Unit 3: Introduction and Lesson 2
Unit Introduction: This unit studies the questions: “What is natural selection and why is natural selection the driving force of biological evolution”. Through the study of genetics and biotechnology, this unit will look at what factors influence species’ survivability as well as the evolution of populations and speciation.

This general 10th grade biology course strives to teach students how to think for themselves, sift through information, come up with hypotheses, back them up with data, and put the scientific inquiry skills to use in other problem solving situations. The course is designed to introduce students to: the study of living organisms, the environment, ecological concerns, animal diversity, living cells, biological evolution, the interdependence of organisms, genetics, biotechnology, ethics, and the energy use of organisms.

Time Frame: Thirty class periods, 45 minute class periods (to be interwoven throughout the first semester of biology) and one day for field trip to the Arizona Museum of Natural History.

Unit Outline:
Lesson 1: Cube Activity and “What is Science” Activity
Lesson 2: Alike, but not the Same Activity: Intro to Genomics
Lesson 3: Constructing a Paper Helix
Lesson 4: The Size of the Genome Activity
Lesson 5: Gel Electrophoresis of Dyes Lab
Lesson 6: DNA Extraction from Fruits
Lesson 7: DNA Fingerprinting Lab
Lesson 8: Microarray Lab
Lesson 9: Pre-Field Trip Lesson Plan Classification Systems: Classifying Foam Shapes
Lesson 10: Field Trip Lesson Plan: The Arizona Museum of Natural History Field Trip
Lesson 11: Post Field Trip

Grade Levels: 10th grade

Subject/Topic Areas: Natural Selection and Biological Evolution
Genotypic and Phenotypic Variations
Environmental Factors
Fossil Records
Biological Classification Systems

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School District: Chino Valley Public School District #51
School: Chino Valley High School, Chino Valley, Arizona

IDENTIFY DESIRED RESULTS
What enduring understandings are desired?
1. Genotypic variation occurs and results in phenotypic diversity, which can result in adaptations that influence an organism’s success in an environment.
   AZ State Standard: Strand 4, Concept 4, PO 2.
2. Natural selection is the driving force for biological evolution.
   AZ State Standard: Strand 4, Concept 4, PO 3.
3. The fossil record along with nuclear chemistry, geology, molecular biology, geographical distribution, and DNA analysis give support to the theory of evolution through natural selection.
   AZ State Standard: Strand 4, Concept 4, PO 5.
Behavioral Objectives: TSW

1. Analyze the importance of finding evidence to help support the understanding of important concepts.
2. Design and conduct an experiment using scientific inquiry skills.
3. Analyze data from experimentation and appropriately communicate the findings.
4. Explain how genotypic variation occurs and why it can result in phenotypic diversity.
5. Identify different components of natural selection.
6. Explain how natural selection is the driving force behind biological evolution.
7. Explain how genotypic and phenotypic variation can result in adaptations that influence a species success in an environment.
8. Analyze patterns in the fossil record, nuclear chemistry, geology, molecular biology, geographical distribution and DNA analysis which give support to the theory of biological evolution through natural selection resulting in the present day biodiversity.
9. Utilize different methods of classification systems to determine the relatedness among various species.
10. Design a cladogram comparing the degree of relatedness among six dinosaurs, six birds, and six reptiles.
11. Become proficient in different biotechnology techniques.

2–6 are adapted from the Arizona Science Standard Performance Level Descriptors for High School.

What essential questions will guide this unit and focus teaching and learning?

Essential Questions:

1. How is natural selection an underlying force of Biological Evolution?
2. How does genetic research support the patterns in the fossil record, giving support to the theory of Biological Evolution?
3. How has biotechnology changed science and led to the formation of new species?
4. Is genetic engineering a form of natural selection?
5. Have bacteria that are resistant to antibiotics been naturally selected?
6. Are dinosaurs, in fact, more related to birds than reptiles?

The next chart is a tentative outline of when to teach the lessons focusing on Biological Evolution and the use of biotechnology to teach those lessons. The sequence starts at the beginning with what science is and moves on through a series of activities ending with analyzing different fish proteins for the degree of relatedness among the different species of fish tested. The activities are only mapped out for the first 10 weeks of the semester. Obviously, due to different needs of different classes, the activities may be changed around and spread throughout the first semester or even year depending upon the needs of the students. The chart is meant to be used in conjunction with the rest of the unit plan for continuity.
2nd Week: Alike, but not the Same Activity: Intro to Genomics
(Activity 1 in Relating Genetics to Everyday Life book)

Time Planned for activities: two class periods (50 minutes each): 1 class period to do activity, the other to do graphs and data analysis

Student Prior Knowledge:
Preferably the knowledge of how to make graphs, but not entirely necessary.

Knowledge Gained from Lesson:
- The students will distinguish between genotypes and phenotypes.
- Students will determine the various factors of genetic variability and how that leads to a species’ survivability.
- Students will produce an easy to comprehend graph of the class results.

Concepts to be covered after this lesson:
- The students will be working with genetic variability all year.
- The students will be leading up to natural selection and Biological Evolution.

Arizona Standards:
Science Standards
- Strand 4: Concept 2: PO3
- Concept 4: PO2
- Strand 1: Concept 2: PO5
- Concept 4: PO2

NSES
Science as Inquiry NSES p.175
Life Science
- The molecular basis of heredity NSES p.185
- Biological evolution NSES p.185

Referenced Common Misconceptions:
“Pupils appear to understand little of the nature or function of genes and chromosomes, not appreciating that there is a chemical basis to inheritance.” (Driver, et al., pg 52).

Essential Questions:
What is the difference between genotype and phenotype?
How is a lab notebook set up?

Student Behavioral Objectives:
- Students will distinguish between genotype and phenotype.
- Students will graph the class results in an easy to understand graph.
- This should be the first lab that goes into the student’s lab notebook so that they can start setting up their notebook.
Description of the lab:
Students conduct an inventory of traits that are similar and different in the classroom. They make histograms of the data to help them understand the relationship between genotype and phenotype.

Inquiry: 3. Work in groups of 2 to 3 students.

Materials:
Handout copies (from Activity)
A clean white board to put the data on. Please read the protocol for a complete list of materials.

Safety Considerations: None

Assessments:
Pre-assessment: A pre-test will be given to assess students’ current knowledge on making graphs and differences between phenotypes and genotypes.

Participation: Question and answer session,
Performance base: during and after the lesson.
Graphs to be turned in for grading. Lab notebook should follow specified format.

Real world connections: Examples of genetic variations in nature and how they may help a population of specie’s survive. Example could include the pepper moth.