Week 3
BIO-1306 - Biology 2 – ICB textbook

Hello and Welcome to the weekly resources for BIO-1306 - Biology 2 – ICB textbook!

This week is Week 3 of class, and typically in this week of the semester. your professors are covering these topics below. If you do not see the topics your particular section of class is learning this week, please take a look at other weekly resources listed on our website for additional topics throughout of the semester.

We also invite you to **look at the group tutoring chart on our website to see if this course has a group tutoring session offered this semester**.

If you have any questions about these study guides, group tutoring sessions, private 30 minute tutoring appointments, the Baylor Tutoring YouTube channel or any tutoring services we offer, please visit our website www.baylor.edu/tutoring or call our drop in center during open business hours. M-Th 9am-8pm on class days 254-710-4135.

***Keywords*:** Population Genetics, Mutations, Hardy-Weinberg

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TOPIC OF THE WEEK: Hardy-Weinberg Equilibrium

- If allele frequencies of a given gene are NOT at equilibrium, then evolution is occurring through natural selection, genetic drift, gene flow, mutation

$p^2 + 2pq + q^2 = 1$

$p + q = 1$

p = frequency of the dominant allele in a population

q = frequency of the recessive allele in a population

- Following conditions for Hardy-Weinberg Equilibrium
  - Random mating
  - Absence of natural selection
  - Very large population size
  - No gene flow or migration
  - No mutation
  - Locus is autosomal

HIGHLIGHT #1: Genetic Variation in Blood Pressure

First, keep in mind that variation among individuals in a given population often has one origin: **DNA**

Let's look at the following example: the Bianchi et al. experiment compared two populations of rats with **different blood pressure**. After 85 generations of experimentation, blood pressure among individuals of the same colony were similar but very different from the pressure in rats from the different colony. Let's keep in mind that these rats are from the same species so we are talking about the *same population*! <u>So what was the difference?</u> The **alleles** of each gene that coded for the two *adducin* protein subunits differed by **only one nucleotide** for each subunit.

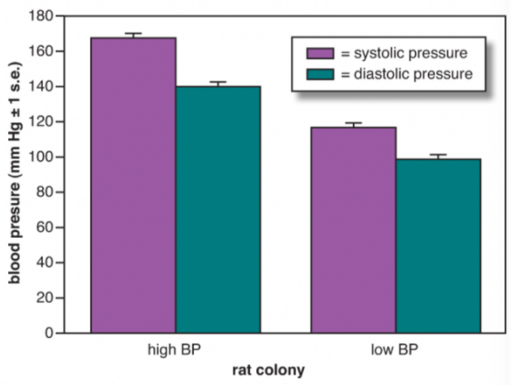


Figure 16.2 Mean blood pressures for rats in the two colonies, measured in millimeters of mercury. All high blood pressure rats were homozygous for the adducin genes (α^Y and β^R). Low blood pressure rats were all homozygous for the α^F gene only. Data from Bianchi et al., 1994.

There were 3 genotypes of the beta subunit shown in mice with low BP so Bianchi et al. compared their blood pressures according to the mutation at the **beta subunit (Q vs. R)**. The variation shown was a result of **point mutations** present in the alpha and beta subunits of adducin.

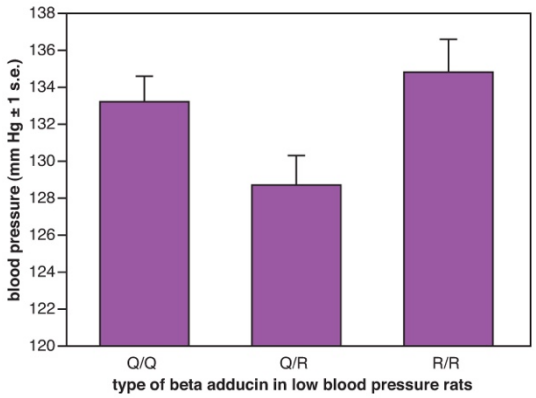
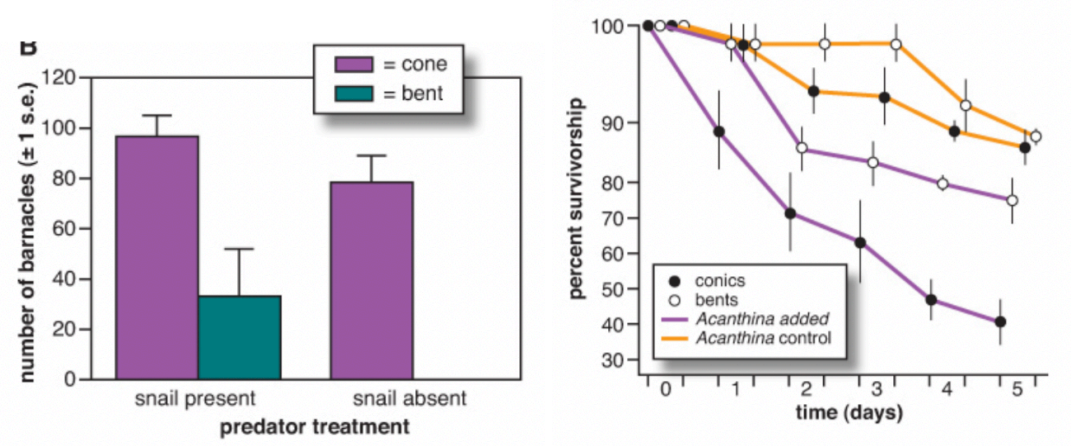


Figure 16.4 Mean systolic blood pressures of the three combinations of two versions of the β adducin gene in rats from the low blood pressure colony. Q and R refer to the amino acid present at position 529 on the β protein subunit of adducin. Error bars = 1 standard error (SE). Data from Bianchi et al., 1994.

HIGHLIGHT #2: Effect of Environment on Behavior

Now, **what happens when individuals share the same genetic make-up, meaning there are no different alleles for a given gene, but are exposed to different environments?** One of the coolest examples here is the change in shape of barnacles in presence of a predator (snails). In absence of snails, barnacles look like tiny volcanoes, but if snails are present, barnacles seem like they were upside down. Go over the plots below, step by step, to practice your graph interpretation skills!



What do you see? In the figure to the left, notice how most barnacles, with or without predators around, often take the "cone" shape, but when predators are indeed around, some of those barnacles will take the "bent" shape. Notice on the other graph, how survival of the barnacles also go down when they fail to take the "bent" shape in presence of snails. Bent barnacles also seem to reduce their survival but nothing as significant as the ones in conical form. This is a prime example of how *environment affects a population's variation.*

CHECK YOUR LEARNING:

1. What would happen if variation within populations did not exist?
2. How many alleles per gene, and can they change?
3. How can one determine if evolution is likely happening in a population?
4. You have sampled a population in which you know that the percentage of the homozygous recessive genotype (aa) is 36%. Using that 36%, calculate the following:

A. Frequency of the “aa” genotype
B. Frequency of the “A” allele
C. Frequencies of the genotypes “AA” and “Aa”
D. Frequencies of the two possible phenotypes if “A” is completely dominant over “a”

THINGS YOU MIGHT STRUGGLE WITH:

1. **Differences between genes and alleles.** Keep in mind that the easiest way to remember this is to see alleles as PARTS of a gene. In other words, an allele is a specific form of a gene.
2. **Graph interpretation:** This will be an every-week task for you all. Please practice your graph interpretation by always going over X- and Y-axes, trends, relationships, etc.
3. **Understand what a frequency is:** Frequencies can also be shown as percentages. It it’s easier, you can compare populations using %s rather than decimals.
4. **Hardy-Weinberg:** Calculating different variables and frequencies can get overwhelming hard to keep track of. Practice is key!!

Thanks for checking out these weekly resources!
Don’t forget to check out our website for group tutoring times, video tutorials and lots of other resources: www.baylor.edu/tutoring ! Answers to check your learning questions are below

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Answers

1. Everyone will be exactly the same and processes like selective advantage would be non-existent.
2. Usually 2, and yes they can (rat blood pressure alleles)
3. Hardy-Weinberg allele frequencies and compare them with observed frequencies. If they differ, evolution is likely happening.
4. A. 36%, B. 60%, C. 40% D. AA = 16% and Aa = 48%, E. Dominant = 64% and Recessive = 36%