

Dancing the relationship between photosynthesis and respiration

by Renee Schwartz

Background:

This lesson was developed as part of our end-of-year class play about the human body. It followed from our photosynthesis lesson which was also a whole body lesson. That lesson involves silver pieces of felt with the letters of the elements written on them, safety pins, and a large green cloth. Some students are elements; some students are sunlight. Students act out photosynthesis by having C, H, or O pinned to their shirts (or being sunlight), standing on the green cloth (the chloroplast), holding hands to form molecules of H_2O (brought up through the vascular tissue from the root system) and CO_2 (brought in through the stomata), having their bonds broken by the energy from the sunlight which comes rushing in and breaking them apart, forming new bonds, and either staying in the leaf as a glucose molecule or floating away as O_2 .

This was inspired by the description of a lesson in

Title: In Search of Understanding: The Case for Constructivist Classrooms

Author: Jacqueline Brooks & Martin Brooks

Publisher: Pearson; 2nd edition (January 8, 2001)

Language: English

ISBN-10: 0130606626

You will need the following supplies:

very large piece of green cloth

a box of safety pins

36 square pieces of silver or grey felt, labelled as follows:

C (6 squares) H (12 squares) O (18 squares)

In order to make a full glucose molecule ($\text{C}_6\text{H}_{12}\text{O}_6$) you would need 36 students to be elements plus several to be sunlight. You can also do the activity on a smaller scale, even as small as having just one molecule of water and one molecule of carbon dioxide, simply to let your students experience how the product, and by-product, are formed.

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My goal with the following lesson was to build on that acting out of photosynthesis and develop a way to act out the relationship between photosynthesis and respiration. We used only a single chime as a prop. It was one of the most successful parts of the class play and ended up being an interpretive dance which we set to background music, acting out the continual interdependence of plants and humans. One student, who was the plant, sewed his own costume, creating a cape covered in green leaves. The lungs were two students dressed in white. The heart was a student dressed in red, and the red blood cells were students all in red who were carrying large red blood cells made of hula hoops outlined in foam pool noodles and swaddled in red fabric.

Arrangement:

This lesson needs a large classroom space or an outdoor space such as a blacktop.

It is designed for seven students but can be adapted with many more students playing the parts (multiple students playing plants, multiple students breathing in as lungs and running as red blood cells) or with multiple sets of students taking turns, or simultaneously acting out the steps. It could also be adapted by having many students on the blacktop to represent the different parts of the body that the red blood cells have to get to.

One student is the plant and holds a single chime and a mallet for striking it. One student stands a good distance opposite the plant and is the heart. Two students are the lungs and they stand one on either side of the heart. Three students are the red blood cells and they stand near the lungs ready to run. They must have a significant amount of space in which to move around. The heart is facing the red blood cells, not the plant.

Lesson:

Review the photosynthesis lesson with students. Remind students that plants need three things to conduct photosynthesis: water, carbon dioxide, and sunlight. Discuss how the plant gives off oxygen, which we need to survive, and how we give off carbon dioxide, which the plants need to survive. Tell students that together they will be acting out the relationship between photosynthesis and respiration.

Arrange the students as indicated. Ask them if they know how choreography works. Explain that professional dancers stay all together in their dances by counting out the beats which make up their song. Each dancer knows that he/she must listen for the correct beat and that the beat of the dance determines their movements. Demonstrate how a count of 8 sounds. Then teach each child his/her part and what count to listen for:

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- 1 The plant conducts photosynthesis and makes a sugar, which is indicated by a single ring of the chime. This means that the plant is also now giving off oxygen.
- 2 The two lungs breathe in, which is indicated by an expansion of their arms. The lungs are now taking in oxygen.
- 3 The oxygen passes from the thin walls of the lungs into the blood which is circulating through the heart. The red blood cells are the cells of the blood which carry the oxygen. The heart pushes the blood through the whole body, so that it can carry oxygen throughout. This is indicated by the heart turning to face the three red blood cells and pushing his/her arms out abruptly as if to shove them (without actually touching them).
- 4/5 For two beats, the red blood cells run all over the space behind the heart and lungs. This part of the blacktop is representing the human body. Red blood cells need to carry oxygen to the entire body. When I acted this out originally, I ran around the blacktop yelling “red blood cells take it to the whole body” and they had to catch me, which is very engaging for student as well. The idea is to be as active as possible, to show how much work the heart is having to do to push the blood that far.
- 6/7 For two beats, the depleted red blood cells need to travel back to the heart. They are now carrying carbon dioxide (a by-product given off by the mitochondria) which needs to pass through the thin walls of the lungs to be transported out of the body through the exhalation.
- 8 The lungs bring their arms in relaxed fashion back to their sides, to show that they are contracting and breathing out the carbon dioxide. The plant immediately uses the carbon dioxide and at beat 1 rings the chime again. The cycle is then repeated as many times as the students allow. They also enjoy switching parts and repeating the skit.

This is very successful with the teacher slowly chanting the beats of 8. It can also be done with a piece of background music (we used a piece from a Music Together CD that the general music teacher was using with the students) but it still works best if the teacher’s voice can be heard above the music keeping the count.

Look around you, if you are doing this lesson outside, and take a minute to look at all of the plant life that you can see. Give students a brief space in time to consider how completely dependent they are on all of those plants. We cannot survive without them *at all*.

The most important element of this lesson is that humans and plants are completely interconnected. However, by acting it out, several other points become clear. These are mainly that the red blood cells carry the oxygen and they have a long way to travel in not much time, and the heart is very strong.

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Extensions:

Follow this lesson with more information about the human respiratory and circulatory system. Inform the students how many times the heart beats per minute and how many times the heart beats in a person's lifetime. Students will also begin to draw conclusions of their own, so give them time to do this by asking "What does this make you think of?" It is readily apparent to students why people die when they drown. Since no new air is getting in to the body, there is no fresh supply of oxygen reaching the body's cells. Students will also immediately see why the heart has four chambers, since so much is going on all the time. It is interesting to raise questions about the blood and show pictures of actual red blood cells and the other two types of cells which make up most of our blood (white blood cells and platelets). Students may also like to see pictures of the color of a red blood cell rich with oxygen versus a red blood cell which is depleted of oxygen. Students will understand why your heartbeat is faster when you exercise -- more oxygen is needed for your muscles -- and this is a good time to get out stethoscopes and have students listen to each other's heartbeats before and after exercise. Students can graph their heart rates before and after exercise or average them to see the mean, median, and mode.

Any information that you wish to provide about the circulatory and respiratory systems will be more interesting to the students after they have physically acted it out. Carefully consider what facts and information are necessary to give *before* the activity and what facts and information will be more relevant to students *after* the activity.