SCIENCE 10th Grade Biology Pacing Guide

Biology is a required course for New Haven students, to be taken before 11th grade. It focuses on science literacy; a combination of understanding major science concepts and theories, using scientific reasoning and inquiry, and recognizing the complex interactions between science, technology and society. The major topics include cells and biochemistry, genetics and evolution, bacteria/viruses, populations and ecosystems and living organisms structure and function. This is a full year laboratory science course where students will use science inquiry, literacy and numeracy skills.

Quarter 1

-UNIT 1 Chemistry of Living Things

10.c.5 (National Standard) Life Science: matter, energy, and organization in living systems.

Enzyme Function**** D.29 Describe the general role of enzymes in metabolic cell processes.***

ST: Apple Juice Embedded Performance Task.

-UNIT 2 Cells, Bacteria & Viruses

*** D.31 Describe the similarities and differences between bacteria and viruses.**

Cell Membrane ***D.30 Explain the role of the cell membrane in supporting cell functions.***

D.27 Describe significant similarities and differences in the basic structure of plant and animal cells.

Quarter 2 Heredity/Genetics & Evolution

-UNIT 3 Heredity/Genetics

*** D.36 Explain how meiosis contributes to the genetic variability of organisms.**

D.34 Describe, in general terms, how the genetic information of organisms can be altered to make them produce new materials.

D.35 Explain the risks and benefits of altering the genetic composition and cell products of existing organisms.

D.37 Use the Punnett Square technique to predict the distribution of traits in mono- and dihybrid crossings.

D.28 Describe the general role of DNA and RNA in protein synthesis.

D.38 Deduce the probable mode of inheritance of traits (e.g. recessive/dominant sex-linked) from pedigree.

*** D.33 Explain how bacteria and yeasts are used to produce foods for human consumption.**

ST: STS Bioengineered Foods Pamphlet.

-UNIT 4 Evolution

*** D.41 Explain how the fossil record provides a scientific explanation for evolution.**

D.40 Explain how the process of genetic mutation and natural selection are related to the evolution of species.

D.42 Describe how structural and behavioral adaptations increase the changes for organisms to survive in their environments.

ST:

Quarter 3 Diseases & Populations

-UNIT 5 Diseases/ *Populations*

*** D.39 Describe the difference between genetics disorders and infectious diseases.**

D.32 Describe how bacterial and viral infectious diseases are transmitted, and explain the roles of sanitation, vaccination and antibiotic medications in the prevention and treatment of infectious diseases.

ST: Yeast Growth Embedded Performance Task.

*** D.44 Explain how change in population density is affected by emigration, immigration, birth rate and death rate, and relate these factors to the exponential growth of human populations.**
D.43 Describe the factors that affect the carrying capacity of the environment.
D.45 Explain how technological advances have affected the size and growth rate of human populations throughout history.
ST: STS Human Population Growth.
CAPT TEST 1st Week of March
UNIT 7 10.c.4 (National Standard) **Interdependence of organisms.**
UNIT 8 10.c.6 (National Standard **Behavior/Structuree of organisms.**

DINQ1 Identify questions that can be answered through scientific investigation.

DINQ2 Read, interpret and examine the credibility and validity of scientific claims in different sources of information.

DINQ3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

DINQ4 Design and conduct appropriate types of scientific investigations to answer different questions.

DINQ5 Identify independent and dependent variables, including those that are kept constant and those used as controls.

DINQ6 Use appropriate tools and techniques to make observations and gather data.

DINQ7 Assess the reliability of the data that was generated in the investigation.

DINQ8 Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.

DINQ9 Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.

DINQ10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

I. Grade/Course Title: *10th Grade Biology*

a. Course Overview/Description: Characteristics of Living Organisms

b. Marking Period 1

II. Unit/ Title: Unit 1 The Characteristics of Life

Unit Length (Time): 3 weeks

a. Unit Introduction:

In this unit the students will be able to list and explain the characteristics that all living organisms share. The chemistry of living organisms, specifically the four organic molecules (carbohydrates, proteins (amino acids), lipids, and nucleic acids) found in living organisms, are identified and described. In the study of proteins, specifically enzymes, **students will describe the role of enzymes in metabolic cell processes (D.29)** and maintaining a constant internal environment**.** Enzymes that function only in a narrow range of temperature and acidity conditions catalyze most of the chemical activities of the cell. The study of the structure and function of enzymes leads into the apple juice embedded performance task.

Objectives:

- Define organism.
- Name the important characteristics of living organisms.
- Distinguish between organic and inorganic compounds.
- Name the four organic molecules found in living organisms.
- Recognize the structure and identify the function and importance of the four major organic molecules (carbohydrates, proteins, lipids, and nucleic acids).
- Explain the role of enzymes as structural components of cells and their functions as catalysts in biochemical reactions.
- List examples of enzymes (salivary amylase, pectinase, cellulase, etc.).
- Explore enzyme activity activity by changing independent variables such as temperature, pH, and enzyme/substrate concentration.
- Analyze the relationship between the properties of water and living systems in an osmosis activity.

b. Standards for Unit 2

- **10.c.5 (National Standard) Life Science: matter, energy, and organization in living systems.**

Enzyme Function

- *** D.29 Describe the general role of enzymes in metabolic cell processes.**

- **ST:** Apple Juice Enzyme Embedded Performance Task.

c. Essential Questions

- What are the characteristics that all living things share?
- How do inorganic and organic compounds differ?
- What is the structure and function of an enzyme?
- What are the four organic molecules found in all living organisms?

d. **Essential Concepts/Content**

1. Organisms share similar characteristics and chemical composition.
2. There are four main classes of organic molecules: carbohydrates, proteins, lipids, and nucleic acids.

3. Enzymes are necessary to speed up the chemical reactions that occur in organisms.

e. Essential Skills

1. Identify question(s) for the apple juice enzyme problem that can be answered through scientific investigation.
2. Formulate a testable hypothesis about which type and amount of enzyme (pectinase or cellulase) will produce the most and cheapest apple juice.
3. Design and conduct an appropriate type of scientific investigation to solve the question: You and your lab partner will design and conduct an experiment to determine which enzyme or combination of the two enzymes maximizes juice production.
4. Identify the independent and dependent variables, including those that are kept constant and those used as controls in the apple juice enzyme lab.
5. Use appropriate tools and techniques to make observations and gather data for the question and scientific investigation formulated for the apple juice lab.
6. Assess the reliability of the data that was generated in the apple juice lab investigation.
7. Articulate conclusions and explanations based on research data, and assess results based on the design of the apple juice investigation.
8. Communicate about the apple juice investigation in an article using relevant science vocabulary, supporting evidence and clear logic (Examples of articles provided from NY Times, *Scientific American, Popular Science, Discover, Seed, American Scientist*. Challenge students with examples from *Nature, Science).*

f. Vocabulary

atom
hydrogen
carbon
nitrogen
oxygen
phosphorous

molecule

organic compound
inorganic compound

polymer
reactant(s)
product(s)

carbohydrate
amino acid
protein

nucleic acid
DNA (introduce term)
lipid

enzyme
substrate
active site
organism

homeostasis
response
stimulus
response

g. Science Misconceptions

Enzymes can be reused until they are damaged/denatured.

h. Recommended Activities

- ST Apple Juice Enzyme Embedded Performance Task.
- NeoSci Unit 1 Biotechnology Techniques Lab: Simulate the process of restriction enzyme digestion. "Understanding Enzymes" NeoSci kit.
- Identify objects as living/non-living.
- Hubbard Scientific Enzyme Experiment Kit.
- NeoSci Understand Enzymes Investigation.
- Make models of organic molecules (examples: use gumdrops and toothpicks, proper modeling kits, or illustrate *Biology Coloring Book* images.
- Design models to demonstrate an understanding of the role of enzymes in biological systems.
- United Streaming video segment on the structure and function of enzymes.
- United Streaming video on the characteristics of life.

i. Resources

- State of Connecticut web site for Significant Tasks: http://www.sde.ct.gov/sde/lib/sde/word_docs/curriculum/science/science_capt_handbook_part3_2006.doc

- United Streaming – search for videos that match standards.
- Textbook.
- Internet.
- http://www.cellsalive.com**.**
- Multimedia presentations.
- Current event articles.
- "Structure of Life" NIH 01-2778 www.nigms.nih.gov
- Free DVDs from Howard Hughes Medical Institute at http://www.hhmi.org/catalog/main?action=home.
- http://serendip.brynmawr.edu/sci_edu/waldron/

IV. Significant Tasks (ST): Enzyme Apple Juice Lab (CAPT)

a. Significant Task Introduction

Students will be able to identify the best enzyme for juice production and variables that affect the ability of an enzyme to function. This curriculum-embedded science performance task is related to the content standards and expected performances for high school, as described in the Core Science Curriculum Framework, under Scientific Inquiry, Literacy and Numeracy, Strand IV – Cell Chemistry and Biotechnology.

b. Length/Timing: 3 days (at least 3, 45-minute periods)

c. Essential Questions

1. What is the cheapest enzyme or enzyme combination to make applesauce?
2. How does an enzyme function?
3. Which enzyme or enzyme combination maximizes juice production.

d. Assessment Tools:

- Have the students write a lab report and assess the lab report with the CAPT lab report rubric.
- Released CAPT questions.

e. Procedure:

1. Read through significant task with students.
2. Explain CAPT lab rubric to students.
3. Students identify variables and control group for the task.
4. Students write experimental design to solve the tasks identified in the enzymes lab.
5. Teacher approves student experimental design.
6. Students perform experiment.
7. Students record and graph results.
8. Students analyze results.
9. Students form a conclusion.
10. Students discuss applications and limitations.

I. Grade/Course Title: *10th Grade Biology*

a. Course Overview/Description: Fundamental life processes depend on the physical structure and the chemical activities of the **cell and the cell membrane**. A comparison between bacterial, viral, animal, plant and yeast cells.

b. Marking Period 1

II. Unit/Title: Unit 2 The Cell Structure and Function. Bacteria, viruses, yeast, and other microorganisms.

Unit Length (Time): 4 weeks

a. Unit Introduction

In this unit, students will review cell parts and their functions. After this review, students will survey the **differences and similarities between bacteria, virus, and animal and plant cells (D.27 & D.31).** After the similarities and differences are studied, the study of the cell narrows to **the role of the cell membrane in supporting cell functions (D.30).**

Objectives:

- Distinguish between prokaryotic and eukaryotic cells.
- Describe how the change from prokaryotic to eukaryotic cellular structure allowed for the increased complexity of organisms.
- List the parts of the animal, plant, and bacterial cell.
- Compare the structure of an animal cell and a plant cell.
- List and describe the types of cells that contain cell walls.
- List the differences between the animal, plant, and bacterial cell.
- Compare and contrast bacterial, plant, and animal cells.
- Identify the cell membrane as the regulator of transport of materials into and out of cells.
- Compare and contrast viruses and cells, both prokaryotic and eukarytic.
- List the parts and functions of the parts of the viral cell.
- Describe why viruses are not considered living things.

b. Standards Unit 2

*** D.31 Describe the similarities and differences between bacteria and viruses.**

D.30 Explain the role of the cell membrane in supporting cell functions.

D.27 Describe significant similarities and differences in the basic structure of plant and animal cells.

c. Essential Questions

- Drawing on your knowledge of molecular structure, what is the essential role the phospholipids play in cellular functioning?
- What is the function of the cell membrane?
- What is the term for the flow of water across the cell membrane?
- What are the differences between the plant, animal, yeast, and bacterial cell?
- Why is a virus not considered a living organism?

d. Essential Concepts/Skills

1. The main differences between bacteria and viruses.
2. The main similarities and differences between plant and animal cells.
3. The role of the cell membrane in supporting cell functions.

e. Essential Skills

1. View pictures of plant, animal, yeast and bacterial cells.

2. Recognize and illustrate plant, animal, yeast, and bacterial cells.

3. Properly use of the microscope to make drawings of plant and animals cells.
4. Communicate about cells and cell function in discussion format after viewing www.cellsalive.com or other animated media.
5. Use appropriate tools and techniques to make observations and gather data from the plant and animal cells in labs.
6. Use appropriate tools and techniques to make observations during the cell membrane lab(s) and gather data.

f. Vocabulary

Organelle / Cell structure terms
cell
prokaryote
eukaryote
cytoplasm
cell membrane
phospholipid
membrane-bound
organelle
golgi appartus
endoplasmic reticulum
nucleus
nuclear envelope
chromosome
DNA
mitochondria
vacuole
cell wall
chloroplasts

yeast
protist
flagella

Respiration terms
carbon cycle
respiration
combustion
glucose
ATP

Photosynthesis terms
carbon cycle
photosynthesis

glucose
algae
plastid

Microbiology terms
microbe
bacteria
endospore
pilus
conjugation

Virus terms
virus
capsid
coat
plasmid
DNA
RNA
reverse transciptase

Diffusion/Osmosis terms
passive transport
active transport
osmosis
diffusion
semipermeable
hypertonic
hypotonic
isotonic

g. Science Misconceptions

- Viruses, bacteria (prokaryotic cells) and eukaryotic cells are not all the same size.
- Viruses are not living organisms.
- Cells are not made from atoms, cells and atoms are the same things, cells and atoms are the same size.
- Cells can be viewed without magnification (ie eggs and grapes are just big, individual cells).

h. Recommended Activities

- View plant and animal cells under the microscope to view similarities and differences.
- Dialysis diffusion lab.

- The Science Source Cell Structure #1700 lab (www.thesciencesource.com).
- Search & view United Streaming Videos that match standards.

i. Resources (suggested)

1. Microscopes.
2. Slides (prepared/unprepared).
3. Diffusion tubing.
4. Sugar.
5. Eggs.
6. White vinegar.
7. Salt.
8. Onions.
9. Iodine solution.
10. Parafilm.
11. Plastic wrap.
12. Plastic baggies.
13. Transparencies/pictures of animal cells, plant cells, bacteria cells, viruses.
14. Textbook.
15. Internet.
16. Multimedia presentations.
17. Current event articles.
18. http://serendip.brynmawr.edu/sci_edu/waldron/

IV.Significant Tasks (ST): The Osmosis in Grapes

a.Significant Task Introduction

In this significant task, students will observe the process of osmosis across a semi-permeable cell membrane. Students will design and conduct an experiment to identify which type of relationship (direct or inverse) exists between the concentration of water outside of plant cells (grapes) and the percent change in mass of those plant cells (grapes). This curriculum embedded performance task is related to the content standards and expected performances for high school, as described in the Core Science Curriculum Framework, under Scientific Literacy and Numeracy, Strand IV – Cell Chemistry and Biotechnology.

b.Length/Timing: 2 days (Lab needs to be run at least 2 consecutive days, as grapes need at least 24 hours in the salt solution).

c.Essential Questions:

1. What is osmosis?
2. What is a semi-permeable membrane?
3. Why do some substances move across a semi-permeable membrane and not others?
4. Describe what causes water to move from higher to lower concentration.
5. Why does fruit look shriveled up after it dries out?

d.Assessment Tools:

- CAPT lab rubric to assess the lab report.

- Osmosis in Grapes questions. Use CAPT rubric to assess the open-ended questions.

e.Procedure:

1. Students read the lab background, relationships between variables, and the task of Osmosis in Grapes.
2. Students write an experimental design that matches the lab task: You and your partners will design and conduct and experiment to identify which type of variable (direct or indirect) exists between the concentration of water outside of plant cells (grapes) and the percent change in mass of those plant cells (grapes).
3. Students perform experiment after approval of experimental design.
4. Students observe, record data in a table, and calculate their results.
5. Students write a lab report using CAPT lab format.
6. Teachers grade lab reports with CAPT lab rubric.
7. Students complete the Osmosis in Grapes lab questions.
8. Teachers grade the Osmosis in Grapes lab questions using open –ended question rubric.

Grade/Course Title: *10th Grade Biology*

a. Course Overview/Description: The sorting and recombination of genes in sexual reproduction results in a great variety of possible gene combinations in the offspring of any two parents. The information passed from parents to offspring is coded in DNA molecules.

b.Marking Period 2

Unit/ Title: Unit 3 Heredity/Genetics

Unit Length (Time): 5 weeks

a. Unit Introduction:

In this unit, the students will be able to explain how meiosis contributes to the genetic variability of organisms (D.36). Meiosis is a type of cellular reproduction that produces sex cells, which allows organisms to pass on their genetic information to their offspring. The concept of DNA/RNA and protein synthesis and meiosis will transition to the study of genetics and heredity, especially how **the genetic information of organisms can be altered to make them produce new materials (D.34)** and **the risks and benefits of altering the genetic composition and cell products of existing organisms (D.35).** The study of genetics will focus on showing **the results of genetic crosses using mono- and dihybrid crosses (D.37).** Once students master the concept of genetic crosses, they will use this skill to interpret pedigree charts: **the genetic history (recessive/dominant, sex-linked) of families can be traced with the use of a pedigree (D.38). Describe the general role of of DNA in protein synthesis and cell reproduction (D. 28)** At the end of this unit, the students will **explain how bacteria and yeasts are used to produce foods for human consumption (D.33).** As a concluding activity, the students will create a pamphlet that takes a position on whether or not bioengineered foods should be labeled.

Objectives:

- Analyze the characteristics and chemical structure of DNA (deoxyribonucleic acid) and RNA (ribonucleic acid).
- Explain how DNA and RNA molecules are replicated.
- Summarize the process of DNA replication.
- Describe the importance of the genetic code.
- Explain the roles of mitosis and meiosis in reproductive variability.
- Explain how meiosis contributes to the genetic variability of organisms.
- Recognize that meiosis involves DNA replication followed by two divisions in order to reduce the chromosome number by half.
- Analyze the effects of crossing-over on variation in offspring.
- Understand the differences between egg and sperm production.
- Define fertilization as the combination of haploid gametes to produce a diploid zygote.
- Discuss the work of Gregor Mendel with pea plant traits.
- Describe in general terms, how the genetic information of organisms can be altered to make them produce new materials.
- Explain the risks and benefits of altering the genetic composition and cell products of existing organisms.
- Use the Punnett Square technique to predict the distribution of traits in mono- and dihybrid crosses.
- Analyze the results of mono- and dihybrid crosses.
- Describe the general role of DNA and RNA in protein synthesis.

- Deduce the probable mode of inheritance of traits (e.g. recessive/ dominant, sex-linked) from a pedigree.
- Use a pedigree to interpret patterns of inheritance within a family.
- Identify phenotypes as the expression of inherited characteristics.
- Explain how bacteria and yeasts are used to produce foods for human consumption.
- Explain how organisms, such as yeast and bacteria, respire without oxygen present.

a.Standards Unit 3

- **D.36 Explain how meiosis contributes to the genetic variability of organisms.**
- D.34 Describe, in general terms, how the genetic information of organisms can be altered to make them produce new materials.
- D.35 Explain the risks and benefits of altering the genetic composition and cell products of existing organisms.
- D.37 Use the Punnett Square technique to predict the distribution of traits in mono- and dihybrid crossings.
- D.28 Describe the general role of DNA and RNA in protein synthesis.
- D.38 Deduce the probable mode of inheritance of traits (e.g. recessive/dominant sex-linked) from pedigree.
- **D. 33 Explain how bacteria and yeasts are used to produce foods for human consumption.**

b.Essential Questions

- What is a monohybrid cross? A dihybrid cross?
- Explain the difference between phenotype and genotype.
- Explain the difference between homozygous and heterozygous.
- What does meiosis produce?
- How does meiosis provide genetic variation in a species?
- How does a DNA molecule control the activities of a cell?
- How does DNA/RNA contain the information needed to make a living organism?
- Why must reproductive cells contain half the normal number of chromosomes?
- What is a sex-linked disorder?
- How does a mutation arise?
- Should bioengineered foods be labeled?

e.Essential Concepts

1. How to create and use a Punnett Square to predict the probability of outcomes of monohybrid and dihybrid crosses.
2. The stages and end product of meiosis (oogenesis and spermatogenesis).
3. The importance of meiotic crossing over in metaphase to introduce genetic variation.
4. The importance of the discoveries made by Gregor Mendel with pea plants.
5. How to trace a genetic disease through a pedigree chart.
6. The difference between dominant and recessive.
7. The genotype is the genetic makeup of an organism. The phenotype is is the appearance of an organism.
8. Discuss the chemical structure of a nucleotide.
9. DNA replication and mRNA transcription.

10. DNA and RNA transcription/replication.
11. Summarize the process of DNA replication.
12. During transcription, DNA acts as a template for directing the synthesis of RNA.
13. Translation is protein generation, at the ribosome, based on the DNA code transcribed to RNA.

f. Essential Skills

- Read, interpret and examine the credibility and validity of scientific claims in different sources of information for the bioengineered food STS.
- Assess the reliability of the data that was generated in the bioengineered food STS.
- Articulate conclusions and explanations based on research data for the bioengineered food STS, and assess results based on the design of the investigation.
- Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic in the bioengineered food STS and other activities.
- Use mathematical operations to analyze and interpret Punnett Squares.
- Interpret the results of monohybrid and dihybrid crosses.
- Use appropriate tools and techniques to make observations and gather data.
- Identify genetics questions that can be answered through scientific investigation.

f. Vocabulary

Heredity & Genetics terms
heredity
genetics
trait
gene
allele
replication
DNA
hydrogen bond
base pair
complementary
mutation
genetic engineering
sexual reproduction
zygote
genetic code
ribosome
bacteria
yeast
X, Y chromosome
genetic disorder (trisomy 21, Kleinfelter's, Turner's syndromes)

Genetic crosses
purebred
hybrid
dominant
recessive
homozygous
heterozygous

genotype
phenotype
Punnett square
monohybrid
dihybrid
distribution

Meiosis (NOTE: MITOSIS?) terms
meiosis
diploid
haploid
autosome
sex cell = "germ" cell
somatic cell
egg
sperm
fertilization
homologous
chromosome
chromatid
centromere

Altering DNA
mutation
cloning
biotechnology
bioengineering

Protein Synthesis
code / codon
mRNA
tRNA
transcription
translation
protein synthesis

Pedigree
Pedigree
inheritance

Science Misconceptions

- All mutations are bad.
- All mutations occur after birth.

Recommended Activities

- Create a pedigree for a trait**.**
- Design and construct a model of the DNA molecule showing its structure and demonstrating the process of reproducing itself.
- Practice sample monohybrid and dihybrid crosses.
- Demonstrate and illustrate the stages of meiosis.
- United Streaming.
- View the *Miracle of Life. Odyssey of Life* is newer, and also very good
- NeoSci Introduction to Genetic Engineering – Bacterial Transformation Investigations:
  - Understand the techniques used in genetic engineering.
  - Demonstrate the process of bacterial transformation.
- Unit 4 Biotechnology & Medicine Investigations:
  - Prepare a human karyotype from an unknown chromosome spread.
  - Predict diseases by the presence of genetic abnormalities.
  - Determine the sex of an individual by analyzing the sex chromosomes present.
- NeoSci Biotechnology for Young Scientists Investigations:
  - Isolate and observe DNA from onion cells.
  - Describe the appearance and physical characteristics of isolated DNA.
- Unit 1 Biotechnology Techiques Lab Investigations:
  - Study the structure and function of DNA.
  - Simulate the process of DNA replication.
  - Understand how restriction enzymes are used.
  - Simulate the process of electrophoresis.
  - Simulate the creation of recombinant DNA.
  - Identify advances and uses of biotechnology and debate the risks and benefits.
- Unit 5 NeoSci Biotechnology & Agriculture Investigations:
  - Identify and describe the genetic material in living organisms.
  - Understand the connection between DNA and the characteristics possessed by an organism.
  - Understand the processes used to produce transgenic crops.
  - Compare the traits between genetically modified and traditional soybeans.
- Unit 2 NeoSci DNA Extraction Investigations:
  - Isolate and observe DNA from onion cells and describe the appearance and physical characteristics of isolated DNA.
  - Describe the appearance and physical characteristics of isolated DNA.
- STS Bioengineered Foods Pamphlet.

i. Resources

- State of Connecticut web site for Significant Tasks: http://www.sde.ct.gov/sde/lib/sde/word_docs/curriculum/science/science_capt_handbook_part3_2006.doc
- United Streaming – search for videos that match standards.
- Textbook.
- Internet.
- Multimedia presentations.
- Current event articles such as "Genome's Riddle: Few Genes, Much

Complexity"
http://www.nytimes.com/learning/teachers/featured_articles/20010213tuesday.html

- www.nigms.nih.gov free booklets
- http://serendip.brynmawr.edu/sci_edu/waldron/

III. Significant Task (STS) Bioengineered Food

a.Significant Task Introduction

This curriculum-embedded science performance task is related to the content standards and expected performances for Grades 9-10, as described in the Core Science Curriculum Framework, under Scientific Inquiry, Literacy and Numeracy, Strand IV – Cell Chemistry and Biotechnology. Students will research bioengineered foods and form an opinion on whether or not bioengineered foods should be labeled. Students will produce a persuasive pamphlet, stating their opinion and supporting evidence that answers the question: should bioengineered foods be labeled?

b. 3 – 5 days

c. Essential Questions:

1. What are bioengineered foods?
2. Are bioengineered foods safe to eat?
3. Should bioengineered foods be labeled?

d. Assessment Tools: Bioengineered foods

- Correct pamplet with NHPS interdisciplinary rubric.
- Bio-engineered foods released CAPT questions.

e. Procedure

1. Read through Bioengineered Foods Task.
2. Internet research on bioengineered foods.
3. Form an opinion on whether or not bioengineered foods should be labeled.
4. Create pamphlets that answer the question: Should bioengineered foods be labeled?
5. Correct pamphlets with NHPS interdisciplinary rubric.

I.Grade/Course Title: ***10th Grade Biology***

a. Course Overview/Description: 10th Grade Biology, Evolution

b.Marking Period 2

II.Unit/ Title: Unit 4 Evolution

Unit Length (Time): 4 weeks

a. Unit Introduction:

In the unit on evolution, the students will **explain how the fossil record provides a scientific explanation for evolution (D.41).** In this study of fossils and the fossil record, the students will relate their knowledge of fossils and genetics and **explain how the process of genetic mutation and natural selection are related to the evolution of species (D.40)**. Through study of natural selection, students will **describe how structural and behavioral adaptations increase the chances for organisms to survive in their environments (D.42).**

Objectives:

- Define evolution**.**
- Explain natural selection with examples, ie peppered moth (NOTE:

  Update http://www.millerandlevine.com/km/evol/Moths/moths.html)**.**

- Discuss the work of Charles Darwin and the theory of natural selection.
- Identify the effects of mutations leading to adaptations and increased survival of organisms.
- State the effects of variation on survival.
- Identify fossils as evidence of changes in organisms over time.
- Describe the process of fossilization and list the steps in fossil formation.
- Identify types of fossil evidence (rock, frozen, impressions/casts).
- Describe the relationship between genetics and natural selection.
- Identify evidence of evolution.

***b.* Standards for Unit 4**

- **D.41 Explain how the fossil record provides a scientific explanation for evolution.**
- D.40 Explain how the process of genetic mutation and natural selection are related to the evolution of species.
- D.42 Describe how structural and behavioral adaptations increase the changes for organisms to survive in their environments.

c. Essential Questions

- How can living organisms provide evidence about the past?
- **What is evolution?**
- **How are the processes of genetic mutation and natural selection related to the evolution of species?**
- How do structural and behavioral adaptations increase the changes for organisms to survive in their environments?
- What is the fossil record and how does it provide scientific evidence for evolution?
- How are most fossils formed?
- List the types of fossils.
- What is the importance of the fossil record?
- What are Charles Darwin's' discoveries and contributions to biology.

- What are some examples of natural selection?

d. **Essential Concepts/Content**

1. Charles Darwin and the theory of natural selection.
2. Formation of fossils and the fossil record.
3. Evolution is the result of genetic changes, random mutations being the original source of these changes.
4. Morphological and genetic information contained in living and extinct organisms continue to provide us with evidence of evolution.
5. The relationship between genetics and evolution.
6. The evidence living organisms provide for evidence of evolution.
7. The relationship between genetic mutations, natural selection, and evolution.
8. The process of fossil formation.

e. Essential Skills

1. Identification of evidence for the theory of evolution.
2. Identify questions about evolution that can be answered through scientific investigation and research.
3. Read, interpret and examine the credibility and validity of scientific claims about the theory of evolution in different sources of information.
4. Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

f. Vocabulary

Fossil terms
Fossil
Fossil record
Sedimentary rock
Igneous rock
Metamorphic rock
Trilobite
Dinosaur
Mammal
Radioactive dating
Isotope
Half-life

Natural Selection terms
Evolution
Natural Selection
Mutation
Variation
Inherited
Adaptation
Fitness
Frequency (of fittest genes)
Natural selection

Selective pressure
Extinct, extinction

Structural, Behavioral adaptation terms
Morphology
Vestigial

g. Science Misconceptions

Humans descended from monkeys.

Evolution has never been observed.

Lack of a complete set of transitional fossils invalidates theory of evolution.

Evolution is JUST a theory... (For students who have not learned: Theory is substantial idea which is supported by many, many experiments.)

Evolution is controversial in the scientific community.

Recommended Activities/Resources

1. View fossils.
2. United Streaming: search for videos that match standards.
1. Make fossils.
2. View a picture, representation of the fossil record.
3. Create a timeline highlighting milestones of life's evolution on planet Earth. Use a football field if available, if not adding machine tape allows students to create their own (to display and keep)
4. NOVA ScienceNow
5. "Evolution" NOVA DVD (also available on ScienceNow and http://www.pbs.org/wgbh/evolution/
6. Visit the Peabody Museum to view evidence of evolution. FREE visits to New Haven teachers and students in fall and winter, before spring rush. http://www.yale.edu/peabody/
7. Investigate Sickle Cell disease as an example of evolution in humans. Other examples are possible, see http://www.pbs.org/wgbh/evolution/educators/course/session7/explain_b_pop1.html
8. Genetics Education Partnership: http://genetics-education-partnership.mbt.washington.edu/
9. http://serendip.brynmawr.edu/sci_edu/waldron/

Significant Task: Allele Frequencies and Sickle Cell Anemia Lab from http://genetics-education-partnership.mbt.washington.edu/class/activities/HS/sickle-bean.htm

a. Significant Task Introduction

Students will be able to observe how selective forces can change allele frequencies in a population and cause evolution to occur. Selective forces are those that shape a population, such as predation, food availability, and disease. Over time, allele frequencies can change and evolution can occur

due to the selective forces in a population. In this lab, students will simulate the effects of a high frequency of malaria on the allele frequencies of a population. This curriculum-embedded performance science performance task is related to the content standards and expected performances for high school, as described in the Core Science Curriculum Framework, under Scientific Inquiry, Literacy and Numeracy, Strand V – Genetics, Evolution and Biodiversity.

b. Length/Timing: 2 class days (2 45-minute periods or 1 1.5 hour period)

c. Essential Questions

1. How are allele frequencies related to evolution?
2. Why is the frequency of the sickle cell allele so much lower in the United States than in Africa?

d. Assessment Tools:

- CAPT open-ended question rubric to grade analysis questions.
- CAPT lab report rubric to grade lab report (optional).
- Grade completed student lab packets.

e. Procedure

1. Students read the objective of the lab and the background article *Sickle Cell Anemia and Genetics: Background Information.* (The link to this article is in the student instructions).

2.Students read the lab instructions on the student instructions.

3.Students formulate a hypothesis about the results of the experiment using the following question: What do you think will happen to the frequencies of the A and S alleles as a result of the presence malaria?

5. Students read lab procedure.
6. Students perform lab and enter data into provided F1 Cup Tally data table.
7. After the F1 Cup Tally Data table has been completed, the students figure out how many surviving alleles they have and enter this information into the F1 Total Surviving Alleles data table.
8. Students put the survivors into the gene pool and create the next generation, entering this data into the F2 Cup Tally data table.
9. Students record the surviving alleles from the F2 generation in the F2 Total Surviving Alleles data table.
10. The individual groups in the class share their results on the Class Results Table overhead transparency, on the board, etc.
11. Students calculate the percent allele frequency for each allele in each generation
12. Students answer the Analysis Questions.
13. Students write a lab report using CAPT lab format using their individual results (optional).

I.Grade/Course Title: *10th Grade Biology*

a. Course Overview/Description: 10th Grade Biology Diseases and Population Dynamics

b. Marking Period 3

II.Unit/ Title: Unit 5 Diseases and Populations

a. Unit Length (Time): 4 weeks

f. Unit Introduction:

The culminating unit for the tenth grade biology curriculum (State of Connecticut Core Science Currriculum) relates all of the topics learned this academic year to the interactions of living organisms in their environment. The students will be able to **describe the difference between genetic disorders and infectious diseases (D.39) and how bacterial and viral infectious diseases are transmitted, and explain the roles of sanitation, vaccination and antibiotic medications in the prevention and treatment of infectious diseases (D.32).** Students will continue their study of the affect of disease on human populations and extend to other selective forces/limiting factors that affect populations. They will **describe the factors that affect the carrying capacity of the environment (D.43) and explain how change in population density is affected by emigration, immigration, birth rate and death rate, and relate these factors to the exponential growth of human populations (D.44).** After students explore the selective forces/limiting factors on human populations, they will **explain how technological advances have affected the size and growth rate of human populations throughout history (D.45).** D.43-D.45 are investigated through the curriculum embedded performance tasks **Yeast Populations** and **Human Population Dynamics**.

Objectives:

- Describe an ecosystem.
- Identify examples of abiotic and biotic factors.
- Analyze the effects of symbiotic relationships on a community.
- List the levels of organization in an ecosystem, from ecosystem to organism.
- Identify the role or roles each organism plays in a food chain/web.
- Compare and contrast community, population, habitat, and niche.
- Define emigration, immigration, birth rate and death rate.
- Describe the effects of natural disasters, disease, population increase, and depletion of food on populations.
- Explain how population growth curves show relationships.
- Suggest ways to minimize human impact on the environment.
- Identify the differences between noninfectious and infectious diseases.
- Identify pathogens as bacterial or viral.
- Explain the use of vaccines in treatment of disease.
- Identify treatment methods for bacterial and viral diseases.
- Identify the beneficial or harmful effects of genetic mutations on an organism.
- Define genetic disease.
- Compare and contrast birth defects versus genetic diseases.
- Identify the beneficial or harmful effects of abnormal chromosome numbers in organisms.
- Explain how monoploidy and triploidy result in human diseases.

g. Standards for Unit 5

- **D.39 Describe the difference between genetics disorders and infectious diseases.**
- D.32 Describe how bacterial and viral infectious diseases are transmitted, and explain the roles of sanitation, vaccination and antibiotic medications in the prevention and treatment of infectious diseases.
- **ST:** Yeast Growth Embedded Performance Task.
- D.44 Explain how change in population density is affected by emigration, immigration, birth rate and death rate, and relate these factors to the exponential growth of human populations.
- D.43 Describe the factors that affect the carrying capacity of the environment.
- D.45 Explain how technological advances have affected the size and growth rate of human populations throughout history.
- **ST:** STS Human Population Growth.

h. Essential Questions

- How is a bacterial infection different than a viral infection?
- What types of diseases are treated with the use of vaccines?
- What types of diseases are treated with the use of antibiotics?
- How is the human population affected by factors such as disease, war, famine, etc.
- What is the difference between a genetic disorder and an infectious disease?
- What are the factors that affect the carrying capacity of an environment?
- How do immigration, emigration, birth rate, and death rate affect population density?
- How have technological advances affected the size and growth rate of populations throughout history?

i. Essential Concepts/Content

- Antibiotics are only effective treatments for bacterial infections.
- Viral infections cannot be treated with antibiotics.
- Viruses are not living organisms.
- Bacteria are not all dangerous, some are vital to living organisms.
- Bacteria and viruses are not the only vectors of disease.
- The human population has increased exponentially due to the advent of sanitation, access to healthcare in developed countries, and access to food in developed countries.
- The development of early agriculture provided a stable supply of food and as a result the human population increased rapidly and reached one billion in 1840.

j. Vocabulary

1. ecosystem
2. community
3. population
4. habitat
5. adaptation
6. niche
7. symbiosis
8. food web
9. producer
10. consumer

11. decomposer
12. bacteria
13. virus
14. disease
15. antibiotic
16. noninfectious (disease)
17. infectious (disease)
18. food chain
19. organism
20. commensalism
21. parasitism
22. mutualism
23. herbivore
24. carnivore
25. omnivore
26. predator
27. prey
28. genetic disease
29. biome
30. precipitation
31. primary
32. secondary
33. tertiary
34. protist
35. vaccine/vaccination
36. prokaryote
37. eukaryote
38. yeast
39. biomass
40. bioaccumulation
41. exponential growth
42. resources
43. limiting factor
44. rate of reproduction
45. carrying capacity

k. Science Misconceptions

- Bacterial and viral infections are the same and treated the same.
- Antibiotics can be used to treat all infections.
- Humans do not have to compete for food.
- Everything needs to be sanitized in order to prevent disease.
- Viruses are living.

Recommended Activities

- STS Human Population Dynamics.

- ST Yeast Populations Lab

IV. Significant Task (ST): Yeast Populations

a. Significant Task Introduction

Students will be able to observe and study the growth of yeast populations under the effects of temperature, food availability, and/or shift in pH that may influence the rate at which a population grows. The students will grow yeast in a molasses solution (food for the yeast) and investigate how one factor influences the change in yeast population growth as measured by the amount of carbon dioxide produced by the yeast. This curriculum-embedded performance task is related to the expected performances for high school, as described in the Core Science Curriculum Framework, under Scientific Inquiry, Literacy and Numeracy, Strand V Genetics, Evolution and Biodiversity.

b. **Length/Timing:** 5 days (1 45-minute period, 10-15 minutes during the rest of the 4 days to record results).

c. **Essential Question**

1. How does one factor (shift in pH, food availability, or temperature) influence the rate at which a population of yeast grows?

d. Assessment Tools

- Have the students write a lab report and assess the lab report with the CAPT lab rubric.
- Released CAPT questions.

e. Procedure

1. Read through significant task with students.
2. Explain CAPT lab rubric to students.
3. Students identify variables and control group for the task.
4. Students write experimental design to solve the task written in the Yeast Populations significant task.
5. Teacher approves the experimental design.
6. Students perform experiment.
7. Students record and graph results.
8. Students analyze results.
9. Students forma a conclusion.
10. Students discuss limitations and applications.

V. Significant Task (STS) Human Population Dynamics

a. Significant Task Introduction

Students will be able to design a PowerPoint slideshow (if available) to compare the population dynamics in an underdeveloped country versus a developed country using www.census.gov/ipc///www/idbsum.html. Students must select one underdeveloped country and one developed country and compare and contrast the following information: the shapes of the population graphs in 2005 for the developed and underdeveloped countries and compare the changes in populations of both countries from 2005 to those projected in 2025. Students must also research and describe three factors that affect changes in the human population of one of the countries studied and explain how one technological advance might affect the change in the human population from 2005 to 2025 in one of the countries studied.

Students must decide if the advancement of technology is a positive or negative influence on population dynamics and state the evidence for their decision.

b. **Length/Timing:** 1-3 days (45-minute periods)

c. Essential Questions

1.How does the population growth of underdeveloped countries compare to developed countries?

2. How does the shape of populations graphs in 2005 compare for a developed versus underdeveloped country?
3. How does the projected population growth of an underdeveloped country compare to a developed country from 2005 to 2025?
4. Does the advancement of technology have a positive or negative influence on population dynamics?

d. Assessment Tools

- Correct assignment with NHPS interdisciplinary rubric.

e. Procedure

1. Read through Human Population Dynamics STS**.**
2. Teachers can give students time in school to do research or assign research as an out-of-school assignment.
3. Students go to www.census.gov/ipc///www/idbsum.html and choose one developed and one underdeveloped country.
4. Students gather data on the underdeveloped and developed countries from www.census.gov/ipc///www/idbsum.html.
5. Students answer all questions (see introduction and essential questions) noted in the STS description of Human Population Dynamics.
6. Students create a PowerPoint presentation on the information researched for the underdeveloped and developed countries.
7. Teachers may alter this activity in order to better serve the students, especially if access to computers/Internet is limited.
8. Teachers assess Human Population Dynamics STS with NHPS interdisciplinary rubric.

5.