Making a Large Leaf Model
Teacher Preparation

The class size model of the leaf helps the students to visualize where photosynthesis occurs in the leaf. This model is a very simple representation. It is important that the students know and understand the reactants and products of photosynthesis and what role each part of the leaf plays in the process.

CDL.7.B.17 Describe the structure and function of the major parts of a plant: roots, stems, leaves, flowers (This lesson involves leaves only)
CDL.7.B.18 Relate the structure of plant tissue to its function: epidermal, ground, and vascular

Objectives:

Students will:

- Examine a leaf model
- Know the basic structure of a leaf
- Relate the structure to the function of a leaf during photosynthesis
- Write a summary of the relationship of the structure of plant tissue to its function as it relates to photosynthesis

Materials per classroom

- 2 pieces of green butcher paper (1.3 m long) or 1 green shower curtain or vinyl tablecloth (or one sheet of green and one sheet of bubble wrap)
- 2 sheets of clear plastic sheeting (.91 m X 1.3 m long)
  (Plastic sheeting usually comes in 36" width which equals .91 m!)
- permanent green marker
- 8-10 brass fasteners
- scissors
- clear plastic tubing (1.3 m) or rope or cording (1.3 m)
- clear tape

Materials for Elements and compounds (for use with large leaf model)

- Colored paper---construction paper or copy paper, four different colors---laminate them for extended use!
- marker

Preparation Tips:

If using a vinyl shower curtain, it can be folded in half and cut.

The plastic sheeting usually comes in 36" (.91 m) width so that is convenient to use for the overall width of the leaf.

Procedure:

1. Layer the sheets on top of one another as follows:

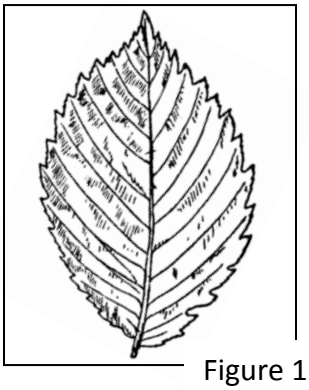


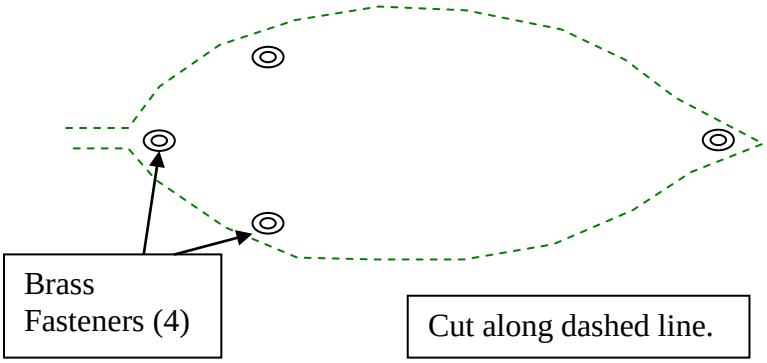
Figure 1

Layer	Sheets	Represents
Top	Clear	Upper Epidermis
Second	Green	Palisade Layer
Third	Green or bubble wrap	Spongy mesophyll
Bottom	Clear	Lower epidermis

2. Use the marker to trace a leaf, including a petiole, on the top clear layer. The leaf shape should just fit inside the sheet. See Figure 1 above.

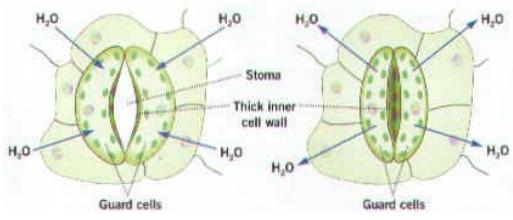
3. Insert the tubing or cord (vein) between the second and third layer of the leaf. Tape the other end of the tubing or cord to the third layer (green sheet or bubble wrap). Let the end of the tubing extend out of the petiole about 3 cm. Attach the layers using brass fasteners that are placed about 3-5 cm inside the leaf edge. Place fasteners at the petiole end approximately 20 cm apart. Put one fastener at the tip end. Use scissors to cut out the leaf shape**. See diagram below.**

Diagram for Cutting Large Leaf



4. Remove the fastener from the tip end of the leaf only. Label each layer with the names in Step 1.

5. On the lower epidermis, draw as many stomata as will fit on your leaf. Using the green permanent marker, trace the stomata on the bottom clear layer using the template provided.



Graphic reference
http://www.biologyjunction.com/leaf_stomata_lab.htm

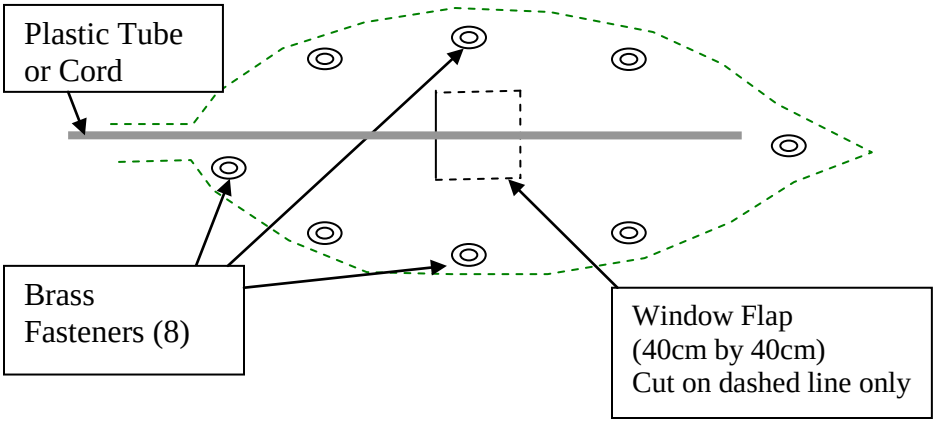
6. On the lower epidermis create open pores by cutting out the vinyl between the open guard cells. These openings allow for the exchange of gases.

7. Draw chloroplasts on the second layer (green sheet) with the green permanent marker. Trace as many chloroplasts as will fit on the sheet. Use the chloroplast template provided.

8. Cut a window flap about 40 cm x 40 cm in the clear upper epidermis layer so that students can lift up this layer to view the chloroplasts in the palisade layer.

9. Attach the layers using brass fasteners so that the layers will stay in place. **See diagram below.**

Diagram of Finished Large Leaf Model



9. Make element and compound circles to use with leaf model. Cut out 8 circles with a diameter of 4 cm from colored paper. (White, yellow, red, and blue) Use the circle template provided.

4 cm diameter circles (Cut 2 circles of each)	Front side of circle	Back side of circle
white	oxygen	O_2
yellow	carbon dioxide	CO_2
red	glucose	$C_6 H_{12} O_6$
blue	water	H_2O

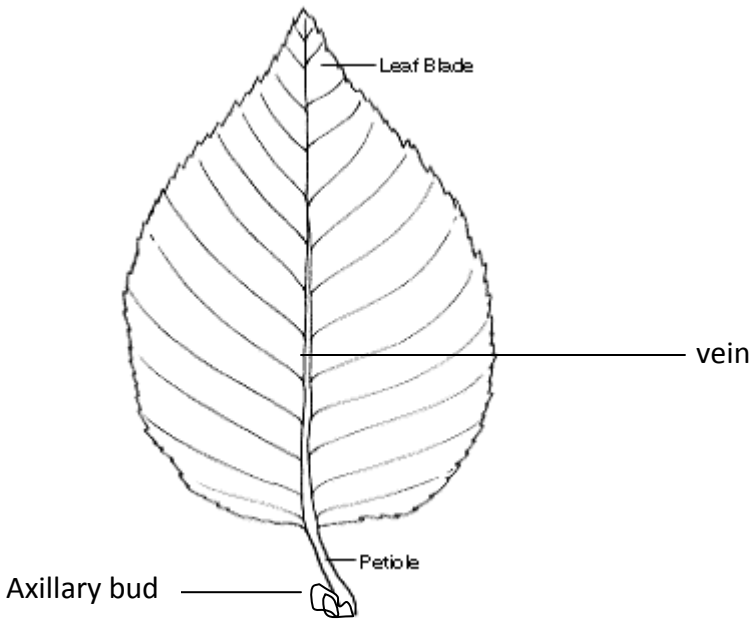
Laminate the circles for extended use!

10. Use the sheet "Teaching Strategies to Use with the Leaf Model".

Teacher Background Information to Use with the Leaf Model

CDL.7.B.17 Describe the structure and function of the major parts of a plant: roots, stems, leaves, flowers (*This lesson involves leaves only*)

A SIMPLE LEAF



Petiole: The stalk of a leaf that attaches the blade to the stem.

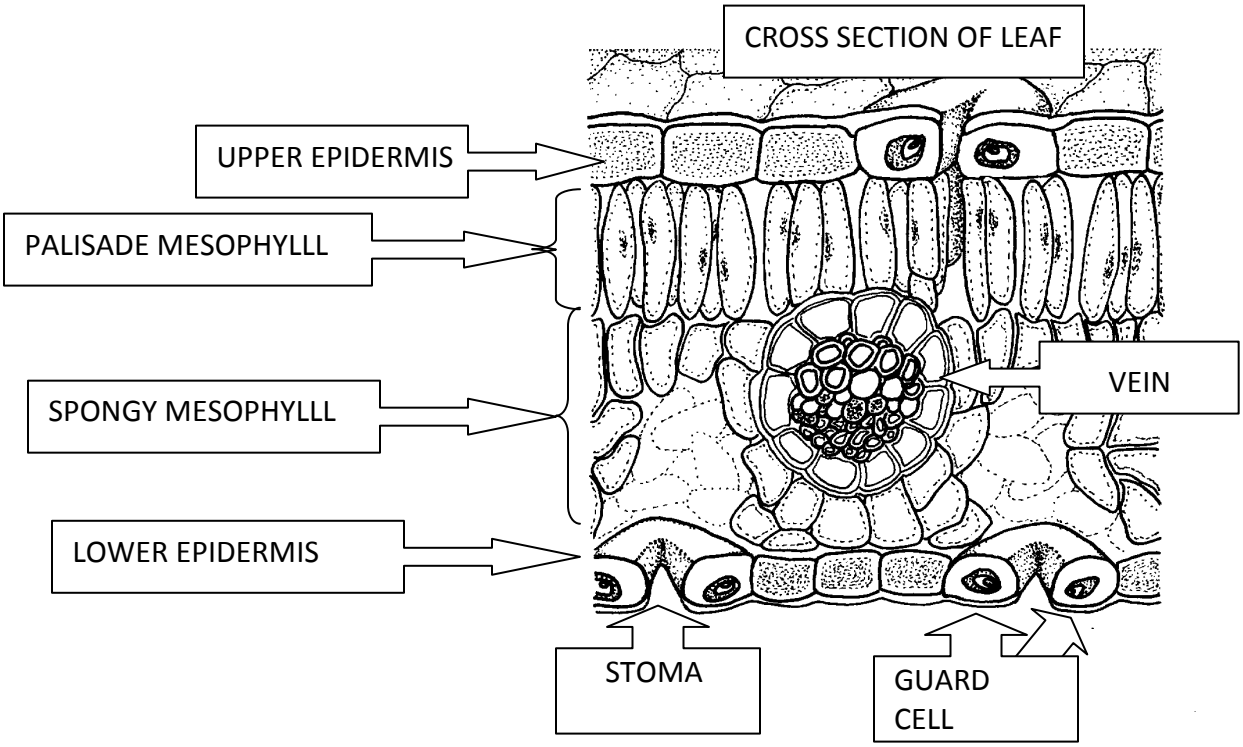
Leaf blade: The broad, expanded part of a leaf that serves to capture light.

Axillary buds: Buds located where a leaf joins a stem.

Vein: Vascular bundles which consist of xylem and phloem tissue give support to the leaf and also transport food and water.

CDL.7.B.18 Relate the structure of plant tissue to its function: epidermal, ground, and vascular

Plants are organized into tissue systems: epidermal, ground, and vascular. Leaves, as part of a plant, include these three tissue systems. The epidermal tissue is like the "skin" of the leaf because it consists of the outermost layer of cells. The vascular tissue is similar in function to the "bloodstream", transporting water and nutrients throughout the leaf in the veins. The ground tissue composes the remaining tissues of the leaf. The ground tissue is where most photosynthesis occurs (mesophyll) and some of it also functions to support the plant structure. Diagram from http://biodidac.bio.uottawa.ca/



Upper Epidermis: translucent tissue that allows light to pass through it to reach the mesophyll also protects the internal tissues.

Palisade Mesophyll: contains the majority of the chloroplasts so photosynthesis occurs here.

Spongy Mesophyll: provides space for the exchange of gases during photosynthesis.

Lower Epidermis: Most of the stomata (thousands per square centimeter) are located in the lower epidermis. Although most of the cells of the lower epidermis resemble those of the upper epidermis, each stoma is flanked by two sausage-shaped cells called **guard cells**. These differ from the other cells of the lower epidermis not only in their shape but also in having chloroplasts. The guard cells regulate the opening and closing of the stomata. Thus they control the exchange of gases between the leaf and the surrounding atmosphere

Teaching Strategies to Use with the Large Leaf Model

1. Peel back the upper epidermis (a layer of clear sheeting) to reveal the chloroplasts. Chloroplasts are mainly located in the palisade mesophyll and this is where most photosynthesis occurs.

2. Turn the leaf over to examine the stomata. Some stomata are open and some are closed.

3. Have the students pass CO_2 molecules (poster board circles) through the stomata.

4. Examine the vein (cording) that runs down the center of the leaf, delivering water to the leaf from the roots of the plant and moving the carbohydrates through the plant.

5. The water (more poster board circles) inside the leaf is released from the vein through osmosis.

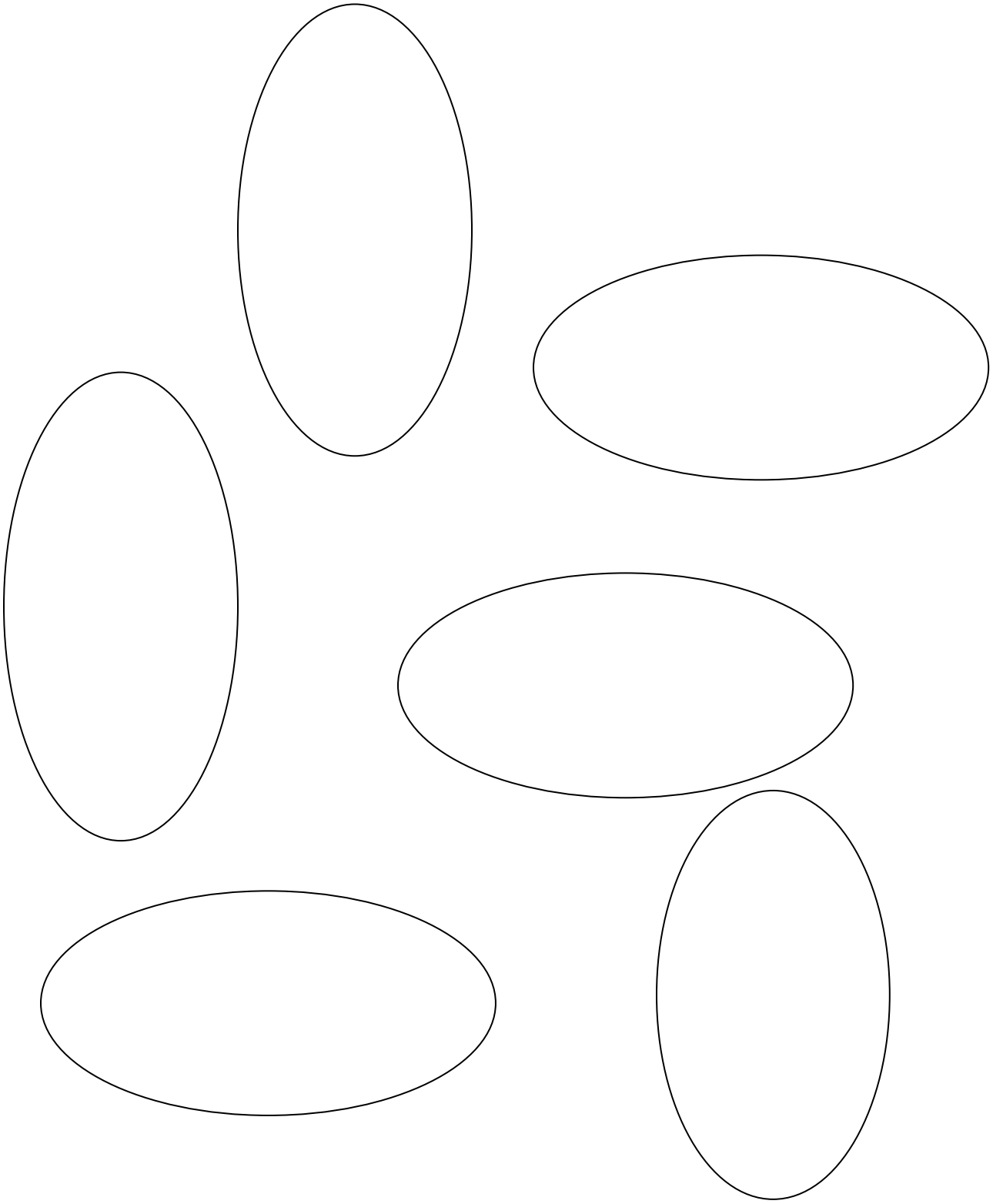
6. This initial examination demonstrates that the reactants of photosynthesis, water and carbon dioxide, along with chlorophyll, are available within the leaf.

7. Turn the leaf back over to the top side…where the process of photosynthesis takes place. Light energy shining on the leaf triggers a chemical reaction with the carbon dioxide, water, and chlorophyll. The carbon dioxide (which enters the leaf through the stomata) and water (which enters through the vein) are represented by poster board circles within the model, but the chlorophyll is just assumed to be present within the chloroplast. The interaction of the light energy, chlorophyll, water and carbon dioxide produces oxygen (O_2) and glucose ($C_6H_{12}O_6$), which are represented by poster board circles---the oxygen passes out of the leaf through the stomata and the glucose is stored within the leaf, stems, and roots.

8. A good assessment is to have the students manipulate the reactants and products and explain what is happening in the leaf.

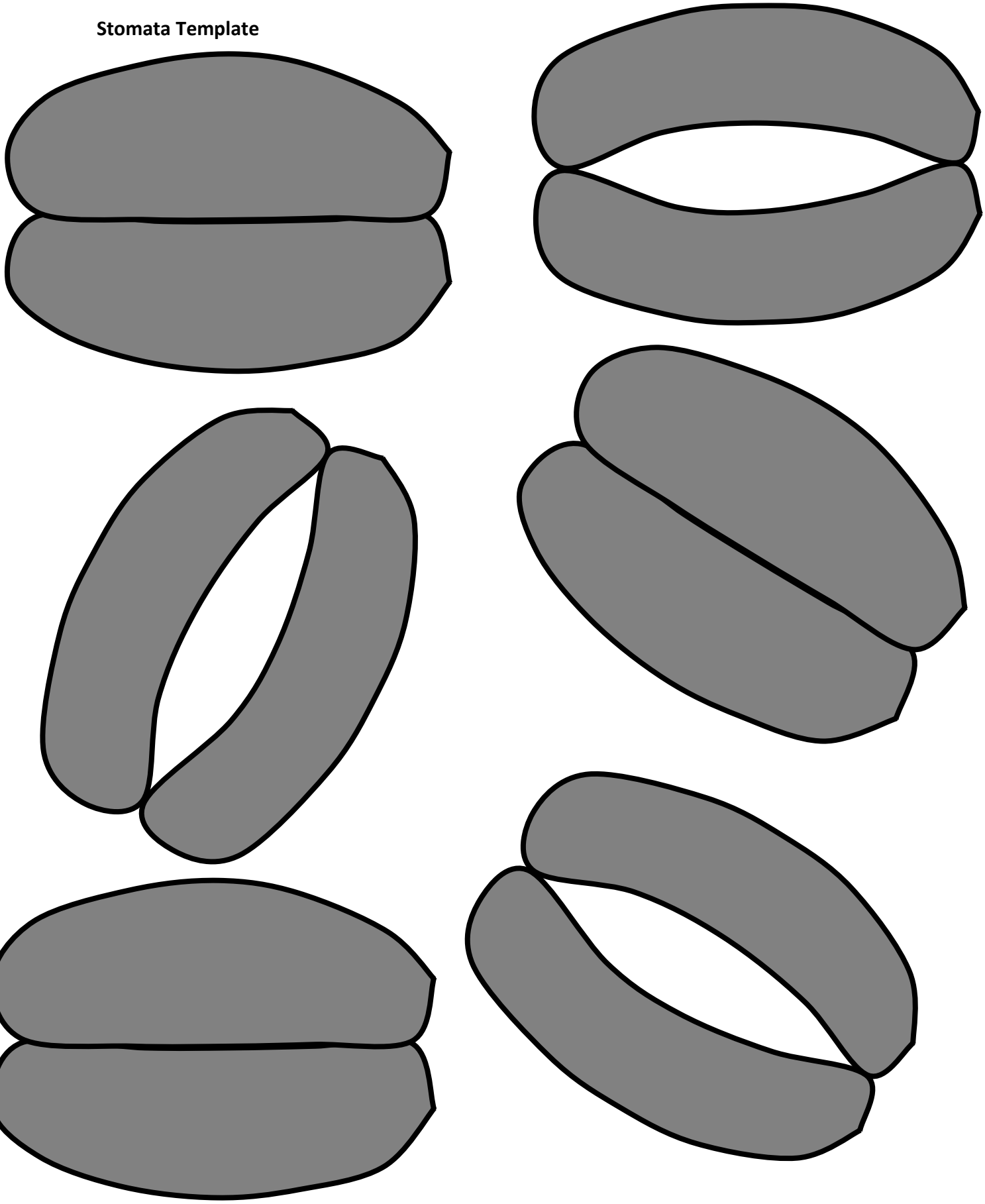
9. If you have the students build their own small model of the leaf, they can use it to explain the leaf layers and what role each plays in photosynthesis.

Adapted from an article, Building Leaves and an Understanding of Photosynthesis, Patty Littlejohn, The Science Scope, p. 22-25, April/May, 2007.



Chloroplast Template

Stomata Template



CARBON DIOXIDE

CO_2

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GLUCOSE $C_6 H_{12} O_6$

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WATER H_2O

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WATER H_2O

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