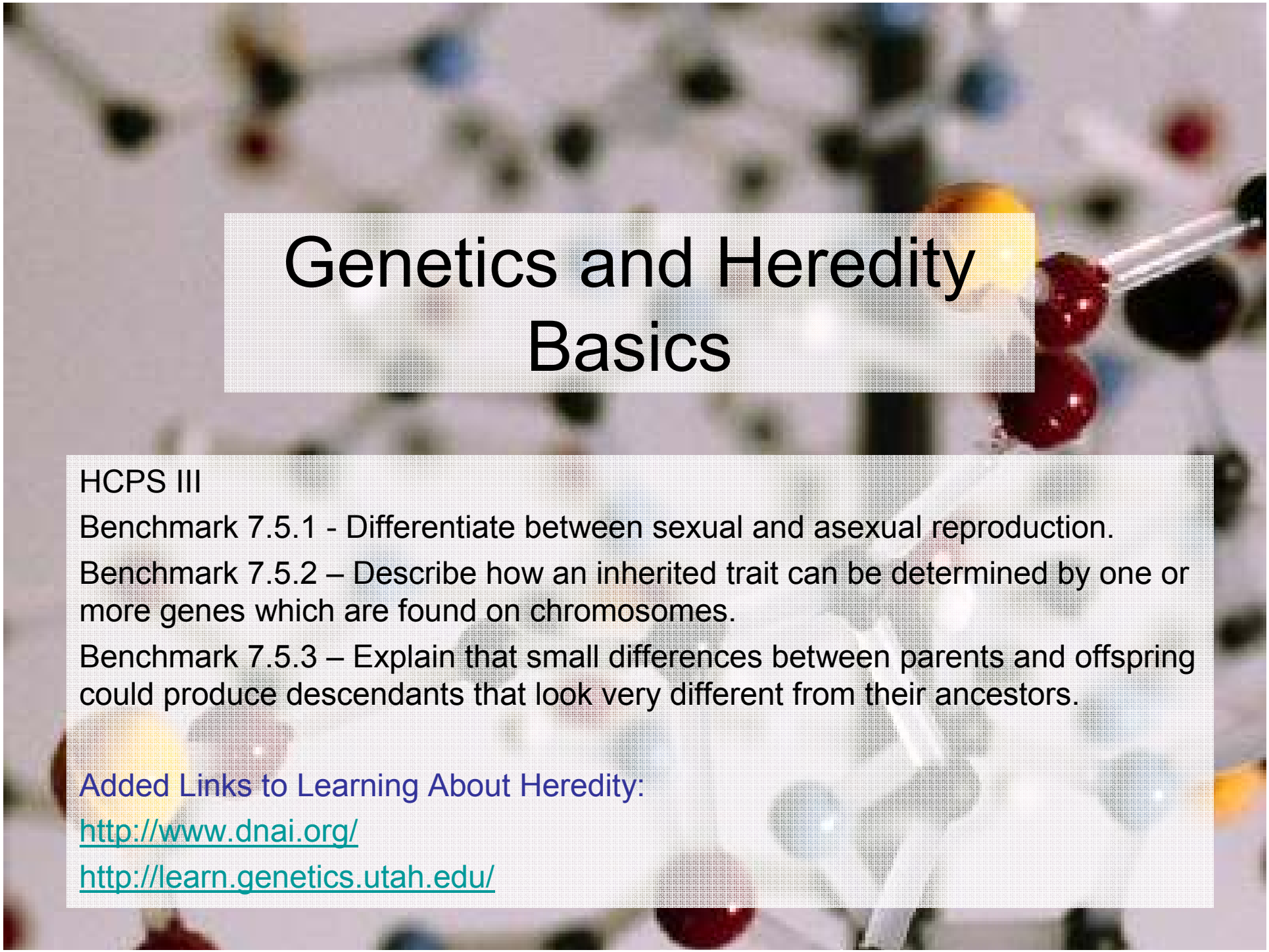


Genetics and Heredity Basics

HCPS III

Benchmark 7.5.1 - Differentiate between sexual and asexual reproduction.

Benchmark 7.5.2 – Describe how an inherited trait can be determined by one or more genes which are found on chromosomes.

Benchmark 7.5.3 – Explain that small differences between parents and offspring could produce descendants that look very different from their ancestors.

Added Links to Learning About Heredity:

http://www.dnai.org/

http://learn.genetics.utah.edu/

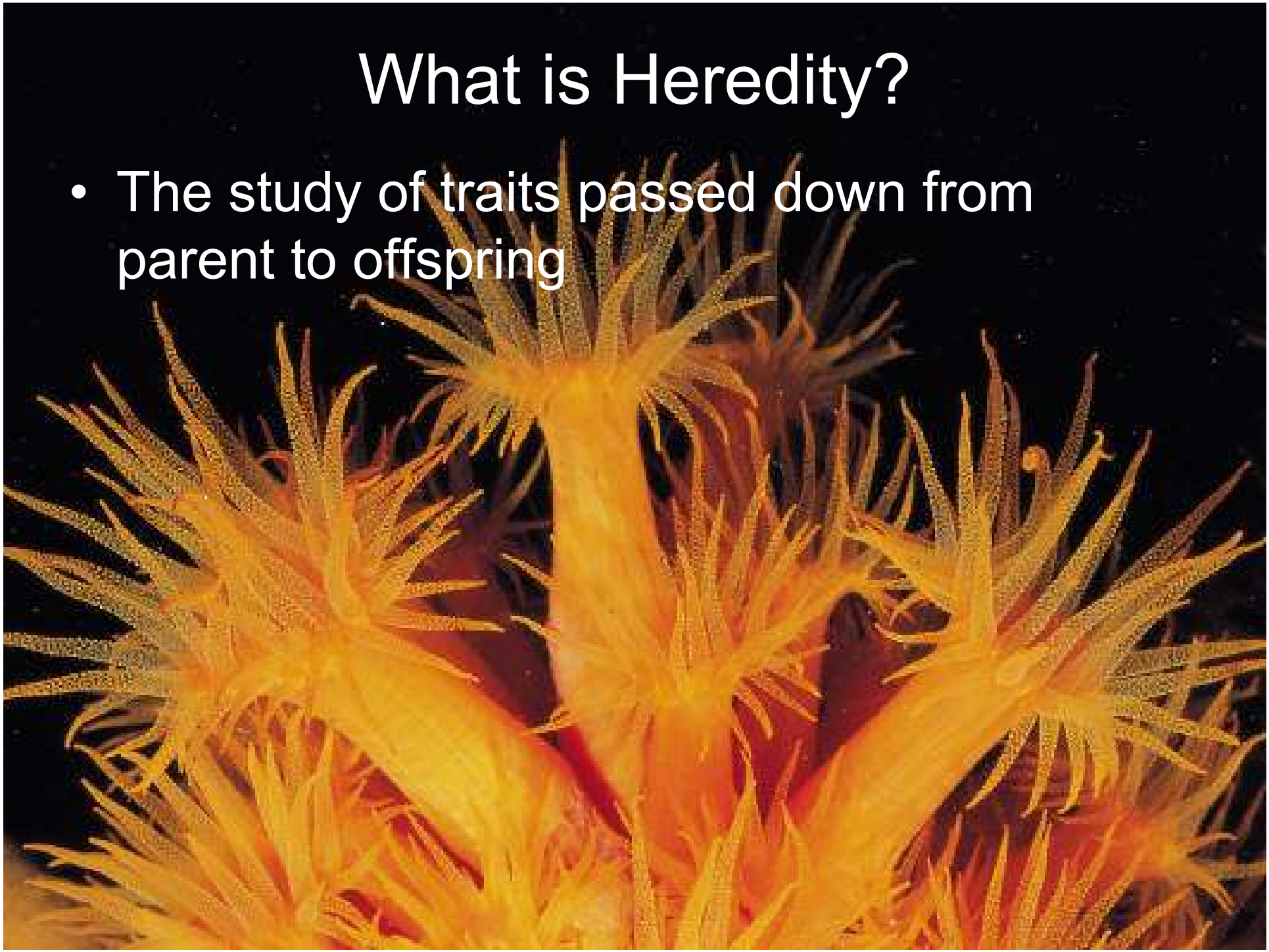
What is Genetics?

- The study of heredity (passing traits from parent to offspring)
- People who study heredity are call geneticists

- Your prior knowledge
  - Brainstorm:
    - What do you know about genetics?
    - Next to each item you wrote write your resource next to it. (example: did you learn this from your teacher, parent, friend, t.v., media, etc.)

What is Heredity?

- The study of traits passed down from parent to offspring



Passing down traits – Asexual vs. Sexual Reproduction

- In both asexual and sexual reproduction traits are passed down from parent to offspring.
  - In Asexual Reproduction
    - An identical set of traits are passed from parent to offspring.
    - There are sometimes variation but they are usually mutations.
  - In Sexual Reproduction
    - Two parents contribute traits to the offspring.
    - The offspring's traits are determined by the combinations of both parents' genes.
    - Mutations could also occur.

Mitosis and Meiosis

- Mitosis – cell division where two daughter cells are the result. Genetic material is replicated.
- Meiosis – cell division where 4 haploid cells are the result. Only half of the genetic material is provided. The other half of instruction is needed for life to begin.
- Link to NOVA: Mitosis vs. Meiosis Animation http://www.pbs.org/wgbh/nova/miracle/divide.html

What are traits?

- Characteristics that are passed from parent to offspring
  - A trait could be acquired
    - Colored hair
    - Lost limb
  - A trait could be genetically determined
    - Eye color
    - Hair color
    - Height

These types of traits are passed down to offspring.

Acquired Traits vs. Inherited Traits

- Acquired traits cannot be passed down to offspring. A red dyed hair on a parent will not show up in the offspring.

- Inherited traits are passed from parent to offspring. If both parents have brown eyes there is a good chance that the offspring will have brown eyes.

Encrypted Code of Life

- Gene - a code which determines a trait of an organism.
- Alleles – an alternate form of a gene, two alleles make up a gene. Varied types, make varied outcomes.
- DNA (Deoxyribonucleic acid) – A set of genes, shaped like a spiral staircase, made up of four basic nitrogen bases: adenine (A), thymine (T), guanine (G), cytosine (C).
- Chromosomes – A structure made of a single strand of DNA and proteins

Dominant vs. Recessive

- **Dominant – the expressed gene, masks or overpowers its counterpart.**
  - Usually represented by a capitalized letter
    - BB has two dominant alleles
    - Bb has only one dominant allele
- **Recessive – the unexpressed gene, only shows up if no dominant gene is present.**
  - Usually represented by a lower case letter
    - bb has two recessive alleles
    - Bb has only one recessive allele

Incomplete Dominance & Co-Dominance

- Incomplete dominance – When there is a blending of the traits
  - Example: The color of flowers in a pea plant
    - Parent 1 = White flowers (rr)
    - Parent 2 = Red flowers (RR)
    - Offspring = Pink flowers (rR)
- Co-Dominance - When the contributions of each parents' genes are presented in the trait.
  - Example: Blood typing
    - Parent 1 = Type A (AA)
    - Parent 2 = Type B (BB)
    - Offspring = Type AB (AB)

What Shows Up? (Phenotype)

- Phenotype – The trait that is physically displayed in the organism.
  - Example: if a person has at least one dominant trait for eye color, that dominant eye color will be displayed
    - BB = Brown eyes.
    - Bb = still equals brown eyes because the dominant trait “B” is present.
    - bb = eyes are not brown because no dominant trait is present.

What it IS? (Genotype: heterozygous, homozygous)

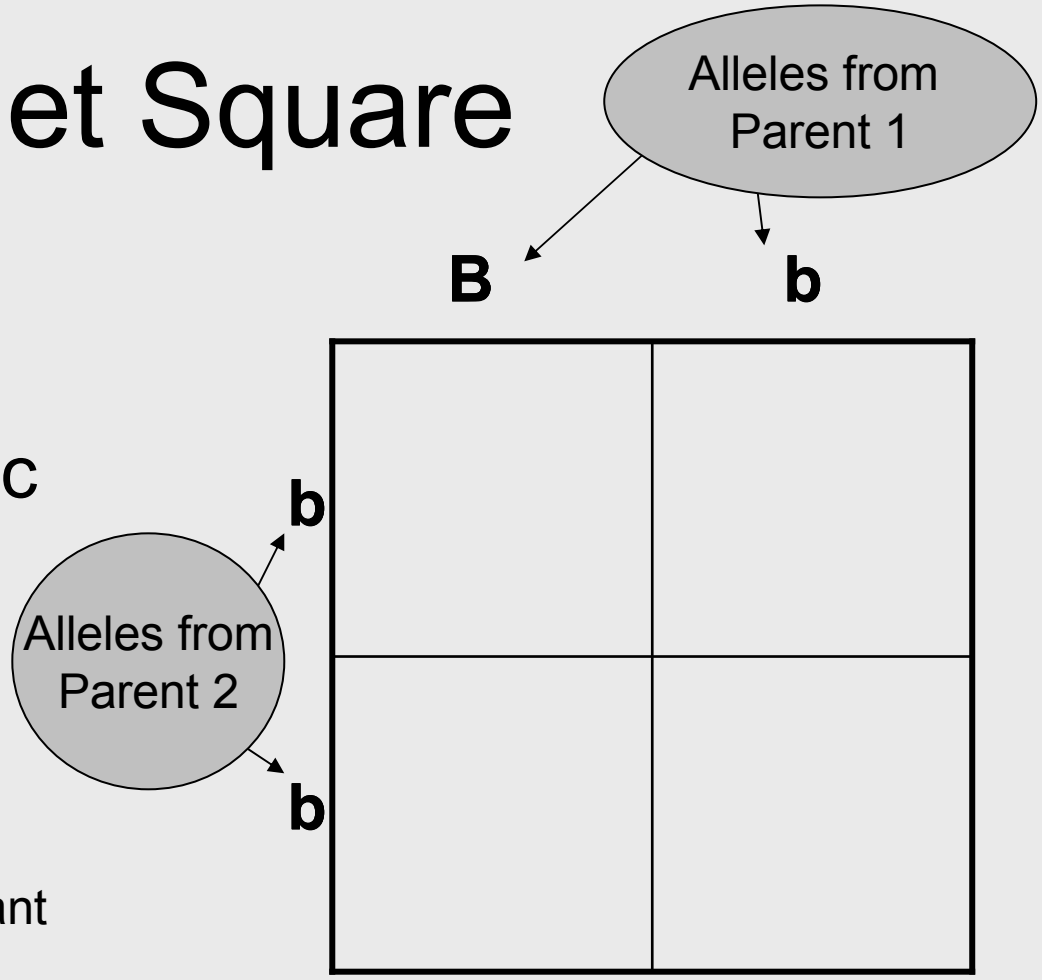
- Genotype – The specific alleles that make up the gene.
  - A person exhibits the dominant eye color.
    - The genotypes of their alleles could possibly be “BB” or “Bb”

When both alleles are different from each other (Bb) then they are said to be heterozygous

When both alleles are identical (BB or bb) they are said to be homozygous

Punnet Square

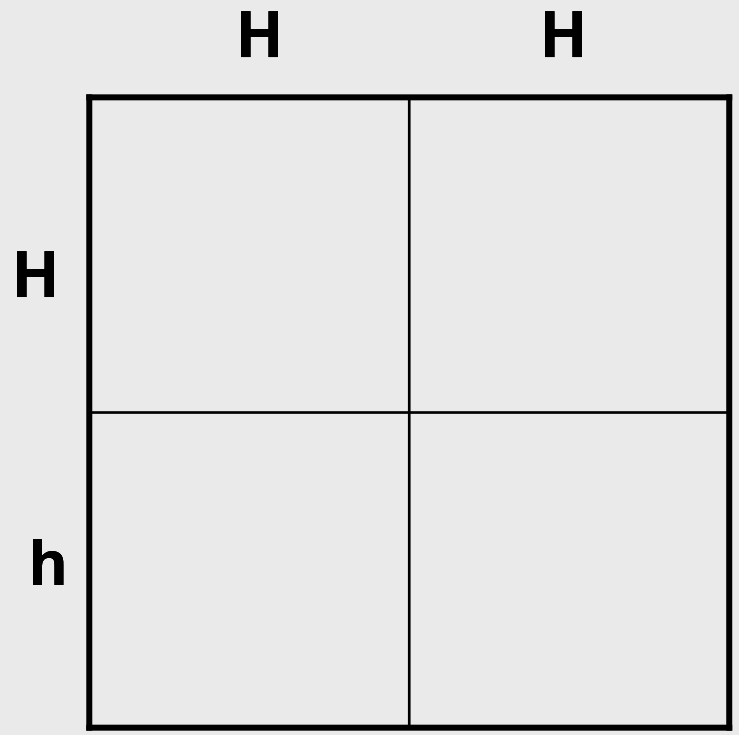
- A simplistic way to demonstrate the probability of genetic traits in offspring, when both parents' alleles are known.
  - Example:
    - Parent 1 = Bb (heterozygous, dominant for brown eyes)
    - Parent 2 = bb (homozygous recessive, for blue eyes)



The outcome shows that 50% of the offspring will have brown eyes, and 50% will have blue eyes.

Identifying Phenotype and Genotype using a Punnet Square

- Phenotype
  - Brown hair 100%
  - Blonde hair 0%
- Genotype
  - Homozygous Recessive 0%
  - Homozygous Dominant 50%
  - Heterozygous 50%



Practice: Determine the Phenotypes and Genotypes for each case

#1. Parent 1 & 2 = (Hh) Heterozygous for brown hair
the recessive trait is blonde hair

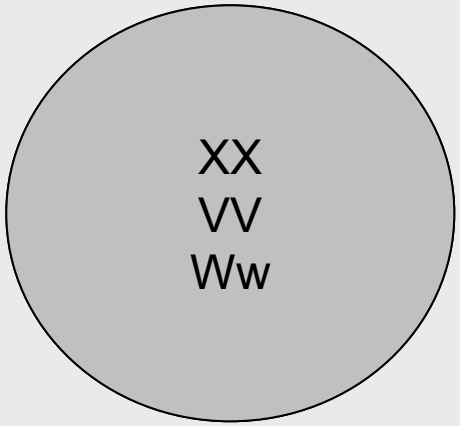
#2. Parent 1 = (BB) Homozygous dominant for brown eyes
Parent 2 = (bb) Recessive for blue eyes

#3. Parent 1 = (Tt) Heterozygous able to roll tongue
Parent 2 = (tt) Recessive unable to roll tongue

#4. Parent 1 = (Ww) Heterozygous for widows peak
Parent 2 = (WW) Homozygous dominant for widows peak
Recessive trait would be a straight hairline

Asexual example of traits passed down from parent to offspring (no variation)

Starts with just 1 parent



Genetic Engineering

- Genetic Engineering requires scientists to analyze sets of codes made up of the four nitrogen bases of DNA. The order of these four chemicals dictate the trait exhibited in the organism.
- The four nitrogen bases are always paired in a particular way:
  - (A) adenine with (T) thymine
  - (C) cytosine with (G) guanine

  - Example: if half of the DNA code reads A A T T G G A T C
  - The second half would be the opposite pair T T A A C C T A G

- When genetic engineers find a set of codes in two different organisms that affect the same trait, and are similar in code, they “cut” that sequence of DNA and “paste” it into the DNA sequence of the other organism. Its not that easy, but that the idea.

Ancient Hawaiian Geneticists

- A paper: Ancient Hawaiian Management of Genetic Material
  - Ancient Hawaiian spiritual beliefs of the importance of preserving genetic material and the MANA or power it held.
  - The careful and meticulous nature in which the Ancient Hawaiian managed desirable genetic traits in farming.
  - http://www.iiirm.org/publications/Articles%20Reports%20Papers/Genetics%20and%20Biotechnology/Ancient%20Hawaiian%20Management%20of%20Genetic%20Material.pdf

The varieties of taro cultivated by the Hawaiians

http://www.hawaiihistory.org/index.cfm?fuseaction=ig.page&PageID=533

Recent Genetic Studies of Some Special Marine Species

- Hawaiian Bobtail Squid – Eye and Skin Genes are similar, the reason behind its ability to mimic its surroundings. http://insciences.org/article.php?article_id=5630
  - More info on the Hawaiian Bobtail Squid
  - http://www.thecephalopodpage.org/Escolopes.php
  - http://scholarspace.manoa.hawaii.edu/bitstream/10125/2570/1/vol56n3-347-355.pdf
- The Seahorse Hawaii Foundation http://www.seahorsehawaii.com/ocean_conservation/

- Hawaii Algae Biofuels
  - http://the.honoluluadvertiser.com/article/2007/Dec/12/bz/hawaii712120377.html
  - http://www.oilgae.com/blog/2006/10/high-octane-algae-biodiesel-research-in.html High Octane Algae – Biodiesel Research in Hawaii
  - More info on algae biofuel http://www.pbs.org/wgbh/nova/sciencenow/0406/02-ask.html
- Other marine organisms
  - Sea Urchins- its genes could help heal humans. http://www.sciencedaily.com/videos/2007/0304sea_urchins_reveal_medical_mysteries.htm
  - Fruitflies and Jellyfish help identify genetic switches. http://video.pbs.org/video/1503825140/

Closing Questions

- Write about the different ways genetics has been used both in the past and the present.
- Give examples of how genetics may hurt and/or help society.
- How is the Ancient Hawaiians' use and understanding of genetics similar or different from that of present day genetics?