Biology A, Cellular Biology; Structures, Processes, and Heredity

Course Description; Biology A is the study of cellular chemistry, cellular biology, molecular genetics, and heredity. The instruction is primarily aimed at aiding the continued development of skills involved with the observing, measuring, sampling, researching, experimenting, documenting, and presenting known as scientific inquiry.

Textbook;

Syllabus;

(Measuring and Significant Digits)

Biochemistry

- **Organic Polymers**
  - (CHNOPS and Covalent Bonding)
  - Carbohydrates
  - Proteins
  - Lipids

Cell Biology

- **Membranes**
  - Phospholipids
  - Proteins
- **Organelles**
  - Membrane derived organelles (ER, Golgi apparatus, vesicles, vacuoles, lysosomes)
  - Mitochondria and Chloroplasts
- **Other Cell Parts**
  - Contractile Fibers (Eukaryotic cytoskeleton)
  - Cell Walls

Cell Transport; (Diffusion, Bulk Flow, Endo and Exocytosis, and Active Transport)

Midterm

DNA Structure and Replication

- **Nucleic Acids** including ATP
- **Binary Fission** (Prokaryotic Cell Division)
- **Mitosis, Meiosis, Cytokinesis** (Eukaryotic Cell Cycle)
- **Protein (Enzyme) Synthesis**

Heredity: Inheritance and Variation of Traits

- **Mendelian Inheritance**; Social Perspectives and Technology

Biology B; The Evolution and Diversity of Life (47 days)

Course Description; Biology B is the study of biological evolution on the planet Earth. Issues of unity between life forms as well as the diversity of life forms are studied with regard to solving environmental challenges. The instruction is primarily aimed at aiding the continued development of skills involved with the observing, measuring, sampling, researching, experimenting, documenting, and presenting known as scientific inquiry.

Textbook;

Syllabus;

- **Viruses**
- **Systematics/Classification/Phylogeny and Relationships**
- **Prokaryotic Life**
  - Domain Eubacteria evolve (change) into Domain Archaebacteria
- **Eukaryotic Life** (Domain Eukaryea)
  - **Protist Kingdoms**
    - Evolution from Unicellularity to multicellularity
  - **Fungi Kingdoms**
    - Evolution over time from subterranean to terrestrial life
  - **Plants;**
    - Process of evolution; Aquatic to Terrestrial Life
    - Moss, Vascular Plants (Ferns), Seed Plants (Gymnosperms, Angiosperms)
- **Midterm**
    - Anatomy and Physiology
      - Meristematic tissues
      - Growth, Development, and Organ formation; Root, Stem, Leaf
      - Transport
  - **Animals**;
    - Selective expression of genes and the embryology of animals from a single stem cell.
    - Porifera, Cnidaria, 3 Worm Phyla, Mollusks, Arthropods, Echinoderms, and Chordates

Biology C; Biological Interactions (47 days)

Course Description; Biology C focuses on the dynamics of energy exchange between living and nonliving systems and the study of Ecology. Students will be expected to design and carryout biological research. The instruction is primarily aimed at aiding the continued development of skills involved with the observing, measuring, sampling, researching, experimenting, documenting, and presenting known as scientific inquiry.

Textbook;

Syllabus;

- **Energy and Dynamics**
  - **Electron Transport Chain**
  - **Photosynthesis**
    - **Pigments**
    - **Light Reactions**
    - **Non-light Reactions**
  - **Respiration**
    - **Anaerobic Respiration**
    - **Fermentation**
    - **Aerobic Respiration**

- **Ecology; Ecosystems and their Interactions**
  - **Populations**
  - **Communities** (trophic pyramid)
  - **Ecosystems**

- **Human Impact to Diversity**

- **Midterm**

- **Applications; Research Project**
  - **1 Week; Asking Questions, and Defining Problems**
    Planning and Carrying out Investigations
  - **2 Weeks; Implementation Planning and Carrying out Investigations**
  - **2 Weeks; Analyzing and Interpreting Data**
    Constructing Explanations or Designing Solutions

Course Title; 10th grade Biology A, Cellular Biology; Structures, Processes, and Heredity (46 days)

Curriculum Map;
Standard 1: Nature of Science
Standard 3: Biology
Standard 5: Personal and Social Perspectives; Technology

Syllabus Topics	Standard Goal	Objective	Instructional Objectives	Essential Vocabulary	Task Analysis	Sample Assessment	Resources
Measuring and Significant Digits Scientific Inquiry; Using Math and Computational Thinking.	Goal 1.3: Understand Constancy, Change, and Measurement	**9-10.B.1.3.1** Measure changes that can occur in and among systems. (648.03b)	**Content Objective:** Design and carry out a scientific experiment using the appropriate tools for measurement. **Language Objective:** Students will document and summarize their lab results.	**Prior:** milli • centi • kilo • meter • liter • gram • Celsius • degree • hecto • length • mass • volume • temperature • deci • deca • nano • micro **Explicit: Introductory**	• Test changes over time using the appropriate tool.	• Measure and collect data from an experiment. Example: • Measure plant growth over a six week period. • Measure heart rate after various activities.	Evolution and Nature of Science teaching activities http://www.indiana.edu/~ensiweb/ Metric Mania Lesson Plans http://sciencespot.net/Pages/classmetric.html
Measuring and Significant Digits **Scientific Inquiry;** Using Math and Computational Thinking.	Goal 1.3: Understand Constancy, Change, and Measurement	**9-10.B.1.3.3** Measure and calculate using the metric system. (648.03c)	**Content Objective:** Students will convert between units within the metric system using dimensional analysis. **Language Objective:** Students will compare their measurements with that of another group.	**Prior:** milli • centi • kilo • meter • liter • gram • Celsius • degree • hectare • length • mass • volume • temperature **Explicit: Introductory:**	• Identify the units of length, mass, volume and temperature of the metric system. • Use the appropriate tool when measuring using the metric system. • Convert between units within the metric system using dimensional analysis. • CCSSR - Read and follow directions to measure various objects.	• Measure length, weight, and volume of classroom objects using metric units.	Candy bar lab http://mrcrick.org/Integrated%20Sci/nerals%20Unit/Candy%20Bar%20Density%20La pdf Metric scavenger hunt. http://www.mv.k12.wa.us/science/physics/Scav.htm l Evolution and Nature of Science teaching activities http://www.indiana.edu/~ensiweb/
Biochemistry; Organic Polymers	Goal 1.8: Understand Technical Communication	**9-10.B.1.8.1** Analyze technical writing, graphs, charts, and diagrams. (658.02a	**Content Objective:** Interpret and draw conclusions from technical writing, graphs, charts, and diagrams. **Language Objective:** Summarize information from technical writing, graphs, charts, and	**Prior:** conclusions • X and Y axis • title • data table • legend **Explicit: Introductory :**	• Interpret and draw conclusions from technical writing, graphs, charts, and diagrams.	• Given a set of charts and graphs answer a series of questions pertaining to the information. Example: - Given a climatogram determine which biome is described.	Evolution and Nature of Science teaching activities http://www.indiana.edu/~ensiweb/

			diagrams.				
Cell Biology; Membranes Organelles Other Cell Parts	Goal 3.3: Understand the Cell is the Basis of Form and Function for All Living Things	**9-10.B.3.3.1** Identify the particular structures that underlie the cellular functions. (651.01a)	**Content Objective:** Students will identify and describe the function of each cell organelle and cellular structures. **Language Objective:** Students will rehearse the name and function of all cell organelles and other cell structures.	**Prior:** nucleus • DNA **Explicit:** **Introductory:** organelle • mitochondria • Golgi apparatus • ribosomes • chloroplasts • cell wall • plasma membrane • vacuole • lysosomes • endoplasmic reticulum • cytoskeleton • cilia • flagella • cytoplasm • nucleolus	• Identify the organelles and cellular structures. • Describe the functions of each of the organelles of a cell.	Draw and label a cell with the structures and organelles listed in the essential vocabulary.	Database of cellular organelles and processes www.cellsalive.com * Cell catalog http://www.accessexcellence.org/AETG/data/released/0496-ChuckDowning/ * Inside a cell video http://www.youtube.com/watch?v=f17tSC3Wg&featu re=related * Database of activities and videos http://free.ed.gov/subjects.cfm?subject_id=41 www.teachersdomain.org/collection/k12/sci.life.gen * Physiology Activities www.the-aps.org/education/ * Lab: Observing plant and animal cells under the microscope * Make a "Catalog" of cell parts: http://t4.jordan.k12.ut.us/teacher_resrces/Science/modelclassroomroot/Activities/Biology%20Activities/Standard%202bjective%203/W holecellcatalog.doc *http://www.teachersdomain.org/collection/k12/sci.life.s tru.cellstruct/ * Surface area to volume lab http://chem.lapeer.org/Bio1Docs/Cellze.html
Cell Biology; Membranes Organelles Other Cell Parts **Scientific Inquiry;** Asking questions and defining problems.	Goal 1.2: Understand Concepts and Processes of Evidence, Models, and Explanations	**9-10.B.1.2.2** Develop models to explain concepts or systems. (648.02b)	**Content Objective:** Design and carry out a scientific experiment using a model. **Language Objective:** Students will document lab results and report their findings to the class. (during trimester C)	**Prior:** model • system **Explicit:** **Introductory:**	• Define model. • List and describe models used in a biology textbook. • Develop a model to explain a concept determined by the teacher.	Build a model to explain a concept determined by the teacher. Example: Erosion in a sand box, Cell model using household items, or DNA model using candy.	Evolution and Nature of Science teaching activities http://www.indiana.edu/~ensiweb/
Cell Transport;	Goal 3.3: Understand the Cell is the Basis of Form and Function for All Living Things	**9-10.B.3.3.2** Explain cell functions involving chemical reactions. (651.01b)	**Content Objective:** Students will describe the movement of materials through a cell membrane. **Language Objective:** Students will define osmosis,	**Prior:** **Explicit:** nucleus • DNA • ATP • enzyme • active transport • osmosis • diffusion **Introductory:**	• Explain the various functions and interactions of cell organelles. • Describe the role of ATP in the cell. • Explain the role of enzymes in the cell.	• Given a list of organelles and cell structures and a list of functions match the function to the correct organelle or cell structure.	Cell models Dialysis tubing/osmosis labhttp://kvhs.nbed.nb.ca/gallant/biology/osmolab.h tml "Stained glass" cells www.graniteschools.org/jr/olympus/Down/Lessons/Stained%20Glass%20Cells.doc

			diffusion, facilitated diffusion, active transport, and passive transport.	organelle • mitochondria • Golgi apparatus • ribosomes • chloroplasts • cell wall • plasma membrane • vacuole • lysosomes • endoplasmic reticulum • cytoskeleton • cilia • flagella • cytoplasm • nucleolus • passive transport • facilitated diffusion • hypotonic • hypertonic • isotonic	• Describe the movement of materials through a cell membrane. • Distinguish between the various forms of active transport.		Database of videos and activities http://free.ed.gov/subjects.cfm?subject_id=41 www.teachersdomain.org/collection/2/sci.life.gen Physiology Activities www.the-aps.org/education/ Using Eggs to Study Osmosis: http://sciencespot.net/Pages/classbi html#Anchor- eggs Enzyme Labs: https://htscience.wikispaces.com/file ew/Catalase +Lab.doc http://www.biologycorner.com/bio3/li _biochem/e nzymelab.html PowerPoint: "Enzymes- models of action" http://www.worldofteaching.com/biol ypowerpoin ts.html Diffusion and osmosis http://biology.about.com/gi/dynamic/site.htm?sit e=http%3A%2F%2Fbiology.arizona.edu%2Fsciconn%2Flessons%2Fmcndless%2Fdef ault.html
DNA Structure and Replication; Nucleic Acids including ATP	Goal 3.3: Understand the Cell is the Basis of Form and Function for All Living Things	**9-10.B.3.3.3** Explain how cells use DNA to store and use information for cell functions. (651.01c) replication	**Content Objective:** Students will construct a DNA model. **Language Objective:** Students will label a DNA model.	**Prior:** **Explicit:** DNA • replication **Introductory:** nucleotide • double helix • base pair • adenine • guanine • thymine • cytosine • deoxyribose • nucleic acid • phosphate	• Recognize complementary base pairs. • Recognize that the specific pairing is due to a chemical structuring of the nitrogen bases. • Describe the DNA backbone being composed of alternating phosphate, sugar molecules, and nitrogen bases. • Diagram the process of DNA	• Given a sequence for one side of a DNA segment build the complementary strand and backbone of that DNA segment. • Take that completed DNA segment and show how replication would occur in that segment.	Build a DNA model with kit or miscellaneous items (gumdrops, toothpicks, licorice, etc). Database of videos and activities http://free.ed.gov/subjects.cfm?subj_id=41 www.teachersdomain.org/collection/2/sci.life.gen Physiology Activities www.the-aps.org/education/ DNA Replication Video on YouTube: http://www.youtube.com/watch?v=hfo9D1tus
DNA Structure and Replication; Binary Fission Mitosis	Goal 3.3: Understand the Cell is the Basis of Form and Function for All Living Things	**9-10.B.3.3.3** Explain how cells use DNA to store and use information for cell functions. (651.01c)	**Content Objective:** Students will explain the steps of mitosis. **Language Objective:** Students will diagram and label the steps of mitosis.	**Prior: Explicit:** chromosome **Introductory:** cell cycle • interphase • prophase • metaphase • anaphase • telophase •	• Diagram and label the steps of mitosis. • Explain the role of mitosis in the cell cycle.	• Diagram and label the steps of mitosis. • Then collaborate with the class to act out the process of mitosis. Be sure to describe the end product of mitosis.	Database of cell structures and processes www.cellsalive.com Mitosis flip book: http://sciencespot.net/Pages/classbi html#Anchor- mitosis Database of videos and activities www.teachersdomain.org/collection/

				cytokinesis			2/sci.life.gen Physiology Activities www.the-aps.org/education/
DNA Structure and Replication; Binary Fission Mitosis **Scientific Inquiry;** Planning and carrying out investigations.	Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills	Use appropriate technology and mathematics to make investigations.	**Content Objective:** Students will utilize technology by creating their own excel spreadsheet and graph. **Language Objective:** Students will summarize their results by explaining their graphs to the class.	**Prior:** technology • research **Explicit: Introductory :**	• Utilize available technology in scientific research and reporting. • Apply mathematics in interpreting scientific data. CCSSR: Convert information from a written format into a table or chart and vice versa.	• Create an excel spreadsheet and graph for a data set.(will be completed in trimester C)	Evolution and Nature of Science teaching activities http://www.indiana.edu/~ensiweb/
DNA Structure and Replication; Meiosis, Cytokinesis	Goal 3.3: Understand the Cell is the Basis of Form and Function for All Living Things	**9-10.B.3.3.3** Explain how cells use DNA to store and use information for cell functions. (651.01c)	**Content Objective:** Students will explain the steps of meiosis. **Language Objective:** Students will diagram and label the steps of meiosis.	**Prior: Explicit:** gametes • allele **Introductory:** diploid • haploid • crossing over • segregation	• Diagram and label the steps of meiosis. • Compare and contrast mitosis and meiosis	• Diagram and label the steps of meiosis. • Then collaborate with the class to act out the process of meiosis. Be sure to describe the end product of meiosis.	Database of cell structures and processes www.cellsalive.com Database of videos and activities http://free.ed.gov/subjects.cfm?subj _id=41 www.teachersdomain.org/collection/ 2/sci.life.gen Physiology Activities www.the-aps.org/education/ PowerPoint: “Meiosis” http://www.worldofteaching.com/biol ypowerpoin ts.html Meiosis Internet Lesson: http://wiki.theplaz.com/w/images/Me sis_Web_W orksheet.pdf Meiosis square dance http://www.youtube.com/watch?v=ea j19_3Zg&fe ature=related
DNA Structure and Replication; Protein (Enzyme) Synthesis	Goal 3.3: Understand the Cell is the Basis of Form and Function for All Living Things	**9-10.B.3.3.3** Explain how cells use DNA to store and use information for cell functions. (651.01c)	**Content Objective:** Students will identify the structure and role of DNA and RNA within a cell. **Language Objective:** Students will compare and contrast the structure and role of DNA and RNA within a cell.	**Prior: Explicit:** RNA • amino acids • transcription • translation • enzyme **Introductory:** mRNA • tRNA • ribosome • codon • anticodon	• Compare and contrast the structure and role of DNA and RNA within a cell. • Diagram the process of protein synthesis	• Given a DNA sequence draw the corresponding mRNA, and tRNA segments. • Then using a amino acid / mRNA codon chart use the information to determine the order of amino acids that was coded for in the given DNA sequence.	Show protein synthesis with DNA/RN kit. Model the gene to protein process. Enzyme lab Liver lab - http://www.sciencebuddies.org/scier e-fair-projects/project_ideas/BioChem_p0 0.shtml Pineapple and jello lab - http://www.woodrow.org/teachers/bi 991/enzymes.htm l Database of videos and activities http://free.ed.gov/subjects.cfm?subj ect_id=41 www.teachersdomain.org/collection/ k12/sci.life.gen Physiology Activities www.the-aps.org/education/ Protein synthesis

							Video on YouTube: - http://www.youtube.com/watch?v=NJ obgkPEAo Protein identification lab http://biology.about.com/gi/dynamic/ site.htm?site=htt p%3A%2F%2Fchem.lapeer.org %2FBio1Docs%2F Amino Acid Bingo http://www.accessexcellence.org/AE EPC/WWC/1994 /codon_bingo.php
DNA Structure and Replication; Protein (Enzyme) Synthesis	Goal 3.3: Understand the Cell is the Basis of Form and Function for All Living Things	**9-10.B.3.3.4** Explain how selective expression of genes can produce specialized cells from a single cell. (651.01e)		**Prior:** **Explicit:** gene • mutation **Introductory:** trait • genetic disease • differentiation • specialization	• Describe the process of gene expression. • Explain the role of mutation in gene function. • Explain the role of genes in cell specialization in multicellular organisms	• Demonstrate a frameshift mutation in a given sequence of DNA and show how that effects the transcription and translation of that DNA sequence.	Database of videos and activities http://free.ed.gov/subjects.cfm?subj _id=41 www.teachersdomain.org/collection/ 2/sci.life.gen http://www.teachersdomain.org/colle on/k12/sci.li fe.stru.differentiation/ Various Genetics Activities http://learn.genetics.ut ah.edu/ The Mighty Mutation Maker Game; http://nature.ca/genome/04/0 413_e.cfm Slooze Worm Mutagenesis: http://learn.genetics.utah.edu/archiv sloozeworm/s cenario.html Oompa Loompa genetics: http://www.biologycorner.com/works ets/Genetics _Oompa_Loompa.pdf Paper Pets: http://www.biologycorner.com/works ets/paperpet s.pdf
Heredity: Inheritance and Variation of Traits; Mendelian Inheritance	Goal 3.3: Understand the Cell is the Basis of Form and Function for All Living Things	**9-10.B.3.3.3** Explain how cells use DNA to store and use information for cell functions. (651.01c)	**Content Objective:** Students will explain the difference between genotype and phenotype. **Language Objective:** Students will define genotype and phenotype.	**Prior:** **Explicit:** genotype • phenotype • allele • homozygous • heterozygous **Introductory:** dominant • recessive • Punnett square • pedigree • genetic recombination • sex linked trait	• Summarize how the process of meiosis produces genetic variability. • Explain the difference between dominant and recessive alleles. • Compute the genotypic and phenotypic ratios from Punnett square crosses. • Analyze and synthesize a pedigree chart.	• Use a punnet square to predict the possible outcomes of a genetic cross.	Database of videos and activities www.teachersdomain.org/collection/ 2/sci.life.gen Physiology Activities www.the- aps.org/education/ Various Genetics Activities http://learn.genetics.ut ah.edu/ Pedigree Worksheets http://teachers.henrico.k12.va.us/De Run/ramsey_ s/RESOURCES_ALL/BIOLOGY/gen cs/pedigree _ws.doc http://drlytle.org/ap%20bio/Mendellia

							%20Genetic s/Pedigrees.doc Pass the Genes Game: http://nature.ca/genome/04/041/ 0414_e.cfm Oompa Loompa genetics: http://www.biologycorner.com/works ets/Genetics _Oompa_Loompa.pdf Paper Pets: http://www.biologycorner.com/works ets/paperpet s.pdf
Heredity: Inheritance and Variation of Traits; Mendelian Inheritance **Scientific Inquiry;** Planning and carrying out investigations.	Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills	**9-10.B.1.6.2** Utilize the components of scientific problem solving to design, conduct, and communicat e results of investigation s. (649.01b)	**Content Objectives:** Students will construct and conduct a scientific experiment. (In trimester C) **Language Objective:** Students will describe the steps of the scientific method used in their experiment.	**Prior:** scientific method • controlled experiment • dependent variable • independent variable • hypothesis • theory • law • analyze • conclusion • modeling • prediction • observation • control • graph • table • chart • report **Explicit: Introductory:** inferring	• Recall the steps of the scientific method. • Describe the steps of the scientific method. • Construct a situation requiring the use of the scientific method. • List the experimental controls. • List the experimental variables. • Construct and conduct a scientific experiment. • Summarize methods used to communicate scientific data (graphs, charts, tables). • Report results from an experiment using graphs, charts, or tables. • CCSSW: Generate a scientific report that includes test, data, graphs, and charts which relates the results of their experiment.	• Given eight to ten kidney beans, design a method to get your beans to sprout the fastest. • Keep track of each step of your method and your results. • Demonstrate how your procedure relates to the scientific method.	dsc.discovery.com/videos Evolution and Nature of Science teaching activities http://www.indiana.edu/~ensiweb/

Course Name; 10th grade, Biology B, The Evolution and Diversity of Life (47 days)

Curriculum Map

Syllabus Topics	Standard Goal	Objectives	Instructional Objective	Essential Vocabulary	Task Analysis	Sample Assessment	Resources
Viruses	Goal 5.2: Understand the Relationshi	**9-10.B.5.2.1** Explain how science advances	**Content Objective:** Students will investigate how scientific findings	**Prior:** technology • science **Explicit:**	• List examples of how science advances technology.	• Each group of students will describe how an assigned scientific discovery led	Database of videos and activities http://free.ed.gov/subjects.cfm?subject_id =41

	p between Science and Technology	technology. (655.01a)	advance technology. **Language Objective:** Students will give examples of scientific discoveries that led to advances in technology.	**Introduc tory:**	• Inspect how discoveries have impacted technology (for example: Watson and Crick, Louis Pasteur, Alexander Fleming).	to advances in technology. • Then present information to the class.	
	Goal 5.2: Understand the Relationshi p between Science and Technology	**9-10.B.5.2.2** Explain how technology advances science. (655.01a)	**Content Objective:** Students will investigate how technology advances science. **Language Objective:** Students will give examples of new technology has led to scientific discoveries.	**Prior:** technology • science **Explicit: Introduc tory:**	• Access how technology advances science (microscope, computer, etc.)	• Complete a lab exercise with outdated technology. • Then repeat the lab exercise with updated technology. • Then present an analysis of the role technology plays in scientific research.	Database of videos and activities http://free.ed.gov/subjects.cfm?subject_id =41
	Goal 5.2: Understand the Relationshi p between Science and Technology	**9-10.B.5.2.3** Explain how science and technology are pursued for different purposes. (656.01b)	**Content Objective:** Students will explain the different roles of technology and science. **Language Objective:** Compare and contrast the roles of technology and science in society.	**Prior:** technology • science **Explicit: Introduc tory:**	• Model how technology and science can be used to solve problems. • Explain the different roles of technology and science.	• Research the technology behind X-rays, MRI's, and CAT scans. • Extrapolate what the future may hold for body scan technology.	Database of videos and activities http://free.ed.gov/subjects.cfm?subject_id =41
Systematics/Clas sification/Phylog eny	Goal 1.1: Understand Systems, Order, and Organizatio n	**9-10.B.1.1.1** Explain the scientific meaning of system, order, and organization.	**Content Objective:** Students will identify the specific parts of a food web. **Language Objective:** Students will design a food web and orally present it to the class.	**Prior:** order • organizati on • system **Explicit: Introduct ory:**	• Explain the meaning of system, order, and organization. • Organize the parts of a specific system and diagram how they interact (for example, cellular system, circulatory system, ecosystem).	Given the following objects: blackberry bush, grass, plankton, minnow, fresh water, salt water, mouse, grasshopper, algae, dragon fly, snake, salmon, hawk, bear, elephant, and decomposing bacteria. Diagram a realistic food web and explain the role of each component of the food web. Explain the relationship between the form and the function of a body system.	Organize the pile of things lab. Give students random collection of things and let them desig a organization system. Survey of body systems. Physiology Activities www.the-aps.org/education/ Evolution and Nature of Science teaching activities http://www.indiana.edu/~ensiweb/ Baloney Detection Kit http://www.physics.smu.edu/~pseudo/baloney html Lesson: A Survey About Science - http://www.pbs.org/wgbh/evolution/educators/ sso ns/lesson1/act1notes.html Museum of Hoaxes http://museumofhoaxes.com/ Gullibility Test http://www.museumofhoaxes.com/test.html Photo quiz http://www.museumofhoaxes.com/tests/hoaxp otot est.html Scientific American Frontiers: “Beyond Science?” (aired November 19, 1997) Nova: Secrets of the Psychics (Original broadcast: October 19, 1993) Sponge Bob/Scientific Method - http://sciencespot.net/Media/scimthdexps.pdf http://sciencespot.net/Media/scimethodconvar

							df http://sciencespot.net/Media/scimethodconvar pdf (others are available at) - http://sciencespot.net/Pages/classgen.html
Systematics/Classification/ Phylogeny	Goal 1.1: Understand Systems, Order, and Organization	**9-10.B.1.1.2** Apply the concepts of order and organization to a given system.	**Content Objective:** Students will identify the specific parts of a food web. **Language Objective:** Compare your food web to that of another classmates.	**Prior:** order • organization **Explicit:** homeostasis **Introductory:** differentiation • interdependence • intradependence	• Differentiate the roles of a system, its components and their interactions.	• Given the following objects: blackberry bush, grass, plankton, minnow, fresh water, salt water, mouse, grasshopper, algae, dragon fly, snake, salmon, hawk, bear, elephant, and decomposing bacteria, diagram two possible food webs and compare the components of each based on their role in the food web.	Physiology Activities www.the-aps.org/education/ Evolution and Nature of Science teaching activities http://www.indiana.edu/~ensiweb/
Prokaryotic Life; Domain Eubacteria Domain Archaebacteria **Domain Eukaryea**	Goal 3.1: Understand the Theory of Biological Evolution	**9-10.B.3.1.1** Use the theory of evolution to explain how species change over time.	**Content Objective:** Students will use evidence such as the fossil record, genetic inheritance, patterns of mutation to explain how organisms evolve. **Language Objective:** Students will define fossil record, genetic inheritance, and mutation.	**Prior:** fossil record **Explicit: Introductory:** inheritance patterns • variation • artificial selection • Darwin	• Define evolution. • Discuss the evidence that convinced Darwin that species could change over time. • Show how natural selection can change a population. • Cite specific examples of natural selection and artificial selection. • Use evidence such as the fossil record, genetic inheritance, patterns of mutation to explain how organisms evolve. • Describe factors that influence speciation. • Relate current organisms to past organisms based on the included evidences	• As a writer for the NY Times write a editorial describing the evidence used by Charles Darwin to form the theory of evolution and the evidence that has been found by others since Darwin.	Database of evolution video clips and activities http://free.ed.gov/subjects.cfm?subject_id =41 Evolution and Nature of Science teachin activities http://www.indiana.edu/~ensiwel example: Fossil footprint. Design a beak or Natural Selection simulatio http://pubs.usgs.gov/of/1998/of98805/lesson /chpt2 /act5.htm Lab-Aids Natural Selection Experiment Kit (available from Carolina Biological) General Information About Evolution: http://evolution.berkeley.edu/evolibrary/home php and http://evolution.berkeley.edu/evosite/evohom .html Database of evolution activities http://www.teachersdomain.org/collection/k1 sci.li fe.evo.processes/
Prokaryotic Life; Domain Eubacteria Domain Archaebacteria **Domain Eukaryea Scientific Inquiry;**	Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills	Formulate scientific explanations and models using logic and evidence. (649.01d)	**Content Objective:** Students will create hypotheses that are testable. **Language Objective:**	**Prior: Explicit: Introductory:**	• Formulate explanations that are based on observations, evidence, and testing. • Create hypotheses that are testable.	• Generate a list of hypotheses for a given problem.	Evolution and Nature of Science teaching activities http://www.indiana.edu/~ensiweb/

Asking questions and defining problems.			Students will persuade their classmates that their hypothesis is testable.		• Using logic and analysis, predict the most reasonable explanation for a set of observations and/or data. CCSSW: Write a reasonable explanation for a set of observations, data, and/or text.		
Prokaryotic Life; Domain Eubacteria Domain Archaebacteria **Domain Eukaryea Scientific Inquiry;** Analyzing and interpreting data	Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills	9-10.B.1.6.5 Analyze alternative explanations and models. (649.01e)	**Content objective:** Students will examine various explanations of a data set. **Language Objective:** Students will compare and contrast two or more possible explanations for a set of data.	**Prior:** compare • contrast • explanation **Explicit: Introductory:**	• Compare and contrast two or more possible explanations for a set of data.	• Given a list of possible hypotheses, determine which are testable.	Evolution and Nature of Science teaching activities http://www.indiana.edu/~ensiweb/
Eukaryotic Life; Plant Anatomy and Physiology;	Goal 3.2: Understand the Relationship between Matter and Energy in Living Systems	**9-10.B.3.2.1** Explain how matter tends toward more disorganized states (entropy). (653.01a)	**Content Objective:** Students will explain what happens to a system when the energy source is lost. **Language Objective:** Student will define entropy.	**Prior:** matter • energy **Explicit: Introductory:** entropy • decomposition	• Define and give examples of entropy.	Which of the following will result in an increase of entropy? a. loss of energy source. b. Increase in energy .	Entropy demo http://www.accessexcellence.org/AE/ATG/data/released/0087- KatharineNoonan/index.ph
Plant Anatomy and Physiology; Meristematic tissues,	Goal 3.2: Understand the Relationship between Matter and Energy in Living Systems	**9-10.B.3.2.2** Explain how organisms use the continuous input of energy and matter to maintain their chemical and physical organization. (653.01b)	**Content Objective:** Students will identify the ultimate source of energy for a system and explain how energy flows through that system. **Language Objective:** Students will explain how energy flows through a food web.	**Prior:** matter • energy • potential • kinetic • chemical • solar • thermal **Explicit:** homeostatis **Introductory:** succession • decomposition	• List and/or describe the different types of energy. • Identify the ultimate source of energy for a given system. • Describe the relationship between energy and matter in maintaining life. • Diagram a local food web.	• Given the following objects: blackberry bush, grass, plankton, minnow, fresh water, salt water, mouse, grasshopper, algae, dragon fly, snake, salmon, hawk, bear, elephant, and decomposing bacteria, diagram a realistic food web and explain the role of each component of the food web.	Gold fish lab/ homeostasis activity with water temperature and respiratory behavior changes http://www.msc.ucla.edu/oceanglobe/pdf/temp_met ab_goldfish_lab.pdf Food web posters www.nationalgeographic.com/

Course Title; 10th grade Biology C; Biological Interactions (47 days)

Curriculum Map

Syllabus Topics	Standard Goal	Objective	Instructional Objectives	Essential Vocabulary	Task Analysis	Sample Assessment	Resources
Energy and Dynamics;	Goal 3.2: Understand the Relationship between Matter and Energy in	**9-10.B.3.2.3** Show how the energy for life is primarily derived from the	**Content Objective:** Students will explain how solar energy is converted into chemical	**Prior:** carbon dioxide • water • oxygen • glucose **Explicit:**	• Define photosynthesis. • Describe the chemical equation of photosynthesis.	• Given the following objects: carbon dioxide, oxygen, water, sunlight, glucose and a small amount of ATP, write an equation to explain the process of	Photosynthesis lab with Vernier (requires Ve probeware) Measuring Rate of Photosynthesis in Elodea http://kenpitts.net/bio/energy/elodea_lab.htm

Electron Transport Chain, Photosynthesis	Living Systems	sun through photosynthesis. (653.01c)	energy by plants. **Language Objective:** Students will name the reactants and products of photosynthesis.	photosynthesis **Introductory:** chloroplasts • chlorophyll	• Explain how solar energy is converted into chemical energy. • Diagram how carbon dioxide and water are used in photosynthesis.	photosynthesis.	Photosynthesis song http://www.youtube.com/watch?v=C1_uez5\ various other versions Photosynthesis lab http://biology.about.com/gi/dynamic/offsite.h e=http%3A%2F%2Fchem.lapeer.org%2FBi %2F
Energy and Dynamics; Respiration Anaerobic Respiration Fermentation Aerobic Respiration	Goal 3.2: Understand the Relationship between Matter and Energy in Living Systems	**9-10.B.3.2.4** Describe cellular respiration and the synthesis of macromolecules. (653.01d)	**Content Objective:** Students will explain how chemical energy from plants is converted to cellular energy in both plants and animals. **Language Objective:** Students will name the reactants and products of cell respiration.	**Prior:** carbon dioxide • water • oxygen **Explicit:** cellular respiration • glucose • ATP • lipids • carbohydrates • nucleic acids • proteins **Introductory:** mitochondria • macromolecules	• Define cellular respiration. • Describe the chemical equation of cellular respiration. • Explain how organisms use chemical energy. • Classify the different types of macromolecules. • Diagram how oxygen and glucose are used in cellular respiration.	• Given the following objects: carbon dioxide, oxygen, water, glucose and a large amount of ATP, write an equation to explain the process of cellular respiration.	Cellular Respiration lab with Vernier (require Vernier probeware) Bromothymol Blue lab Google The Effects of Exercise on Respirat Molecules of life lab (from Ward's catalog) M fatigue lactic acid lab (tennis ball) kuszaj.srhs.net/Word%20Docs/Muscle%20 %20Lab.doc Measuring Yeast Fermentation Using Balloo http://www.prairiepride.org/teachertools/staf ender_Yeast%20Lab%20.pdf
Ecology; Populations	Goal 3.1: Understand the Theory of Biological Evolution	**9-10.B.3.1.2** Explain how evolution is the consequence of interactions among the potential of a species to increase its numbers, genetic variability, a finite supply of resources, and the selection by the environment of those offspring better able to survive and reproduce. (652.01a)	**Content Objective:** Students will identify the processes that result in changes in a population. **Language objective:** When given a specific case of a change in a population students will write a hypothesis to define the causes of the change and orally defend their hypothesis.	**Prior:** interactions • habitat **Explicit:** niche • carrying capacity **Introductory:** genetic fitness • genetic variability • resources selection • limiting factors	• Define the following terms: Genetic Fitness, Genetic Variability, Resources, Selection, Interactions, Habitat, Niche, Limiting Factors, Carrying Capacity. • Predict what happens to a population when the following conditions change: Carrying Capacity, Limiting Factors, Genetic Variability and Fitness.	Bird Nest Assessment a. students are paired. b. pairs build a nest with material provided. c. students make paper eggs and choose the amount. d. Students then do a feeding simulation (in 30 seconds they gather one paper worm at a time). e. After feeding count up worm total. Determine who survives when it takes five worms per egg and six worms per adult to survive. f. Repeat feeding simulation after allowing students to modify nests and number of eggs. g. Describe all behaviors that occur during feedings and explain how they demonstrate the essential vocabulary.	Project Wild workshop manual Database of evolution video clips and activit http://free.ed.gov/subjects.cfm?subject_id=4 Evolution and Nature of Science teaching a http://www.indiana.edu/~ensiweb/ Lab-Aids Natural Selection Experiment Kit (available from Carolina Biological) General Information About Evolution: http://evolution.berkeley.edu/evolibrary/hom http://evolution.berkeley.edu/evosite/evohor Database of evolution activities http://www.teachersdomain.org/collection/k1 fe.evo.processes/
Ecology; Communities (trophic pyramid) and Ecosystems	Goal 3.2: Understand the Relationship between Matter and Energy in Living Systems	**9-10.B.3.2.5** Show how matter cycles and energy flows through the different levels of organization of living systems (cells, organs, organisms, communities) and their environment. (653.01h)	**Content Objective:** Students will describe the roles of biogeochemical cycles in an ecosystem. **Language Objective:** Students will draw and label each of the biogeochemical cycles.	**Prior:** matter **Explicit:** autotrophs • heterotrophs • ecosystem • community • biosphere **Introductory:** biogeochemical cycles • food webs • energy pyramids • trophic levels	• Trace matter through a biogeochemical cycle. • Examine the flow of energy through a living system (for example: a food web or organism).	• Take a previously created food web and add the following biogeochemical cycles to a food web: - Carbon cycle - Nitrogen cycle - Phosphorous cycle - Water cycle	Organism flip chart (autotroph or heterotrop a series of pictures on flashcards and have label as autotroph or heterotroph Database and activitieshttp://free.ed.gov/subjects.cfm?sub 41 Database of videos and activities http://www.teachersdomain.org/collection/k1 fe.eco.cycles/
Human Impact to Diversity	Goal 5.1: Understand Common Environmental Quality Issues, Both Natural and	**9-10.B.5.1.1** Analyze environmental issues such as water and air quality, hazardous waste, forest health, and agricultural	**Content Objective:** Students will identify the impact of humans on the	**Prior:** agriculture • pollution • energy sources **Explicit:** **Introductory:** conservation •	**Idaho Standard Task Analysis:** • Critique the impact of humans on the environment (for example: stream degradation, logging, mining,	• Simulate a town meeting, with assigned roles in the town, to discuss and vote on a proposed expansion of logging near the town.	ecological footprint quiz www.myfootprint.org Database of videos and activities http://free.ed.gov/subjects.cfm?subject_id=41 http://www.teachersdomain.org/collection/k12/sci.li fe.eco.human/ Database of ecology activities http://www.teach-

	Human Induced	production. (656.01a)	environment. **Language Objective:** Students will write a persuasive paper about one issue involving ecological human impact.	preservation • sustainable development • hazardous waste • air quality • water quality • deforestation • fertilizer • pesticides • herbicides •	dams, and wind turbines).		nology.com/teachers/lesson_plans/science/biology/ecology/ Build mini-ecosystems http://www.bottlebiology.org/
Human Impact to Diversity	Goal 5.3: Understand the Importance of Natural Resources and the Need to Manage and Conserve Them	**9-10.B.5.3.1** Describe the difference between renewable and nonrenewable resources. (656.03a)	**Content Objective:** Explain the impact of using renewable and nonrenewable resources. **Language Objective:** Debate the impact of using renewable and nonrenewable resources.	**Prior:** renewable • nonrenewable • recycling **Explicit:** **Introductory:** resource	• Compare and contrast renewable and nonrenewable resources. • Debate the impact of using renewable and nonrenewable resources.	• Students make a list of items in their backpacks. • Determine if each item is a renewable or nonrenewable resource.	ecological footprint quiz www.myfootprint.org Renewable/nonrenewable activities http://www.uncw.edu/smec/gk_fellows/Documents/RenewableResourcesActivity.pdf
Midterm							
Research Project; Asking questions and defining problems.	Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills	**9-10.B.1.6.1** Identify questions and concepts that guide scientific investigations. (649.01a)	**Content Objective:** Students will formulate questions that address problems that can be investigated scientifically. **Language Objective:** Students will write their own question which can be investigated scientifically.	**Prior:** scientific method • controlled experiment • dependent variable • independent variable • hypothesis • theory • law • analyze • conclusion • modeling •	• Formulate questions that address problems that can be investigated scientifically. • Explain how observations guide scientific investigations. • Differentiate between scientific and non- scientific endeavors.	• Given a list of questions determine which can be answered scientifically or not. Example: - How many angels can fit on the head of a pin? Not answered scientifically. - How many drops of water can fit on a penny? Can be answered scientifically.	dsc.discovery.com/videos Evolution and Nature of Science teaching a http://www.indiana.edu/~ensiweb/
Research Project; Asking questions and defining problems.	Goal 1.2: Understand Concepts and Processes of Evidence, Models, and Explanations	**9-10.B.1.2.1** Use observations and data as evidence on which to base scientific explanations. (648.02a)	Design and carry out a scientific experiment. **Language Objective:** Students will document lab results and report their findings to the class.	**Prior:** hypothesis data • controlled experiment • dependent variable • independent variable • theory • law • scientific method • analyze • conclusion • modeling • prediction • observation • control group • evidence • graphing	State that explanations are based on observations, evidence, and testing. • Explain that hypothesis must be testable. • Compare and contrast qualitative and quantitative data. • Recognize that science changes with additional data. • Predict the most reasonable explanation for a set of observations and/or data. • Draw conclusions based on data.	Given a classroom animal make and re**Content** observations. • Discuss and identify which observations are measurable and which are not. Example discussion: - Cute is not measurable - Size is measurable with estimates or comparisons not with words such as big.	http://www2.gsu.edu/~mstnrhx/Lessons/ilp1 dsc.discovery.com/videos Evolution and Nature of Science teaching a http://www.indiana.edu/~ensiweb/
Research Project; Planning and Carrying out	Goal 1.3: Understand Constancy, Change, and Measurement	**9-10.B.1.3.2** Analyze changes that can occur in and among systems.	**Content Objective:** Design and carry out a scientific experiment using the proper data analysis tool. **Language Objective:**	**Prior:** interpret • table • chart • graph **Explicit:** **Introductory:**	• Apply mathematics in interpreting scientific data. • Analyze and extrapolate data from a chart, graph or table.	• Using data from an experiment compile a excel spreadsheet and display the appropriate graph.	dsc.discovery.com/videos Physiology Activities www.the-aps.org/education/ Evolution and Nature of Science teaching a http://www.indiana.edu/~ensiweb/

Investigations.		(648.03b)	Students will document and summarize their lab results using a table, graph or chart.				
Research Project; Analyzing and interpreting data	Goal 1.2: Understand Concepts and Processes of Evidence, Models, and Explanations	**9-10.B.1.2.3** Develop scientific explanations based on knowledge, logic and analysis. (648.02c)	**Content Objective:** Given a problem students will form a hypothesis then design and carry out a scientific experiment to test their hypothesis. **Language Objective:** Students will document lab results and report their findings to the class.	**Prior:** analysis • hypothesis • scientific method • observation • conclusion • evidence **Explicit:** **Introductory:**	• State that science is information about the natural world collected in a measurable and repeatable process called the scientific method. • State that explanations are based on observations, evidence and testing. • Explain that hypothesis must be testable. • Using logic and analysis, predict the most reasonable explanation for a set of observations and/or data.	• Design and carry out a scientific experiment. Then report the results of the lab. Example: • Given a coin determine the probability of it landing on the heads sides each time you flip it. • Then predict how many times you would get heads when you flip a coin ten times. • Flip the coin ten times and record data. • Repeat this when flipping the coin twenty times. • Compare actual results to predictions.	dsc.discovery.com/videos Evolution and Nature of Science teaching a http://www.indiana.edu/~ensiweb/
Research Project; Constructing explanations or designing solutions.	Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills	**9-10.B.1.6.6** Communicate and defend a scientific argument. (649.01f)	**Content objective:** Students will examine various explanations of a data set. **Language Objective:** Students will debate the pros and cons of a current event that is based on scientific data.	**Prior:** debate • pros • cons **Explicit:** **Introductory:**	• Debate the pros and cons of a current event that is based on scientific data. CCSSW: Write an argument using evidence from a written source taking a stand on a scientific issue.	• Given literature about stem cell research, prepare to debate the pros and cons of this issue.	Evolution and Nature of Science teaching a http://www.indiana.edu/~ensiweb/
Research Project; Constructing explanations or designing solutions.	Goal 1.6: Understand Scientific Inquiry and Develop Critical Thinking Skills	**9-10.B.1.6.7** Explain the differences among observations, hypotheses, and theories. (649.01g)	**Content Objective:** Students should be able to distinguish between observations, hypotheses, law, and theories. **Language Objective:** Summarize the differences between observations, hypotheses, law, and theories.	**Prior:** theory • law • hypothesis • observation **Explicit:** **Introductory:**	• Distinguish between a theory and law, hypothesis and observations, and hypothesis and theory.	• Given several statements, label them as theory, observation, hypothesis, or law.	Evolution and Nature of Science teaching a http://www.indiana.edu/~ensiweb/

Reading, Literacy, and Writing Standards

Reading Standards for Literacy in Science						
Content Standards			Objectives		Sample Assessment	

Cite, Determine, and Analyze Key Ideas and Details	1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.		• Summarize text passages. • Provide examples from the text to support the conclusions.		Use highly effective questioning techniques to have students demonstrate understanding of a text passage.	
	2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.		• Identify the main idea of a passage. • Outline the description of a process from the passage.		Create a graphic organizer of a biological concept.	
	3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions		• Read instructions. • Analyze procedures.		Read and analyze a procedure to perform a lab experiment.	
Determine and Analyze Craft and Structure	4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical		• Define and comprehend essential vocabulary and measurement units.		Define essential vocabulary from the text into their own words. Relate appropriate units to scientific measuring.	
	5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).		• Compare and contrast key vocabulary terms and concepts.		Relate the connections between variables in an experiment. Create a Venn Diagram using vocabulary or concepts from the text.	
	6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the		• Define the question the author seeks to address. • Identify the reasons an author uses a specific example in the text.		Trace the development of an idea using historical milestones such as the discovery of the structure and function of DNA.	
Translate, Assess, and Compare and Contrast Knowledge and Ideas	7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g.,		• Create a diagram, graph or table from written information. • Interpret a diagram, graph or table into words.		Draw a food web based on information from an article about a local ecosystem. Given a punnett square, describe the possible offspring.	
	8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or		• List the supporting evidence the author provides. • Determine if the evidence is based on scientific data. • Evalute how well an author supports his/her		List the ideas of natural selection and provide observational evidence for each idea. Peer review another student's scientific argument using steps in the task analysis column.	
	9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or		• Compare and contrast experimental results to key concepts presented in text.		Students may conduct an experiment from the text, comparing results to those obtained in the text.	
Read and Comprehend Text Complexity	10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.		• Implement RST standards 1-9 throughout the course.		See all of the above.	

Writing Standards for Literacy in Science,						
Write Arguments and Informative/Explanatory Texts	1. Write arguments focused on discipline-specific content.		• State your argument. • Distinguish between your claim and alternate and/or opposing claims. • Supply data and evidence for your claim. • Link claims together in a paragraph form using content vocabulary. • Provide a conclusion.			
	2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.					
	3. Not applicable					
Produce, Develop, and Distribute Writing	4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.					
	5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing					
	6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display					
Research and Gather Information to Build and Present Knowledge based on Evidence	7. Conduct short as well as more sustained research projects to answer a question (including a selfgenerated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize					
	8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas,					
	9. Draw evidence from informational texts to support analysis, reflection, and research.					
Produce Range of Writing over Extended Time Frames	10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.					

Scientific Inquiry (NGSS in bold)

Prepared by Elaine Asmus

There are activities and labs. Every science course should include labs based on scientific inquiry. It is part of scientific inquiry to experience odd results at times or find that there is an error in the way an experiment was carried out. Scientists collaborate at these times and start again. The process is fun; a possible discovery is the treat! Emphasize scientific inquiry throughout coursework.

1. **Using Math and Computational Thinking**
   Emphasis on proper measuring techniques during the investigation
   Can the students use tools and properly measure?

2. **Asking Questions, and Defining Problems.**
   Research
   Develop and Use Models
   Form a Hypothesis Statement
   Supported hypothesis become Laws

3. **Planning and Carrying out Investigations**
   Measuring
   Gather data into charts
   Single Variable; should be identified
   All other factors remain the same
   Control Group/Experiment Group
   (High school) multiple experimental groups
   Include a high number of subjects

4. **Analyzing and Interpreting Data**
   Results are entered onto a Data Chart
   Dependent & Independent variable (begin in Junior High)
   Charts generate Graphs
   Using Math and Computational Thinking;
   (High School?) Graphs produce Mathematical Formulas
   (High School) Chi Square Value; differences are significant

5. **Constructing Explanations or Designing Solutions**
   Obtaining, Evaluating, and Communicating Information
   Engaging in Argument from Evidence

Producing a Graph from a Data Chart; Instructions and Rubric; **Names _____**
Long Form

Scientists qualify information by carrying out scientific experimentation through a process known as the scientific method. In an experiment, the variables which will not be studied are controlled. The scientist selects a single variable to change (independent variable) and watches the effect of that change on another variable (dependent variable). Data is collected and placed in a chart.

Scientists quantify the results of an experiment when he/she graphs the collected data. The data collected is represented by dots on the graph. The best-fit line of a graph represents the result or lesson proved from the experiment. Scientists and mathematicians create formulas from line graphs. All formulas arise from graphs.

What are the 2 variables being watched? Factor 1 _____Factor 2 _____

Which is the Independent Variable? _____ Range of values (units)? _____to _____

Which is the dependent Variable? _____ Range of values (units)? _____to _____

On the graph (use the ۞to check off the items as you place them on the graph);

۞Title both axes (Independent variable is placed on the x-axis, dependent variable on the y-axis).

۞Label both axes' units.

۞Using the range for each variable, place the units on each axis **utilizing the entire axis**. It is important to have the same amount of unit variation between each line on the graph, for example, each line represents an increase of 5 numerals.

۞Place data dots onto the graph in the appropriate places.

Best Fit Line; represents **the trend** of the data points. Best-fit lines are often either straight **or** curving lines. Discuss the following with the teacher if necessary before drawing a best-fit line;

۞Does the graph's best fit line pass through the origin? _____Why or why not? _____

_____

۞Does a best fit line connect the dots? _____Why or why not? _____

_____

۞Within the lab group, discuss if any data points might be random mistakes and why these data points might be excluded from the best fit line. Label these points and the reason for excluding any data point from the best fit line.

۞Is the best fit line straight or curved? _____

۞The best fit line should be solid as the line passes between data points, but dashed if the line is extended past or before data points. A dashed line represents predicted behavior not supported by the current experiment.

۞Draw a best-fit line

Abstract and results; each graph should include an abstract sentence or paragraph. The abstract should sound like,

"The lab group found that as the <u>independent variable</u> <u>increases</u>, the <u>dependent variable</u> <u>decreases</u>",

where the student substitutes the specific experimental data for the underlined items. Also include any explanations or notable events of the experiment.

۞ Write the abstract statement or paragraph on the bottom of the graph.

۞ Write a complete sentence for the graph title. Titles should be clear and concise.

Advanced; determination of a graph's formula.

Straight line graphs produce the following formula format;

$$y = m x + b$$

Where m = slope of the line and b = the y intercept of the line.

The formula should read;

<u>Dependent variable</u> = <u>m</u> times the <u>independent variable</u> + <u>b</u>

where the student substitutes actual experimental data for the underlined items.

- Calculate the formula showing all work.
- Write the formula in sentence form.
- Calculate a “y” value that was not experimented by randomly selecting an x axis value and using the formula. Please show all work.

Producing a Graph from a Data Chart; Instructions and Rubric; **Names _____**
Short Form (more experienced science students)

Scientists qualify information by carrying out scientific experimentation through a process known as the scientific method. In an experiment, the variables which will not be studied are controlled. The scientist selects a single variable to change (independent variable) and watches the effect of that change on another variable (dependent variable). Data is collected and placed in a chart.

Scientists quantify the results of an experiment when he/she graphs the collected data. The data collected is represented by dots on the graph. The best-fit line of a graph represents the result or lesson proved from the experiment. Scientists and mathematicians create formulas from line graphs. All formulas arise from graphs.

What are the 2 variables being watched? Factor 1 _____Factor 2 _____

Which is the Independent Variable? _____ Range of values (units)? _____to _____

Which is the dependent Variable? _____ Range of values (units)? _____to _____

On the graph (use the ۞to check off the items as you place them on the graph);

۞Title both axes (Independent variable is placed on the x-axis, dependent variable on the y-axis).
۞Label both axes' units.
۞Using the range for each variable, place the units on each axis **utilizing the entire axis**. It is important to have the same amount of unit variation between each line on the graph, for example, each line represents an increase of 5 numerals.
۞Place data dots onto the graph in the appropriate places.

Best Fit Line; represents **the trend** of the data points. Best-fit lines are often either straight **or** curving lines. Discuss the following with the teacher if necessary before drawing a best-fit line;

۞Does the graph's best fit line pass through the origin? Why or why not?
۞Does a best fit line connect the dots? Why or why not?
۞Within the lab group, discuss if any data points might be random mistakes and why these data points might be excluded from the best fit line. Label these points and the reason for excluding any data point.
۞Is the best fit line straight or curved?
۞The best fit line is solid as the line passes between data points, but dashed if the line is extended past or before data points. A dashed line represents predicted behavior not supported by experimentation.
۞Draw a best-fit line

Abstract and results; each graph should include an abstract sentence or paragraph. The abstract should sound like, "The lab group found that as the <u>independent variable</u> <u>increases</u>, the <u>dependent variable</u> <u>decreases</u>", where the student substitutes the specific experimental data for the underlined items. Also include any explanations or notable events of the experiment.

۞ Write the abstract statement or paragraph on the bottom of the graph.
۞ Write a complete sentence for the graph title. Titles should be clear and concise.

Advanced; determination of a graph's formula.

Straight line graphs produce the following formula format; y = m x + b, Where m = slope of the line and b = the y intercept of the line. The formula should read; Dependent variable = m times the independent variable + b, where the student substitutes actual experimental data for the underlined items.

- Calculate the formula showing all work.
- Write the formula in sentence form.
- Calculate a "y" value that was not experimented by randomly selecting an x axis value and using the formula. Please show all work.