CONCEPT: HERITABILITY

● **Heritability** is the proportion of variation in a population that's due to genetic factors

□ It is a very _____ measurement that is only true for a certain population in a certain environment

- It measures from 0 to 1, and the larger the value, the more variation is explained by genetic differences

- Ex: h=0.65 means 65% of the overall population variation is explained by genetic differences in individuals

□ **Broad-sense heritability** measures the contribution of genotypic variance to total phenotypic variance

- $H^2 = V_G/V_P$

- A H^2 close to 1 = environmental conditions had little impact on variation

- A H^2 close to 0 = environmental conditions had a major impact on variation

EXAMPLE: Calculate broad sense heritability for each trait

Trait	**V_P**	**V_G**	**V_A**
Body Fat	40.5	16.9	7.66
Body Length	43.6	17.9	5.12

□ **Narrow-sense heritability** measures the proportion of phenotypic variation due to additive genotypic variance

- **Additive variation (V_A)** is genetic variance caused by average differences between allelic characteristics

    - Dominant and recessive alleles have different characteristics

- **Dominance variance (V_D)** is gene variance from heterozygotes not being intermediates of homozygotes

    - Heterozygotes are different than an intermediate between dominant and recessive homozygotes

-The _____ to know are:

- $h_2 = V_A/V_P$

- $V_G = V_A + V_D$

EXAMPLE: Calculate narrow-sense heritability for each trait

Trait	**V_P**	**V_G**	**V_A**
Body Fat	40.5	16.9	7.66
Body Length	43.6	21.7	5.12

Artificial Selection

● **Artificial selection** is the process of choosing specific individuals for phenotypic breeding purposes

□ Breeders use narrow-sense heritability to predict the impact of _____

- The higher the h_2 value the more likely the breeder will observe a change in offspring

□ $h_2 = R/S$

- R = Mean of the offspring – overall mean – called **selection response**

- S = Mean of the parents – overall mean - called **selection differential**

EXAMPLE: Which of the following traits will respond best to selection by a breeder?

Trait	**V_P**	**V_G**	**V_A**
Body Fat	40.5	16.9	7.66
Body Length	43.6	21.7	5.12

Twin Studies

● Humans cannot be bred to determine heritability, so _____ studies are used

□ **Monozygotic twins** arise from a single zygote that mitotically divides and splits into two cells

- Have same genetics, and therefore only exhibit environmental variation

- But some genetic changes can occur in early development (Ex: copy-number variations)

□ **Dizygotic twins** are from two separate fertilization events

- Are genetically as close as any other sibling set, but often share similar environment

□ Twin expression of a trait can be classified in two ways

- **Concordant** is when both or neither twins express a trait

- **Discordant** is when one twin expresses a trait but not the other

PRACTICE:

1. A chicken breeder has a population of chickens where the average number of eggs laid per hen per month is 34. The narrow-sense heritability is 0.75. With this information is it likely that a breeder could select for an increase in eggs per hen laid each month?
    a. No, breeders never know whether they can select for a trait
    b. No, the breeder will need to know the broad-sense heritability to determine whether selection could cause an increase in eggs?
    c. Yes, because the narrow-sense heritability is 0.75, this means selection is likely to occur

2. The narrow-sense heritability of the number of seeds per flower is 0.9. The mean of the population is 6.0 seeds per flower. A flower breeder crosses one flower with 7 seeds to another plant with 9 seeds. What is the expected number of seeds per flower in the offspring of this cross?
    a. 5
    b. 6
    c. 7
    d. 8

3. Heritability calculations were calculated for a variety of different traits. Which of the following traits would respond best to selection?
    a. $H_2 = 0.8$, $h_2 = 0.3$
    b. $H_2 = 0.3$, $h_2 = 0.3$
    c. $H_2 = 0.9$, $h_2 = 0.8$
    d. $H_2 = 0.5$, $h_2 = 0.9$