# Reports—Current Topics—Queries

## BIOMETRICS OF SEED GERMINATION: A HOME LABORATORY

To help my students study the growth of a germinating seed, I have devised the following take-home lab. The only materials that are needed are red kidney beans, a blotter, water, a drinking glass, and a metric ruler. The procedure is as follows:

1. Place a folded blotter around the inside of an ordinary glass (approximately 250 ml) so that the blotter takes the shape of the curved glass surface. Push the blotter down so that it is touching the bottom of the glass.
2. Place four red kidney beans between the blotter and the inside of the glass so that they are equidistant from the top and bottom of the blotter and from each other.
3. Put enough water in the glass to fill it about 1 cm from the bottom. Make sure that the bottom of the blotter is always immersed in water but that the water does not reach the level of the beans. The blotter should always be damp to the touch.
4. Place the glass in a warm place away from direct sunlight and observe it every 24 hours. Each observation should be recorded with a "word picture" of what you see. Periodically make a sketch of any major changes.
5. When the hypocotyl has emerged sufficiently, carefully make 3 lines on it, equidistant from each other, either with India ink or vegetable coloring. These markings will help you determine the relative growth rate of each part of the hypocotyl. Once you have made the marks, measure and sketch them every 24 hours.

Also make daily measurements of the length of the hypocotyl in millimeters. The hypocotyl will be the first structure to appear from the cotyledon. After this appears, it will form an arch (called the hypocotyl arch). The upper portion of this arch, the plumule, will start growing away from gravity. Measure the plumule in millimeters also. Place a mark in the middle of the arch to denote where the hypocotyl ends and the plumule begins. Record your data from step 5 in table form.

6. Continue these observations for 14 days. Then prepare two separate graphs on hypocotyl growth and plumule growth. Plot time on the abscissa and growth on the ordinate.

After students have completed their observations, I give them the following guidelines to help them clarify their conclusions:

1. Interpret your graph to help explain your results.
2. Explain the meaning of biometrics and its use in scientific experimentation.
3. What is the function of water in the above exercise?
4. What process takes the water from the bottom of the vessel to the seed?
5. Why is it important not to cover the germinating seed with water?

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## REARING SILKWORMS IN THE CLASSROOM

The silkworm moth *Bombyx mori,* which undergoes complete metamorphosis, is an excellent organism for classroom use. The occurrence of dramatic events during its life cycle will expose students to many first-hand experiences. It is very hardy, odorless, and easy to rear. It was, at one time, practical for teachers to rear silkworms only during the spring months when mulberry leaves could be obtained. Now, however, artificial food is available, and the rearing of silkworms provides teachers with an activity independent of the seasons.

Begin with about 100 silkworm eggs. For these approximately 50 g of artificial food (available from Nippon Formula Feed Co., 640 Higashiterao, Tsurumi-ku, Yokohama, Japan) will be needed.

To prepare the rearing medium, place the 50 g of powdered food in a beaker. Slowly pour 150 ml of water over the powder, mixing carefully with a glass rod. Pour equal amounts of the mixture into four Petri dishes. Steam the mixture in each dish using the following procedure: place a large container (beaker or coffee can) over heat; invert a flower pot in the container and fill about one-quarter full of water; when the water is heated, place the Petri dish on the flower pot and cover the container. Allow the mixture to steam for 20 min. After steaming, mix the medium in each dish again, pressing the mixture to flatten it. The medium may be stored in a refrigerator for two weeks.

When the eggs (they will be small—approximately 1 mm in diameter—and usually light brown in color) arrive from a supply company, place a piece of waxed paper in the bottom of a Petri dish and put three or four small pieces of food on the paper. Remove the eggs from the shipment package and carefully sprinkle them around the food. Cover the dish and keep the eggs warm—25–28 °C. Near hatching time the outer hard shell of the egg turns green.

The eggs should hatch three–four days after they are received. The small larvae are 3–4 mm long and very hairy. They are extremely active and will eat voraciously. Supply new food every two days and remove feces from the dishes daily. The larvae may be handled with a camel-hair brush. If condensation occurs in the Petri dishes, open the tops slightly.

After they have eaten for two or three days, the larvae's hair will become less noticeable and their bodies will thicken. The silkworm passes through five larval stages. At the end of each stage a period of rest occurs which lasts about a day. During each rest the skin, or cuticle, splits and they molt. The time between molts is about five days.

After the final molting—the fifth stage—the larvae are mature, about 8 cm long. Now they will enter a final eating stage which lasts about eight days. During this period they will consume many times their weight in food.

The larvae become rather sluggish and transparent as they approach the pupa stage. Soon the fore part of their bodies will oscillate, indicating the initial spinning process. When the larvae begin to spin silk they should be removed from the Petri dishes into spinning chambers. The following procedure can be used to construct adequate spinning chambers: cut 17 25-cm-by-3-cm strips of lightweight cardboard. In 11 of the strips make notches 4.5 cm apart and on the other 6 strips make notches 2.5 cm apart. Fitted together, the strips make compartments that look like the cardboard separators used for packing bottles, where the larvae can spin their cocoons. A day after the completion of the cocoon the silkworm molts and becomes a pupa.

Pupas should be removed from the cardboard container and placed in a container (such as a vegetable crisper) lined with paper. Within two weeks the adult moth should emerge—usually in the morning hours. The adults—which are flightless—will mate, and the females will each deposit 300–500 eggs on the paper. The adult may live as long as 25 days and requires no food or water.

Before investigations are planned and conducted by the students, they should be given the opportunity to become knowledgeable about the silkworm's life cycle and the rearing of these organisms. Encourage students to collect data through observing, identifying, and describing the various states: egg, larva, pupa, and adult. Then some of the following activities may be appropriate for your class:

Investigate the effects of temperature, humidity, light, or insecticides upon (i) duration of the life cycle; (ii) duration of individual states; (iii) spinning behavior; (iv) eating behavior; (v) mating; (vi) movement in the larva; and (vii) frequency of egg hatching.

Study the anatomy of the adult, larva, and pupa. Observe, describe, and collect and record data about external and internal structures. Some students may also be interested in observing and describing egg hatching, spinning behavior, the depositing of eggs, and the emergence of the adult from the cocoon.

Investigate relationships, if any, between body weight and food consumption and between cocoon size and larval weight.

Many students will enjoy supplemental reading about the silk industry and the history of silk.

*Bombyx mori* offers many opportunities for unusual classroom activities. The required equipment and material are inexpensive and require minimal preparation. Rearing silkworms is easy, and the dramatic life cycle will stimulate much interest among students.

**References**

ANON. *Turtox science leaflet no. 13: rearing the silkworm moth.* General Biological Supply House, Chicago.

BARUFALDI. J. P. 1973. A silkworm encounter. *American Biology Teacher* 35:416.

HOLLAND, W. J. 1968. *The moth book.* Dover Publishing Co., New York.

STEPP, A. 1972. *A silkworm is born.* Sterling Publishing Co., New York.

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## DEVELOPING SKILL IN THE USE OF THE STEREOMICROSCOPE

In one of my biology classes much of the work involved the use of the stereomicroscope to examine *Drosophila melanogaster*. Manipulations under the stereomicroscope require more dexterity that do exercises using the unaided eye; so to give my students practice in its use I distributed to each two forceps, a needle, and a thread. Each student was then required to thread the needle, using the forceps, while looking through the stereomicroscope. After a few anguished groans, most students were able to accomplish the task. It should be noted that the class happened to consist of all girls. Males, however, can be just as skillful. I was able to do the exercise after a few tries.

An example of how this exercise can be applied would be the removal of the salivary glands for the purpose of studying chromosomes.

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## A MODEL FOR DEMONSTRATING ALGAL BLOOMS IN ARTIFICAL RESERVOIRS

Thanks to the great surge of interest in the environment over the past few years, the term eutrophication has been added to the vocabulary of many Americans. The popular conception of eutrophication seems to be the accelerated growth of aquatic plants in lakes, resulting from the addition of pollutants. Concurrently, the construction of artificial lakes is offered as a solution to the problems of storing