Bioinformatics is a rapidly expanding field that incorporates applications from computer science (e.g., data retrieval) with biological investigations (e.g., nucleotide and amino acid sequence analysis) (Mount, 2004). Several introductory textbooks have been written with exercises that introduce students to bioinformatics (e.g., Campbell & Heyer, 2002), and some standard genetics textbooks now include a chapter or two on bioinformatics (e.g., Hartl & Jones, 2004). Despite these advances, however, there is still a significant conceptual and technical gap between standard genetics laboratory exercises and bioinformatic experiences. Too often students are not provided with contextual experiences in bioinformatics in their standard biology laboratory exercises, or such experiences are provided to a select few who choose to enroll in specialized advanced courses, if available in the undergraduate curriculum. I have developed a set of complementary bioinformatic activities that is integrated into a genetics laboratory exercise in an introductory biology course. This approach exploits a student-driven inquiry-based mode of investigation, in that as questions arise regarding data interpretation from the genetic experiments, the students learn to explore and utilize bioinformatics tools as a means of self-learning. During this inquiry process, students begin to enter into other fields of biology (e.g., biochemistry, cell biology) and can experience the interconnections between the different life science disciplines. Finally, the bioinformatic analysis entailed herein leads the students into a discovery that provides support (at the molecular level) of the common ancestry of four divergent groups of organisms: fruit flies, humans, yeast, and roundworms.

Materials

The model system for the genetics laboratory exercise is the fruit fly, Drosophila melanogaster. The following required materials can be ordered from the Carolina Biological Supply Company (www.carolinabiologicalsupply.com):

- One vial of Drosophila stock culture of choice (either the F₁ apterous x sepia, the F₁ vestigial x sepia, or the F₁ vestigial x ebony cross) for each set of ten students.
- One Drosophila BioKit for a class of up to 30 students.
- Either a 10X hand lens or a dissecting scope for each pair of students.

Procedure

Fruit Fly Lab Protocol

Week 1

1. When the Drosophila stock cultures arrive, maintain them in a cool (room temperature) environment. Observe daily until approximately 20 or more adult flies are visible; this typically occurs 3-5 days after receipt of the stock culture.

2. Each team of two students should set up three new vials of fresh Drosophila medium. Anesthetize the adult flies and, in each new vial, place three wild type males and three wild type females. Cap the new cultures and maintain at room temperature.

Weeks 2-3

3. After 7-10 days, remove the six F₁ adult flies from the new cultures and dispose of properly.

Weeks 4-5

4. After approximately 2 weeks of incubation, new adult flies (the F₂ generation) should now appear in the new cultures. Adult flies should be counted and assigned into separate phenotypic classes as designated in Table 3. These counts should begin...