Honors Biology

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Chapter 1

The Scientific Method

1.1 Steps to the Scientific Method

1. Make an Observation
2. Ask a question
3. Experiment: test the hypothesis and gather data
4. Analyze the data
5. Draw a conclusion

1.2 Characteristics of a Good Experiment

- Tests one variable at a time: If more than one thing is tested at a time, it won't be clear which variable caused the end result
- Fair and unbiased: Experimenter must not allow his or her opinions to influence the experiment
- Repeated trails: Repeating the trials in the experiment will reduce the effect of experimental errors and give a more accurate conclusion

1.3 Variables

Definition 1.3.1 (Variable)**.** A variable is anything in an experiment that can change or vary

- Any factors that can have an effect on the outcome of the experiment

There are three main types of variables:

Definition 1.3.2 (Independent Variable)**.** The variable intentionally changed by the scientist

- What is tested or manipulated
- Only change on independent variable at a time

Definition 1.3.3 (Dependent Variable (Responding Variable))**.** Something that is affected by the change in the independent variable

- What is observed and measured (Data collected)

Definition 1.3.4 (Controlled Variable)**.** Variables that are not changed, constants

1.4 Control Group

Definition 1.4.1 (Control Group)**.** Group that isn't tested, but used for comparison as a reference for what "normal would be like

Definition 1.4.2 (Positive Control)**.** Group that you expect to give a positive result

Definition 1.4.3 (Negative Control)**.** Group that you expect to give a negative result

Both ensure the validity of the experiment

1.5 Hypothesis

Definition 1.5.1 (Hypothesis)**.** Proposed explanation for a set of observations

- Leads to predictions that can be tested in experiments
- Should be based off past experiments and background research
- Not only a prediction, not a research question, not a theory
- "If... then... because..."

Chapter 2

The Standard Deviation

Definition 2.0.1 (Standard Deviation)**.** The extent to which the data are spread out from the mean, described as:

$$S = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

2.1 Error

The standard deviation error bars on a graph can be used to get a sense for whether a difference is significant. Overlap can show that the difference is not statistically significant.

Definition 2.1.1 (Standard Error of the Mean (SEM))**.** Measures how far the sample mean of the data is likely to be from the true population mean.

- Always smaller than the Standard Deviation
- Shows how accurate your estimate of the mean is likely to be

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

Chapter 3

Genetics

Definition 3.0.1 (Pangenesis)**.** Proposed around 400 BCE by Hippocrates, was an early explanation for inheritance that suggested that particles called pangenes came from all parts of the organism to be incorporated into eggs or sperm and characterists acquired during the parents' lifetime could be transfered to offspring.

Aristotle rejected pangenesis; instead of particles, the potential to produce the traits was inherited

Definition 3.0.2 (Blending Hypothesis)**.** Hereditary materials mix in forming offspring.

Suggested in the 19th century by scientists studying plants; later rejected because it did not explain how traits that disappear in one generation can reappear in later generations.

Definition 3.0.3 (Heredity)**.** The transmission of traits from one generation to the next

Definition 3.0.4 (Genetics)**.** the scientific study of heredity

Definition 3.0.5 (Gergor Mendel)**.** began the field of genetics in the 1860s, deducing the principles of genetics by breeding garden peas, relying upon a background of mathematics, physics, and chemistry.

In 1866, Mendel correctly argued that parents pass on to their offspring discrete "heritable factors" and stressed that the heritable factors (today called genes), retain their individuality generation after generation.

Definition 3.0.6 (Character)**.** A heritable feature that varies among individuals, such as flower color

Definition 3.0.7 (Trait)**.** Each variable character

Definition 3.0.8 (True-breeding)**.** True-breeding varieties result when self-fertilization produces offspring all identical to the parent

Definition 3.0.9 (Hybrid)**.** The offspring of two different varieties
The cross-fertilization is a hybridization, or genetic cross

Definition 3.0.10 (P generation)**.** True-breeding parental plants

Definition 3.0.11 (F_1)**.** Hybrid offspring

Definition 3.0.12 (F_2)**.** A cross of F1 plants

Definition 3.0.13 (Monohybrid Cross)**.** A cross between two individuals differing in a single character

Mendel performed a monohybrid cross between a plant with purple flowers and a plant with white flowers.

The F_1 generation produced all plants with purple flowers The F_2 generation produced three plants with purple flowers and one plant with white flowers

Mendel developed four hypotheses:

Definition 3.0.14 (Alleles)**.** Alleles are alternative versions of genes that account for variations in inherited characters

For each characteristic, an organism inherits two alleles, one from each parent. The alleles can be the same or different

Definition 3.0.15 (Homozygous Genotype)**.** Identical alleles

Definition 3.0.16 (Heterozygous Genotype)**.** Two different alleles

If the alleles of an inherited pair differ, then one determines the organism's appearance and is called the dominant allele. The other has no noticeable effect on the organism's appearance and is called the recessive allele.

Definition 3.0.17 (Phenotype)**.** The appearance or expression of a trait.

Definition 3.0.18 (Genotype)**.** The genetic makup of a trait.

Definition 3.0.19 (Law of Segregation)**.** A sperm or egg carries only one allele for each inherited character because allele pairs separate (segregate) from each other during the production of gametes.

Definition 3.0.20 (locus)**.** The specific location of a gene along a chromosome

For a pair of homologous chromosomes, the alleles of a gene reside at the same locus (Homozygous have same allele on both, Heterozygous have different allele on both homologues)

Definition 3.0.21 (Dihybrid Cross)**.** Mating of parental varieties that differ in two charactersP generation: RRYY and rryy F1 generation: all RrYy F2 generation:

- 9/16 with R and Y dominant
- 4/16 with r and Y dominant
- 4/16 with R and y dominant
- 1/16 with r and y dominant

Definition 3.0.22 (Testcross)**.** The mating between an individual of unknown genotype and a homozygous recessive individual

Can show whether the unknown genotype includes a recessive allele