Topic 5: Genetics – 5b. Computer Fly Lab

Resources:

Miller, K,, Levine J. (2004). *Biology.* Boston, MA: Pearson Prentice Hall.

Henig, Robin Marantz (2001). *The Monk in the Garden.* Houghton Mifflin Harcourt Publishing Company.

Biology Labs ON-LINE [Internet]. Old Tappan, NJ: Pearson Education. Available from: http://biologylab.awlonline.com/

AssessNet. Cambridge Assessment Network [Internet]. University of Cambridge, UK. 23 Oct. 2007. Available from: www.assessnet.org.uk

Building on:

Genetics can be an abstract concept for some students. Working with *Punnett squares* and *probability* can be difficult, but these are fundamental skills that must be mastered to understand genetics. It is important that students be able to distinguish between *phenotype* and *genotype; heterozygous* individuals and *homozygous* individuals; *dominant* traits and *recessive* traits. Adding things like *co-dominance, sex-linked* traits, and *multiple alleles* add to the complexity of the subject.

Given *word problems* and *pedigree charts,* students can learn to work genetics problems with really understanding how these traits are inherited and how data can be analyzed to find inheritance patterns. It is important for students to experience the laboratory procedures of genetics. *Fruit flies* are the ideal tool for genetics; they are small, they reproduce rapidly, and they produce high numbers of offspring. Working successfully with fruit flies requires care and patients, but it is an experience that is very beneficial to students, even if they are just identifying the different genders or attempting a simple monohybrid cross. In place of flies, *Indian corn* or *albino tobacco seeds* can be used; either way, the real experience of genetics is valuable.

The analysis of data to determine means of inheritance is the ultimate test of student understanding. Unfortunately, students often get very bad (inaccurate) data when they conduct their fly crosses. To supplement the lab experience, an online lab is helpful. Students will be given data that will be closer to the ideal and force them to *think analytically* to conclude the means of inheritance.

Links to Chemistry and Physics:

Statistical analysis
Probability

Stories:

Johann Mendel was born on July 22, 1822, the son of a poor farmer. Mendel did not show a strong aptitude for farming and managed to enroll in a local school. He eventually joined St. Thomas Abby, allowing him to continue his education and escape many financial burdens. At that time he took the new name, Gregor.

While at the Abby, Gregor began breeding mice. He wanted to see how their coat color was inherited. The Abbot of the Abby objected to Mendel working with mice because they smelled bad and the Abbot did not think it appropriate for a monk to watch animals mate.

Mendel took up gardening, working almost exclusively with pea plants. Peas were a good choice because they are self-pollinating which makes it easier to control the crosses. Mendel worked on seven distinct traits in peas. Unknown to him, five of the seven traits were on different pairs of chromosomes, and the two traits that were linked on the same chromosome were so far apart on that chromosome, that crossing over made them appear to sort independently.

Mendel published his work in 1866, but he got very little attention. When he presented his findings, most of his audience was unable to understand his formulas or his math. However, he was contacted by one gentleman, Karl von Nageli of the University of Munich. He asked Mendel to test his theories on a plant called hawkweed. After many tries Mendel gave up, assuming that much of his work had been in error. What he and von Nageli did not know is that hawkweed is a plant that only reproduces asexually.

Mendel ended his life studying meteorology and raising bees. He died in 1884.

In the early 1900s, three men working independently rediscovered Mendel's work. He is now known widely as the father of genetics.

Instructions for the Lab:

The lab attached here is for the Biology ON-LINE website, called the FLY LAB. This is a subscription site, although you can get a one-day free trial. Many other labs are available through this site, but I just use the Fly Lab. You can get a subscription for ten lab stations (computers) for about $100 per year. Once students have your login and password, they can access the lab from just about any computer.

I like this simulation because you can make the same cross three different times and you will get slightly different numbers each time. If two students turn in labs with the same numbers, something fishy is going on. The numbers that represent the results of a cross are never perfect; they more closely resemble what you would expect in a real lab situation.

This lab forces students to think. The fact that the numbers are not perfect bothers them, but they are forced to look at patterns.

You can do monohybrid, dihybrid, sex-linked and linked traits. You can get the data needed to determine cross over frequency of linked traits. You can make this lab as easy or as difficult as would be appropriate for your students.

I wrote the attached lab for beginning biology students.

I have also supplied a link to a free, much more simplistic website that lets you breed rabbits. It is a good site for lower level students. It is sponsored by Cambridge University in England and will require that you sign up; you must have Adobe Shockwave Player on your computers. The site is free and is the same site that is used for the Energetics: Photosynthesis Water Weed Simulation.

Biology: Computer Fly Lab

Name________________

URL: http://biologylab.awlonline.com

Under *Established User?,* select "FLY LAB."

Login name: ___________________

Password: _____________________

Select "Start Lab."

MONOHYBRID CROSSES

I. Sepia-eyed female X wild male

1. Hypothesis: Do you think the sepia-eyed will be dominant or recessive? Why?

2. Based on your hypothesis, what do you predict the ratio of sepia:wild will be in the F1 generation?

3. Make the actual cross following these steps:
   a. Under female → design → eye color, select "sepia."
   b. Under male → design → eye color, select "wild."
   c. Click "mate."

   The flies that will appear on your screen will represent the F1 offspring of the cross you just made. To see a summary of the results, select "analyze results."

   Write the actual phenotypic ratio of your F1 generation:

4. If you cross two of your F1 flies, based on your previous results, what do you hypothesize will be the phenotypic ratio of the F2 generation?

5. To make an F1 cross:
   a. Under offspring, select “female.”
   b. Under offspring, select “male.”
   c. To complete the cross, now select the “mate" button and the F2 flies will appear.
   d. Select “analyze results” and record the phenotypic ratio of the F2 generation.

6. Do the results support or refute your hypothesis in question 1?

II. Make a similar monohybrid cross to test how eye shape: lobed, is inherited.
   1. Your hypothesis:

   2. F1 phenotypic ratio:

   3. F2 phenotypic ratio:

   4. Your conclusion:

III. Make a similar monohybrid cross to test how eye color: purple, is inherited.
   1. Your hypothesis:

   2. F1 phenotypic ratio:

3. F2 phenotypic ratio:

4. Your conclusion:

DIHYBRID CROSSES: Now you will cross for two traits at the same time to determine how those traits are inherited.

IV. Body color: ebony; wing size: vestigial.

1. Hypothesis (Do you believe ebony and vestigial are both dominant, recessive or a particular combination? and why?):

2. Based on your hypothesis, what do you expect the F1 phenotypic ratio to be? Write the ratio and the description below each number:

3a. Under female → body color → ebony → wing size, select “vestigial.”
3b. Then under male → body color → wild → wing size, select “wild.”
3c. Now click “mate” and record the phenotypic ratio of the F1 generation.

4. Make an F1 cross:
   a. Under offspring, select “female.”
   b. Under offspring, select “male.”
   c. Click “mate.”

   The F2 generation will appear; analyze the results and write the phenotypic ratio (include a description of each phenotype) here:

5. Conclusion:

V. Make a similar dihybrid cross for eye shape: lobed; and eye color: brown.
   1. Hypothesis:

   2. F1 phenotypic ratio:

   3. F2 phenotypic ratio:

   4. Conclusion:

Test Cross: Make a test cross (and you should know what a test cross is) to determine if curly wing flies are homozygous or heterozygous.

1. Describe the two flies you are crossing:

2. Phenotypic ratio of their offspring:

3. Describe the next two flies you are crossing:

4. Phenotypic ratio of their offspring:

5. Conclusion:

The Brain Burner (Everyone must complete this problem.)
Determine how the trait for yellow body color is inherited. (Hint: Try two different parent crosses: one with the male having the yellow body and the female wild; then a cross with the female having the yellow body and the male wild.)

Show all of your crosses and their results in this section:

Conclusion: