Introduction to Genetics

GEMS 2014 Prateek Yadav

Title: Nice Genes

Synopsis: Students will explore many of the different ways that genetics plays a role in everyday life through the use of exploring their own traits and doing hands-on activities.

Purpose: For students to be introduced to the concept of genetics and understand why or how living things are the way they are now through the process of evolution.

Next Generation Science Standards:

Students who demonstrate understanding can:

MS-LS3-1.	Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [*Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.*]
LS3.A: Inheritance of Traits	Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)
LS3.B: Variation of Traits	In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)

Developing and Using Models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)
MS-LS3-2.	Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

Objectives:

- Understand general concept of DNA and genes
- Know the difference between dominant vs. recessive traits
- Make the connection between why and how some traits are affected by environmental changes
- Construct Punnett squares and understand how and why they are used
    - Genotype vs. Phenotype
- Understand Darwin's theory of Natural Selection (survival of the fittest)
- Learn the importance of how scientists use genetics to benefit us (breeding ideal traits in animals, plants…)

Introduction: All living things – humans, plants, animals – have various unique sequences of DNA. It acts as a type of instruction manual for cells. It DNA is made up of nucleotides that consist of a sugar, a phosphate group, and a nitrogen base (adenine, thymine, guanine, cytosine – ATGC) bonded together in a double helix shape. The letters of the nitrogen bases are lined up and make three-letter words (codons) that form a sentence. This sentence would be a **gene**. Genes are what helps determine basically how we are – our physical characteristics and even how we smile or laugh. Genes are passed on from parent to offspring during reproduction. They play a role in determining what traits we will express in our lives.

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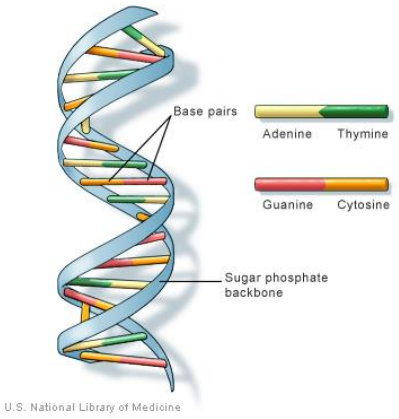

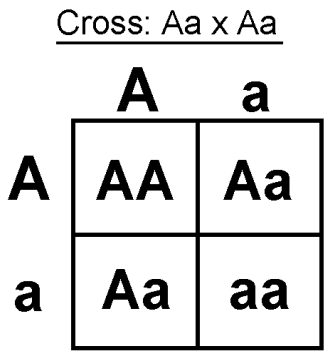

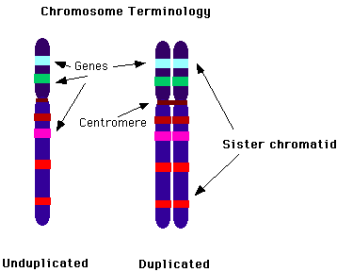

Career Connections:

- Anthropologist – search for ancient existence and track evolution. Deal with fossils
- Geneticist – explore human genes and discover new information about the functions of each one. Can explore various things such as specific diseases and disorders
- Forensic scientist/pathologist – deal with figuring out information of dead people to determine cause of death.
- Molecular Biologist – research how or why specific factors affect an individual's DNA

Activity 1

Materials

- Worksheet
- Pencils

Set-up

- Make worksheet that has a list of questions such as: "How many in your group have straight hair? Curly hair? Wavy hair?" "How many in your group have freckles? No freckles?" "How many can roll his or her tongue? Can't?" etc. for many different traits

Procedure

- Have all students take out worksheet and look over questions
- Work as a whole table and read each question out loud.
- Have students observe each other at the table to see who has whatever trait
- Have students write down the numbers of each trait.

- When tables are done, as a class go over and add up all the numbers for each trait
- Discuss results

Discussion questions
Why may some people have a particular trait while others do not have that trait?
Why are there a large number of people who have this particular trait?
Why are there a small number of people who have this particular trait?
Introduce Dominant vs. Recessive

Activity 2

Materials
- Worksheet
- Blank Paper
- Pencils, colored pencils, markers, crayons
- 1 dice per pair

Set-up
- Everyone gets punnett square worksheet
- Each pair gets one blank sheet of paper

Procedure
- Split your table up into pairs
- Each pair has one piece of paper
- Work on the punnett squares as partners
- After punnett squares are finished, roll the dice until you get a number that is on each punnett square. This number will determine what genotype you will have. Circle the one you got
- Use the key to see what the phenotype of the chosen genotype is
- Students must draw a figure that contains all the traits they picked
- If there is extra time at the end: tell very short stories of things occurring that would kill off creatures with certain traits (environmental changes, or something silly) and see whose creature survives (natural selection, survival of the fittest).

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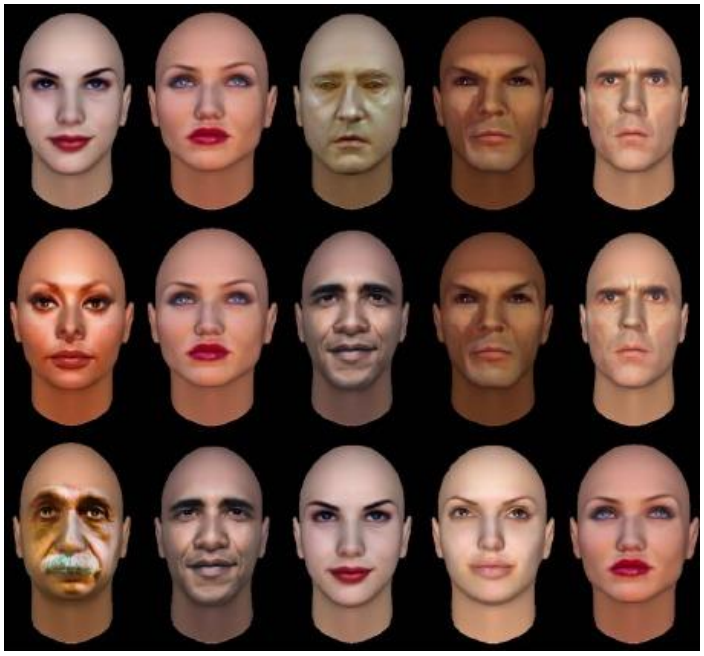

Discussion questions

Reiterate with the students which traits they have are dominant and which are recessive.

Explain about probabilities of the genotypes.

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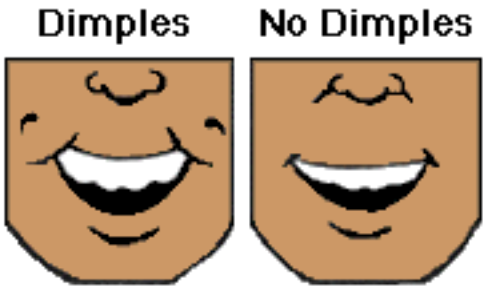
Activity 1: My Genes Worksheet

How many people in your group…

Have freckles? _____ No freckles? _____

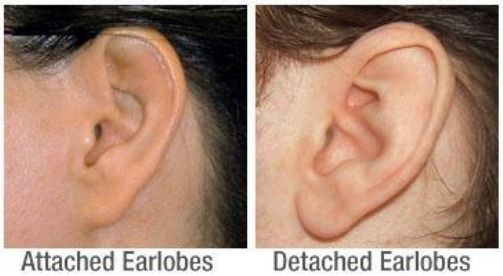
Freckles No Freckles

Have dimples? _____ No dimples? _____



Have straight hair? _____ Wavy hair? _____ Curly hair? _____

Have attached earlobes? _____ Detached earlobes? _____



Attached Earlobes Detached Earlobes

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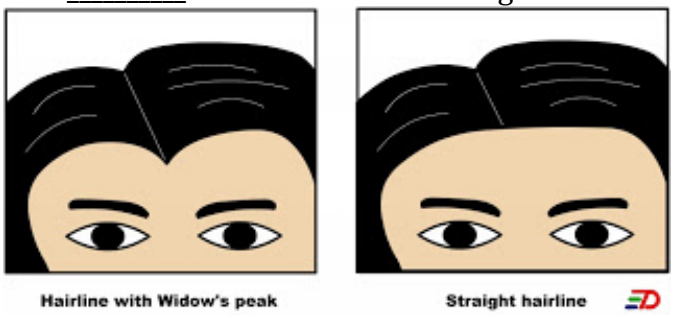
Have a widow's peak? _____ Straight hair line? _____



Can roll their tongue? _____ Can't roll tongue? _____

Can taste PTC? _____ Can't taste PTC? _____

Why do you think some people have a certain trait while others do not?

Why are there a large number of people who have this particular trait?

Why are there a small number of people who have this particular trait?

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Activity 2: Build-a-Thing!

<u>Head shape</u>

	H	h
H	1	2
h	3	4

Eyes

	E	e
E	1	2
e	3	4

Nose

	N	n
N	1	2
n	3	4

Ears

	A	a
A	1	2
a	3	4

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Hair

	R	r
R	1	2
r	3	4

Mouth

	M	m
M	1	2
m	3	4

Arms

	S	s
S	1	2
S	3	4

Legs

	L	l
L	1	2
l	3	4

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Height

	G	g
G	1	2
g	3	4

Tail

	T	t
T	1	2
t	3	4

Key

RR – Curly hair
Rr – Straight hair
rr – no hair

EE – One eye
Ee – two eyes
ee – five eyes

NN – Elephant nose
Nn – Beak
nn – pig nose

AA – Elf ears
Aa – droopy dog ears
aa – rabbit ears

HH – round head shape
Hh – oval head shape
hh – long head shape

MM – Buck tooth
Mm – Fangs
mm – beak

SS – Wings
Ss – tentacles
ss – claws

LL – horse legs
Ll- giraffe legs
ll – bird legs

GG – Tall
Gg – medium
gg – short

TT – alligator tail
Tt – horse tail
tt – rabbit tail