Richard D. Squire Jan. 2002

BIOL 6617 Advanced Genetics Syllabus

Lecture topics:

1. Interactions between genes (9 hrs.): complete dominance, incomplete dominance, epistasis, F_1 and F_2 ratios, developmental and biochemical pathways and their implications, typical genetic crosses (Punnett squares, algebra, probabilities). Examples from domestic organisms: (a) eye pigments in Drosophila (brown ommochrome and bright red drosopterin pathways), (b) detailed genetics of mammalian coat colors with an emphasis on cats and mice [agouti series (A), brown series (B), tyrosinase series (C), dilution series (D), extension series (E), melanin inhibitor (I), orange (O), piebald spotting (S), dominant white (W)]. Developmental and biochemical mechanisms are emphasized.

2. Polygeny (1 hr.): introduction, multiple factor inheritance, human skin color, medical examples, variable gene pools.

3. Genetic control of development and differentiation (4 hrs.): emphasizes critical periods of development, triggers (inducers), canalization, threshold effects, phenocopies.

4. Biochemistry of allozyme variations (1/2 hr.).

5. The problem of selection for desired traits and inbreeding depression(1 hr.): Why inbreeding leads to increased homozygosity. Why increased homozygosity (reduced genetic variability) leads to inbreeding depression.

6. Genetics of Domestication (3 1/2 hrs.): Genetically determined behavior of domesticated mammals, evolution of biochemical, physical and behavioral traits (cats, dogs, horses, Siberian foxes, mice).

7. Genetics of human personality, behavior and intelligence (1 hr.).

8. Duplicate genes (11/2 hrs): origin, adaptive and evolutionary importance. We will consider the hemoglobin family in detail.

9. Genetic control of sex determination (5 hrs.): single locus systems, polygenic and multiple allelic systems, sex chromosomes, haplo-diplo system, coccid-type systems.

10*. Control of genetic variability: recombination, super genes, chromosome number, breeding systems, mating patterns.

* Time varies according to the interests of the class.

Laboratory exercises:
Each exercise takes several weeks to complete. Laboratory reports are required for each experiment. The students will work in groups, but must write individual reports. The data will be the same for the members of a group, but the analyses must be done individually.

1. Introduction to the use of Drosophila melanogaster as a laboratory animal. Life cycle, anatomy, identification of sexes, mutants, culture techniques. Expand stocks.

1. Phenocopy experiment. The environment in manipulated in order to induce phenotypic changes which mimic the effects of mutant genes. Use lobe, eyeless, and wild strains of D. m.. In lecture, this environment-gene interaction is related to threshold effects and the availability of genes to selection.

2. Mating preference experiment. Demonstration of mate selection in Drosophila, and its potential effect on gene frequencies. Use white and wild strains of D. m..

3. The use of a genetic marker Drosophila stock [Curly over Plum (2): Dichaete over Stubble (3)] to identify the chromosomal location of an unknown mutant gene.

Grades:

midterm exam - 33%
second exam - 33%
laboratory work and lab. reports - 33%
Extra points may be given based upon my subjective evaluation of your work during the semester.