that lit the candle—see comment below.

3. a) Burn

b) It's interesting to listen to students' views on this. Allow them to debate it for awhile. Ask them whether gas is given off when other things melt, like ice. We're trying to establish the important idea that this process of releasing energy involves a chemical change (actually many chemical changes.) Melting is only a change in state and, in fact, the butter **absorbs** energy from the burning process as it melts. Burning is a chemical process that changes the butter into new chemical substances.

4. Oxygen is needed. Eventually, the oxygen under the beaker would all be used up and the candle would go out.

As the candle burns under the beaker, students may notice the level of BTB inside the beaker going up. This is not the crucial observation (the color of the BTB, indicating released CO_2, is) but some students might ask about this. It is because there is more oxygen used by this chemical reaction than carbon dioxide produced, reducing the number of molecules inside the beaker, and therefore reducing the pressure. The outside air pushes up the water from the outside.

Where does the energy come from? Energy released by the butter, both in the candle and inside one's body, is stored as chemical energy in food—a type of potential energy. The energy released is not produced by changing matter into energy. Instead, you can think of energy as being "locked up" in the glucose when it is made by plants—this energy originally coming from the sun—and unlocked in cellular respiration. Students may understand this from their earlier studies of photosynthesis or energy flow in ecosystems.

But the concept of potential energy is still often vague. Sometimes students believe that the energy they see in the candle simply came from the match that was used to light it. If this is what

(continued on next page)

Lesson 11