By the end of this semester, students will be able to…

* Be able to identify and define the following: research question, hypothesis, rationale, independent variable, dependent variable, control, materials section, methods section.
* Be able to explain why only one independent variable is allowed per experiment.
* Identify the components of an effective methods section.
* Be able to effectively set up an experiment to test a hypothesis.
* Define and provide examples of the following: atom, element, and molecule
* State which element is most common in living organisms and why.
* Define and summarize the processes that comprise the carbon cycle.
* Summarize how a plant makes glucose and from what.
* Define and provide examples of carbohydrates.
* Identify which is the simplest carbohydrate and how other carbohydrates are made.
* Summarize what occurs in each of the following: photosynthesis, respiration, and decomposition.
* Identify what processes add carbon dioxide to the air and what processes remove carbon dioxide from the air.
* Identify what processes change inorganic carbon molecules into organic carbon molecules.
* Identify what processes change organic carbon molecules into inorganic carbon molecules.
* Summarize where the weight and mass of a log goes as it is burned.
* Summarize from where a plant acquires its mass/carbon molecules.
* Compare and contrast producers, consumers, and decomposers.
* Provide examples of organic and inorganic carbon molecules.
* Identify the sources of excess carbon dioxide in the atmosphere and summarize the impact that this has on the atmosphere and on biological processes in ecosystems and agriculture.
* Summarize how we know that the current changes to the atmosphere are not part of a natural cycle.
* Propose strategies for how the levels of CO2 could be reduced.
* Summarize the importance of the carbon cycle to agriculture.
* Effectively write a title for a science publication that includes the study subject, independent variable, dependent variable, and outcome.
* Summarize information needed for the Background Information section of the introduction of a scientific paper.
* Demonstrate proper parenthetical and bibliographical citation using the APA format.
* Properly write the research question, hypothesis, rationale, and summary of methods in the introduction of a scientific paper.
* Properly write a methods section that includes the materials and a step-by-step summary of the procedure used in an experiment.
* Properly write a results section that includes a graph with a caption and a written description of the results and observations.
* Properly write a discussion section that includes restating the hypothesis, addressing how data relates to the hypothesis, and a summary of the value and predictability of the experiment.
* Cite sources in APA format in a bibliography.
* Orally present the results of an experiment using a research poster in a symposium format.
* State the four requirements for life
* Define what is the smallest indivisible unit of matter.
* Describe what is the smallest unit of life
* Identify and label the parts of an atom, and their charges
* Define atoms, molecules, and macromolecules
* Identify and define organelles and function
* Define Cells, Tissue, Organs, and Systems
* State the function and role of the following: ATP, ADP, and ATP Synthase
* Describe the role of oxygen and hydrogen in ATP production
* Identify the waste products from ATP Production
* Utilize your understanding of cell biology to describe how better-producing plants and animals could be developed.
* List the parts of the mitochondria and where each step of respiration occurs in the cytosol/mitochondria.
* State the differences and similarities between substrate-level phosphorylation and oxidative phosphorylation.
* Identify the roles of glucose, pyruvate, NAD+/FAD+, the TCA cycle, the Electron Transport System, hydrogen, ATP Synthase, and oxygen.
* List 5 ways to increase ATP production
* Summarize the 4 steps of respiration: Glycolysis, TCA cycle, Electron Transport System, and Oxidative Phosphorylation.
* Demonstrate their understanding of the components of cellular respiration through laboratory procedures.
* Develop a procedure to potentially increase ATP production by yeast and implement this procedure using standard laboratory supplies.
* Measure the production of CO2 from their protocol and determine if their choice of independent variable had an impact on ATP production in yeast.
* Analyze and use their data to defend or reject their hypothesis regarding ATP production in yeast.
* Use the results of their experiment and apply it to larger industry-based considerations such as food production and environmental protection.
* Define the following: mean, variation, standard deviation, standard error, error bars, margin of error, statistically significant results, null hypothesis, alternative hypothesis, p-value.
* State the difference between standard deviation and standard error and describe the purpose of each test in regards to research.
* State how the amount of data and the variability of that data affect its reliability.
* Compare graphs and determine if the data is statistically significantly different based on whether or not the error bars overlap.
* Calculate the mean, standard deviation, and standard error for a given sample of data (not on quiz).
* Use calculated standard error to determine the margin of error and to create error bars.
* Determine whether or not the null
* Identify the molecules that are absorbed, produced, and released by a plant cell during photosynthesis.
* Compare and contrast an animal cell to a plant cell.
* Identify the part of the chloroplast where hydrogen is stored.
* Identify the part of the chloroplast where glucose is produced.
* Identify the part of the chloroplast where ATP is produced.
* Identify the part of the chloroplast where chlorophyll is found.
* Identify the part of the chloroplast where the light reaction takes place and where the Calvin cycle takes place.
* Compare and contrast a chlorophyll’s structures to those of a mitochondria.
* State the role that each of the following plays in photosynthesis: hydrogen, photons, oxygen, ATP, NADP+
* Summarize what occurs during the light reaction.
* Summarize what occurs during the Calvin cycle.
* Summarize the roles that RuBP and G3P play.
* Define photophosphorylation
* Describe why plants need a) sunlight, b) fertilizer, c) aerated soil, and d) water as they pertain to the molecular processes that occur during photosynthesis.
* Identify where the following are found or take place in a plant:
  + Carbon dioxide absorption
  + Water absorption
  + Xylem & Phloem
  + Photosynthesis
  + Root Hairs
  + Stomata
  + Lenticels
* Describe what strategies a plant has for staying upright.
* Define each of the following: lignin, phloem, stomata, xylem, lenticels
* Compare and contrast: C3 plants, C4 plant, CAM plants, legumes.
* Explain two reasons why the Calvin Cycle is impaired in hot and dry weather in C3 plants.
* Define Rubisco and state its function.
* Summarize how C4 and CAM plants prevent interruptions to photosynthesis in hot and dry weather.
* Explain how a C4 plant is different from a CAM plant.
* Define nitrogen fixation.
* Explain how legumes utilize their root nodules for nitrogen fixation.
* Provide examples of each: C3, C4, CAM, legumes.
* State how a legume as a crop provide additional value for farmers

Semester 2

* What is an allele? A phenotype? A genotype?
* What is homozygous recessive? Homozygous dominant?
* What is heterozygous?
* If an organism has the recessive phenotype, what is their genotype?
* If a couple has all recessive-phenotype children, what are their genotypes?
* If a couple has ¼ recessive-phenotype children, what are their genotypes?
* If half the children of a couple have recessive phenotypes, what are the genotypes of the parents?
* If a heterozygous couple has 3 offspring, all with the dominant phenotype, what are the odds their 4th offspring will have the recessive phenotype?
* Difference between co-dominance and incomplete dominance
* Definition of epistasis
* How blood types work
* How Punnett Squares work with co-dominance and incomplete dominance
* Dihybrid Punnett Squares
* Dihybrid predictions of offspring
* What does DNA do? What does it code for?
* What is a gene?
* What is DNA made from?
* Identify the parts of DNA by their picture
* What are bases? What do they do?
* What does the sugar and phosphate do?
* How do bases pair up? Why?
* How is DNA read?
* ID DNA, mRNA, rRNA, and tRNA by their picture.
* What does helicase do?
* What does polymerase do?
* What function do mRNA, rRNA, and tRNA perform?
* How is RNA different from DNA?
* What is a codon? Why does it matter?
* What is transcription and translation? What is the difference? Where does each occur?
* How is mRNA read by a ribosome? How does a ribosome make a protein?
* How does tRNA know what amino acid to bring?
* How do you read an amino acid chart?
* Which items above are a part of transcription? Translation?
* Definition of a polypeptide (or sub-unit).
* 3 properties of amino acids that contribute to the shape and function of a protein.
* How cysteine amino acids bond in a protein.
* How function relates to shape in proteins.
* Difference between hydrophilic and hydrophobic amino acids.
* Properties of oppositely-charge and similarly-charged amino acids.
* Describe the primary, secondary, tertiary, and quaternary structures of a protein.
* State how these four levels of organization change with mutations.
* Identify an alpha-helix and a beta-sheet.
* Transcribe and translate a DNA sequence into mRNA and then an amino acid chain.
* Kinds of mutations.
* What is a chromosome? How many do humans have? How many from each parent?
* What did each of the following do? Darwin, Mendel, Watson & Crick, and Babcock?
* What is a breed?
* What factors were responsible for the creation of breeds? Why did they develop?
* What conditions would create a high-milking cow? A strong cow? A dual-purpose cow?
* What are each of the following breeds like? Holstein, Jersey, Milking Shorthorn, Brown Swiss
* How do you read a Sire Summary chart? How can you use this to improve the genetics of a herd?
* What is heritability? What does it tell us?
* How can we improve the rate of genetic improvement in animals?
* What is Galton’s Law? How does it affect our ability to change animals?
* How could you use a sire summary to pick the right mate for a cow?
* Definition of biotechnology
* Purpose and goal of biotechnology
* Kinds of biotechnology (green, white, red)
* Definition of a genome
* Define & describe the following: artificial selection, artificial insemination, brewing & fermentation, gene splicing, cloning, vaccines, antibiotics, stem cells, genomics, protein purification, and microbial synthetic biology.
* To sequence DNA, what kind of cells would we normally use?
* What does it mean to centrifuge a blood sample?
* How do we get to the nuclei from inside of cells? What must we do to the cells?
* How are nuclei separated from the rest of the cell?
* How is the DNA removed from the nucleus? How is the DNA separated from the rest of the cell contents?
* What method reads DNA letter by letter?
* What do we use to break up the DNA into manageable chunks?
* What do we use to make copies of the DNA?
* What does it mean to denature DNA?
* What does a primer do for DNA?
* Why is polymerase added to the DNA?
* What is a ddNTP? Why is it important for this process?
* Why is a gel needed for this process? What does it do for the DNA?
* How does a computer determine the base sequence from the DNA in the gel?
* What is the difference between an intron and an exon?
* How does a scientist tell the difference between an intron and exon?
* Why was the Human Genome Project important for science?
* Definition of genetic engineering
* Difference between recombinant DNA, gene knockouts, and gene knock-ins.
* How genetic engineering was used to manufacture human insulin.
* Definition and importance of sticky ends.
* How sticky ends make genetic engineering possible.
* Purpose and value of DNA ligase.
* How genetic engineering was used to make Bt Corn; value and purpose of Bt corn.
* How Bt Corn works.
* Safety and controversy of Bt Corn.
* How genetic engineering was used to make Golden Rice; purpose and value of Golden Rice.
* How Golden Rice was made and how this differs from Bt Corn.
* How transgenic animals are made.
* Definition of DNA Microinjection.
* Definition of a pronucleus and relationship to DNA Microinjection.
* Definition and purpose of a knockout mouse; value to medicine.
* Definition of a chimera and how this relates to knockout mice.
* How stem cells are involved in the creation of knockout mice.
* Definition and purpose of a knock-in mouse; value to medicine.
* What is PCR? What is Electrophoresis? What is Restriction Fragment Analysis?
* What is a DNA Fingerprint?
* What do we use to create a DNA Fingerprint? Why do we use this?
* What is an STR? How does this relate to a DNA fingerprint?
* How do we use STR’s to ID someone in a forensics crime scene? What are the limitations of this?
* How does PCR work? What are the steps?
* Why must we use Taq polymerase for PCR?
* What is the purpose of heat in PCR?
* What is the purpose of electrophoresis?
* Why do you have to stain the gel after running current through the gel?
* How do you read an electrophoresis gel?
* Definition of a zygote
* Summarize each of the following’s work:
  + Hans Spemann
  + Briggs & King
  + John Gurdon
  + Dolly the Sheep
* How was Dolly cloned?
* How many attempts did it take?
* Health problems that Dolly had.
* How Dolly’s cells were different.
* What is a telomere and how did it related to Dolly?
* How a clone is similar and different to the original.
* How did the first cloned cat differ from its original and why?
* Your personal position on cloning.