

# Biology Grade 1

Cell Biology (2019)

## folder

- BI.1.01 - Analyze the factors of diseases eradication: 1) Explain the factors of...[expand\\_morelink](#)

Week 01 - Week 01

Comment(s): Studying diseases in this learning outcome is considered an introduction, This Learning Outcome is the thread which ties the unit together. It begins by discussing the importance of disease. In order to understand disease and disease interventions students need to know about the healthy cell - its structures, how they function normally and how they are changed by disease. Students return to this LO after studying the whole unit. In WEEK14 they design possible interventions for a disease prevalent in Egypt. They present their work to the class, arguing from evidence about the justification of their interventions and benefit versus trade-offs involved.

Learning Outcome: Analyze the factors of diseases eradication: 1) Explain the factors of spreading, controlling and transmitting of each disease; 2) Classify disease as infectious or non-infectious; 3) Study Malaria and sickle cell anemia; 4) Explain how the disease affects cells.

Key Concepts:

- 1. Cell theory and disease.
  - a. Infectious or noninfectious and factors
  - b. Vectors
  - c. Non-infectious factors
- 2. Relation between diseases and economic development
- 3. Case study: Malaria (from SEPUP only)

Skills: 1. Describe trends and relationships in data. 2. Develop and support conclusions based on evidence. 3. Use the microscope to differentiate between healthy and unhealthy cells.

Essential Questions: What threatens life?

Textbook and Resource Materials:

1- SEPUP Book, unit 3 Cell Biology Activity 2 teacher SEPUP page 259: 271 student SEPUP 161: 170 Links: 1-<http://www.cdc.gov/>

Evidence of Learning: 1. Students use sheets of SEPUP that are mentioned in the Activity Teacher Guide unit 3 - Act 02 - SS2.1 2. Students create a poster about the diseases 3. Exit tickets

Capstone Connection: The student should to take into consideration what makes an environment healthy during their capstone design.

SEC Topic & Code: HSS-BI 1.01 (HSS-BI 1.01)

## assignment

- BI.1.02 - Compare and contrast the structures within the cells of plants, animals,...[expand\\_morelink](#)

## Week 02 - Week 04

Comment(s): This unit includes many laboratory experiences which is particularly good for these first-year students who may never have handled laboratory equipment before. These initial labs have them using the microscope and learning to draw in a scientific way as they study cells.

Learning Outcome: Compare and contrast the structures within the cells of plants, animals, protista and bacteria which function to enable the cell to live.

Key Concepts:

- 1. Compare and contrast eukaryotes and prokaryotes
  - a. Size.
  - b. Internal structures (membranes, DNA, ribosomes).
  - c. Example organisms.
- 2. Eukaryotic cell structure and function will include:
  - a. Cell membrane
  - b. Endomembrane system (and its function as a transport and packaging system)
  - c. Mitochondria and chloroplast (and their function of energy conversion)
  - d. Nucleus (and its function as a storage of genetic material).
  - e. Ribosome (and its function of protein synthesis).
  - f. Smooth endoplasmic reticulum (and its function of lipid synthesis).
- 3. Plant vs. animal cell structures.
- 4. TB as a case study from SEPUP.

Skills: 1. Use a microscope to make observations of general eukaryotic cell structures. 2. Make scientific drawings. 3. Make conclusions based on evidence. 4. Make accurate inferences using text materials. 5. Use the tools to prepare slides for plant and animal cells.

Essential Questions: How does structure influence function?

Textbook and Resource Materials:

SEPUP Materials - Unit 3 Cell Biology Activity 3 teacher SEPUP page 272: 283, student SEPUP 171: 179 Activity 4 teacher SEPUP page 284: 289, student SEPUP page 180 : 183 [http://SEPUPlhs.org/high/sgi/teachers/cell\\_sim.html](http://SEPUPlhs.org/high/sgi/teachers/cell_sim.html)  
<http://www.molbiolcel1.0rg/content/21/22/3786.full> Activity 5 teacher SEPUP 290 :293, student SEPUP184 : 185

[http://SEPUPlhs.org/high/sgi/teachers/special\\_cell\\_sim.html](http://SEPUPlhs.org/high/sgi/teachers/special_cell_sim.html) Activity 6 teacher SEPUP 294 : 299 student SEPUP 186 : 190 - Simulation

<http://sumanasinc.com/webcontent/animations/content/diffusion.html> - Links

<https://www.youtube.com/watch?v=svAAiKsJa-Y>

<https://www.youtube.com/watch?v=prfMUwjbo8>

<https://www.youtube.com/watch?v=Ao9cVhwPg84>

<https://www.youtube.com/watch?v=URUJD5NEXC8>

Evidence of Learning: -Using SEPUP analysis questions Unit 3 - Act 03 - Drawings of cells in science notebook Unit 3 - Act 03 - Venn diagram showing structures cells have in common Unit 3 - Act 04 - SS 4.1 Unit 3 - Act 05 - SS 5.1 Unit 3 - Act 06 - Analysis Questions - Exit ticket

Capstone Connection: Students should be able to discuss how form and function are related in their capstone projects. Other subject connection: • Chemistry CH.1.0.1; CH.1.0.2. • Geology ES.1.02. • Math – MA.1.04. • Arabic – ask to write an article or research paper about biology topics. • English- reading, speaking, writing and listening skills. • French-reading, speaking and writing. • German-reading, speaking and writing. • Art AR.1.01 how to draw. • Computer science- CS.1.04 presentation. • Home economy-module 2 nutrition needs. • P.E- module 2 teamwork • Library- LI.1.05; LI.1.01 library type • Music- MU.1.01; MU.1.02; MU.1.03; MU.1..4

assignment

- BI.1.03 - Connect the structure of a healthy cell membrane to the functions it...[expand\\_morelink](#)

Week 05 - Week 06

Comment(s): These activities include two laboratories which explore the nature of membranes and lay the groundwork for the more detailed explanation of how and why a cell membrane works as it does. Doing these laboratories in advance will make learning the details more meaningful to students and leads to deeper understanding and higher retention.

Learning Outcome: Connect the structure of a healthy cell membrane to the functions it performs; 1) develop an explanation of the structure of the cell membrane to include how the structure enables the processes of diffusion and osmosis to occur; and 2) describe the nature of phospholipids.

Key Concepts:

- 1. Cell membrane
  - a. Barrier function
  - b. Phospholipids and proteins.
  - c. Fluid structure
  - d. Membrane models for study of function
- 2. Cell membrane and diffusion
  - a. Diffusion.
  - b. Osmosis.
  - c. Selective permeability
  - d. Protein channels and facilitated diffusion.
  - e. Concentration gradients,
  - f. Transport proteins and active transport
  - g. Diabetes as a case study (from SEPUP)

Skills: 1. Make and record laboratory data. 2. Analyze laboratory data to infer the nature of features of membranes. 3. Make accurate inferences from text materials.

Essential Questions: How does structure determine function?

Textbook and Resource Materials:

1- SEPUP Materials in Unit 3 - Cell Biology Act. 07 teacher SEPUP 300 : 308, student SEPUP 191 : 197 Act 07 - TR 7.1; TR 7.2 Act 07 - SS 2.1 to use for diabetes reading Act 08 teacher SEPUP P. 310 : 319 student SEPUP P. 198 : 205 Act 08 - SS 2.1 to use for HIV reading Act 09 teacher SEPUP P. 321 : 329 student SEPUP P. 206 : 212 Act 09 - TR 9.1

Evidence of Learning: 1- Use of the Analysis questions for each Activity. 2- Students' successful use of lab materials in Act 7 & 8. 3-Analysis question 6 for Act 9 as an assessment.

Capstone Connection: Again, students should relate form to function within their Capstone project.

SEC Topic & Code: HSS-BI.1.02 (HSS-BI.1.02)

assignment

## folder

- BI.1.04 - Create a model which shows the structure of DNA and RNA as a genetic material...expand\_more

### Week 07 - Week 07

Learning Outcome: Create a model which shows the structure of DNA and RNA as a genetic material only: 1) The difference between DNA and RNA structure. 2) Complementary base pairing rules .

Key Concepts:

- Modeling DNA structure:
  - 1. Deoxyribonucleic acid (DNA).
  - 2. Nucleotide subunits.
  - 3. Nitrogenous bases.
  - 4. Sugar–phosphate backbone.
  - 5. Complementary strands.
  - 6. Double helix.
- RNA structure

Skills: Compare and contrast the structure of DNA and RNA.

Essential Questions: How is genetic information recorded?

Textbook and Resource Materials:

Unite 4 Genetics - Act.10 Modeling DNA Structure (Te.SEPUP 505-513 -S.SEPUP 228-333) Unit 4 Genetics - Act 10 - TR (10.1+10.2+10.3+10.4)

[http://www.nobelprize.org/educational/medicine/dna\\_double\\_helix/readmore.html](http://www.nobelprize.org/educational/medicine/dna_double_helix/readmore.html)

Evidence of Learning: - Record of lab work in science notebook - Exit ticket -Answer Analysis Questions

SEC Topic & Code: HSS-BI.1.01, HSS-BI.2.01 (HSS-BI.1.01, HSS-BI.2.01)

## assignment

- BI.1.05 - Investigate the functions of different classes of proteins and the factors...expand\_morelink

### Week 08 - Week 09

Comment(s): Again, there is a very important lab in this section (Act 11). In this lab students actually design their own experiment with a testable hypothesis. This is their first opportunity to practice this extremely important skill in science.

Learning Outcome: Investigate the functions of different classes of proteins and the factors affecting their performance: 1) know the structure, classes and functions of proteins; 2) know the mechanism of an enzyme function as a catalyst and the factors that effect on it.

Key Concepts: Functions of proteins in cells:

- a. Proteins in cells.
- b. Protein classification.
- c. Enzyme structure, functions and factors affecting rates.

Skills: Correlate (identify the relationship between) structure and function.

Essential Questions: What are proteins and why are they important?

Textbook and Resource Materials:

Cell Biology- Unit 3 - Act.10 Functions of Proteins in Cells(Teacher .SEPUP 330-338 - S.SEPUP 213-215) Unit 3 - Act 10 - TR 10.1; SS 10.1 Cell Biology- Unit 3 - Act.11 Investigating Enzyme Function (Teacher .SEPUP 339-346 -S.SEPUP 216-218) Unit 3- Act 11 - TR 11.1

Evidence of Learning: Use of all Analysis Questions Unit 3 - Act 10 - SS 10.1 Unit 3 - Act 11 - Entries in science notebooks of hypothesis, procedure, data collected, etc. Unit 4 - Act 16 - SS 16.1

Capstone Connection: A healthy environment includes good temperature control and clean water for the human body to function optimally.

SEC Topic & Code: HSS-BI.1.01 (HSS-BI.1.01)

assignment

Cell Biology (part 2) (2019)

folder

- BI.1.06 - Create a model which outlines the cell cycle in controlled and uncontrolled...expand\_more

Week 10 - Week 10

Comment(s): Activity 13 which is used to teach this Learning Outcome does not go into the phases of mitosis. The phases of mitosis are taught in Grade 2. The Cell Cycle at this point is generalized. We'd need to be careful that students don't get confused by the use of the word phases both in the sense of the cell cycle phases and then in the sense of mitotic phases. I would recommend leaving the teaching of the mitotic phases to Grade 2. At this point they only need to realize that body cells replicate at different rates for different reasons. All the details can be left to Grade 2 where they'll need more detail in order to understand mutation.

Learning Outcome: Create a model which outlines the cell cycle in controlled and uncontrolled cell divisions, including uncontrolled cell division resulting in cancer.

Key Concepts: The cell cycle:

- 1. Cell growth and division.
- 2. Phases sequence (G1, S, G2, M).
- 3. Normal and abnormal rates and processes.
- 4. Rate differentiation based on cell type.
- 5. Cancer as case study (from SEPUP only)

Skills: Record observations and identify trends in data

Essential Questions: How does life maintain itself?

Textbook and Resource Materials:

Unit 3 Cell Biology Act.13 The Cell Cycle (Teacher: SEPUP 360-370; Student: SEPUP 229-235)

Evidence of Learning: Unit 3 - Act 13 - SS 13.1 - Exit ticket - Group presentations - Solve

Analysis questions Other subject connections: • Arabic – ask to write an article or research paper

about biology topics. • English- reading, speaking, writing and listening skills. • French-reading, speaking and writing. • German- reading, speaking and writing. • Computer science – 1.0.7 chart.

SEC Topic & Code: HSS-BI.1.03 (HSS-BI.1.03)

## assignment

- BI.1.07 - Evaluate stem cells as possible cures for some diseases: 1) cell...expand\_more

Week 11 - Week 12

Comment(s): Material from the Genetics unit (Unit 4) has been added here to explain the mechanism of stem cell differentiation in greater depth. This material is not being used by Grade 2 and it is logical to include it here.

Learning Outcome: Evaluate stem cells as possible cures for some diseases: 1) cell differentiation; and 2) stem cells as a cure for disease.

Key Concepts:

- 1. STEM cells types according to differentiation
  - a. Totipotent
  - b. Pluripotent
  - c. Multipoint
- 2. Types of STEM cells according to its presence
  - a. Embryonic
  - b. Adults (somatic).
- 3. Layers of the embryo
  - a. Ectoderm
  - b. Endoderm
  - c. Mesoderm
- 4. STEM cells as a treatment
  - a. Treatment for leukemia
  - b. Umbilical cord blood STEM cells therapy
  - c. Bone marrow transplant
- 5. New researches treatment for diabetes
- 6. The STEM cells debate.

Skills: 1. Distinguish scientific questions from ethical questions. 2. Investigate through modeling and developing explanations.

Essential Questions: Can stem cells be used to cure diseases?

Textbook and Resource Materials:

Unit 4 Genetics - Act 17 Cell Differentiation and Gene Expression (Teacher: SEPUP 572: 581

Students: SEPUP 376 : 381) Parts A & B only Act 17 - SS 17.1

Evidence of Learning: - SEPUP students' sheet - unit 4 - Act 17 - SS 17.1 - Solving Analysis Questions

SEC Topic & Code: HSS-BI.1.03 (HSS-BI.1.03)

## assignment

- BI.1.08 - Create a simulation to show how viruses infect a cell: 1) know organelles of...[expand\\_more](#)

### Week 13 - Week 13

Comment(s): By the end of the first semester students will study six diseases (Malaria, sickle cell anemia, TB, diabetes, cancer, and HIV from SEPUP information only) and these diseases will be included in the exam. The student will choose any other disease rather than these six diseases to do it as a project related to his learning outcomes. Week 14 circles back to disease and interventions as students give their presentations. This will conclude Learning Outcome 1.

Learning Outcome: Create a simulation to show how viruses infect a cell: 1) know organelles of healthy cells; 2) explain why a virus can't replicate by itself and must use the cell's organelles; and 3) identify which organelles are used by the virus.

Key Concepts: HIV/AIDS: Virus and cell organelles:

- 1. The relationship between cell protein and viral protein.
- 2. Receptor proteins and enzymes.
- 3. Protein manufacture of virus utilizing cell organelles.
- 4. HIV virus mechanism of infection and replication.
- . 5.HIV as a case study (from SEPUP).
- a. Disease symptoms.

Skills: 1. Explain and interpret data. 2. Design and prepare a simulation.

Essential Questions: Is virus a living thing?

Textbook and Resource Materials:

Unit 3 - Act.16 HIV/AIDS Infection and Cell Organelles (Teacher: SEPUP 381-388; Student: SEPUP 244-249) Act 16 SS 16.1; SS 2.1

<http://sumanasinc.com/webcontent/animations/content/lifecyclehiv.html>

Evidence of Learning: Make a simulation Unit 3 - Act 16 - SS 16.1

[assignment](#)

Plant Anatomy and Physiology (2019)

[folder](#)

- BI.1.09 - Providing supplies as the microscopic slides. Focusing on the study of leaf...[expand\\_morelink](#)

### Week 01 - Week 01

Comment(s): Students should observe and draw the dicot leaf as they see it under the microscope and predict from what they know what the structures may be. Then they go to an illustration which points out the structures and go back to the slide to label the structures with the aid of the illustration. This would serve as a pre-assessment of their knowledge and would give the lab an inquiry-based approach. Students may be uncomfortable with guessing, but inquiry-based approaches require becoming able to take an intellectual chance and then go from there to learn.

Learning Outcome: Providing supplies as the microscopic slides. Focusing on the study of leaf structure in a dicot plant. Relate the structure of specialized plant structures to their function

within the plant and within the process of photosynthesis. 1) examine and draw cross section of dicot leaf; 2) include structures of mesophyll cells, stomata, xylem, phloem, and chloroplast; and 3) include other plant structures listed under concepts section.

Key Concepts:

- 1. Plant tissues: meristematic and permanent.
- 2. Meristematic
  - a. Apical,
  - b. Vascular cambium.
  - c. Cork cambium
- 3. Permanent tissues
  - a. Parenchyma,
  - b. Collenchyma.
  - c. Sclerenchyma.
  - d. chlorenchyma.
- 4. Complex permanent tissues
  - a. Vascular,
  - b. Dermal.
  - c. Ground tissues
- 5. Plant tissue adaptation.
- 6. Transpiration and capillary action.

Skills: 1. Use of microscope. 2. Make detailed observations and records. 3. Deduce cell processes from structure and function of cell parts. 4. Scientific drawing of a microscopic section.

Essential Questions: Why are plants the foundation of life?

Textbook and Resource Materials:

Dynamics. 23.1 - 23.2p. from 605 to 618 Modern Ch.29 from p.583 to p.603

Evidence of Learning: Quiz (Laboratory Practical Quiz?). Drawings of microscope slides. Writings in science notebooks. Comparing slides and identifying them according to their characteristics.

Exit ticket - H.W.

Capstone Connection: Structures and functions of plant parts can inform building design from materials to function to structure to help understand heat flow????

SEC Topic & Code: HSS-BI.1.04 (HSS-BI.1.04)

## assignment

- BI.1.10 - Compare and contrast the processes of photosynthesis and cellular...[expand\\_morelink](#)

## Week 02 - Week 03

Learning Outcome: Compare and contrast the processes of photosynthesis and cellular respiration: 1) describe the process of photosynthesis including the interactions between the light dependent and light independent stages of photosynthesis; 2) describe the process of cellular respiration, both aerobic and anaerobic; and 3) identify the factors that influence photosynthesis and cellular respiration.

Key Concepts:

- 1. Capturing the light energy.
- 2. Pigments (chlorophyll a – chlorophyll b – Xanthophyll – Carotene) (considering the color and the ratio)
- 3. Chloroplast



- 4. Photosynthesis process
  - a. Light dependent reactions
  - b. light independent reaction / Calvin Cycle (ATP/ADP – NADP+/NADPH – PGAL (G3P) – RuBP – 3PGA)
- 5. Cellular respiration
  - a. Glycolysis is part of both:
    - I. aerobic respiration
      - a. Krebs cycle
      - b. Chemiosmosis
    - II. Anaerobic respiration (Fermentation)
      - \* Lactic acid fermentation
      - \*\* Alcoholic fermentation.

Skills: Make accurate inferences and conclusions using text materials

Essential Questions: Could a plant be a photochemical cell?

Textbook and Resource Materials:

SEPUP Ecology Unit Act.9 - Photosynthesis and Cellular Respiration Shuffle, Teacher 158-163;  
S 100-102 SEPUP Cell Biology Unit Act.12 - Photosynthesis and Cellular Respiration, Teacher  
347-359; S 219-228

Evidence of Learning: Answer the Analysis questions. Compare between light and chemical reactions.

Capstone Connection: Energy conversion in a plant can be compared and contrasted to energy conversion in a dwelling.

SEC Topic & Code: HSS-BI.1.01; HSS-BI.1.04 (HSS-BI.1.01; HSS-BI.1.04)

## assignment

- BI.1.11 - Create your own experiment to investigate a factor that affects...[expand\\_morelink](#)

Week 04 - Week 06

Comment(s): This is a new Learning Outcome that is very, very important for a student learning science. This experience gives an opportunity to BE a scientist using experimental design to ask your own questions! This is extremely important in a STEM school education! It is wonderful to see that the Biology teachers added this!

Learning Outcome: Create your own experiment to investigate a factor that affects photosynthesis and/or respiration using the steps of experimental design.

Key Concepts:

- 1. Experimental design
  - a. Reproducible procedures
  - . b. Independent variable to be manipulated.
- 2. Cellular respiration in plants
- 3. Energy release.
- 4. Photosynthesis.
- 5. Capture of energy and production of carbon dioxide.
- 6. Impact of variables on photosynthesis and cellular respiration
  - a. Temperature.
  - b. Amount of light
- 7. Chemical indicators

Skills: 1. Design and conduct investigations 2. Make and record observations and measurements  
3. Develop conclusions based on evidence 4. Make predictions

Essential Questions: Can we influence the capture and release of energy?

Textbook and Resource Materials:

SEPUP Ecology Unit 2 Act.10 - Respiring Beans, Teacher 164-170; S 103-106 Act.11 -

Respiration and Photosynthesis in Plants, Teacher 171-178; S 107-110 Act.12 - Too Much Life, Teacher 179-186; S 111-115

Evidence of Learning: Make predictions. Take measurements, collect and record data. Quality of student experimental designs. Entries in science notebooks - procedure, data, analysis and conclusions based on their real data.

Capstone Connection: Experimental design can be compared and contrasted with designing a test plan for the Capstone prototype.

SEC Topic & Code: HSS-BI.1.04 (HSS-BI.1.04)

assignment

Ecology (2019)

folder

- BI.1.12 - Create a model that shows the interdependence of living organisms within an...[expand\\_morelink](#)

Week 07 - Week 08

Comment(s): The Biology teachers have done an excellent job preserving the most important parts of the Ecology unit, while making time in the semester for an in-depth study of plants.???

Learning Outcome: Create a model that shows the interdependence of living organisms within an ecosystem: 1) describe the relation between the trophic levels and its numbers concerning energy loss; and 2) explain the roles of producers and consumers in a food web.

Key Concepts: 1. Ecological biodiversity. 2. Habitat variety. 3. Micro to macro constituents of food web. 4. Producers and consumers. 5. Food as energy source. 6. Varieties of consumers a. Herbivores. b. Carnivores. c. Omnivores. d. Decomposers. 7. Food web diagram. 8. Energy flow and pyramid. 9. Consumers levels a. Primary b. Secondary c. Tertiary consumers 10. Ecosystem diversity, disruption and collapse.

Skills: 1. Use microscopes to make and record observations of diversity in aquatic ecosystems (water samples). 2. Compare microorganism diversity in water samples from different ecosystems. 3. Make predictions 4. Identify and describe trade-offs involved in ecosystem changes. 5. Use case studies to make accurate interpretations, inferences and conclusions from text.

Essential Questions: Is energy neither created nor destroyed within an ecosystem?

Textbook and Resource Materials:

SEPUP Ecology Unit 2 Act.6 Producers and Consumers, Teacher p. 134-142 S p. 85-89 Act.7

Energy Flow Through an Ecosystem, Teacher p. 143-151 S p. 90-95

Evidence of Learning: Complete all activity sheets from SEPUP - SS 6.1; SS 7.1. Quiz - Draw food web and answer questions. Use dichotomous key to identify name of specimens. Answer some of the Analysis questions at the end of each activity.

Capstone Connection: Apply understanding of energy use and flow to varied alternative energy processes

SEC Topic & Code: HSS-BI.1.06; HSS-BI.1.07 (HSS-BI.1.06; HSS-BI.1.07)

## assignment

- BI.1.13 - Connect the cycling of carbon to global climate change: 1) forms of carbon...[expand\\_morelink](#)

### Week 09 - Week 09

Learning Outcome: Connect the cycling of carbon to global climate change: 1) forms of carbon within the carbon cycle, how conserved within nature; and 2) effect of humans on the carbon cycle.

Key Concepts: 1. Carbon cycle. 2. Carbon reservoirs. 3. Quantity of carbon – fixed. 4. Reservoir quantity – fluctuates. 5. Forms of carbon (e.g., CO<sub>2</sub> and carbohydrates). 6. Human impact on reservoirs.

Skills: 1. Make predictions using evidence

Essential Questions: How does non-living matter cycle?

Textbook and Resource Materials:

SEPUP - Ecology Unit 2 Activity 8 - Carbon Cycle, Teacher p. 152-157 S p. 96-99

Capstone Connection: A dwelling's carbon footprint is connected to our contribution to the carbon cycle.

## assignment

- BI.1.14 - Analyze how natural and human-caused events can unbalance an ecosystem and...[expand\\_morelink](#)

### Week 10 - Week 11

Comment(s): If time is running short in the semester, the teacher may want to talk through Activity 4 on invasive species rather than have students do all the case study reading. I also moved Act 18 & 19 to this Learning Outcome because they were more closely connected to it and again if time is running short in the semester it may be that the teacher gives an overview of them rather than having the students actually do them. It is more important that students have the time to apply what they have been learning about ecosystems to problems in Egypt itself than to go into more depth about fisheries in particular.

Learning Outcome: Analyze how natural and human-caused events can unbalance an ecosystem and describe possible strategies for restoring balance to damaged ecosystems.

Key Concepts: 1. Ecosystem services. 2. Management of resources. 3. Natural and human-caused disturbances. 4. Ecosystem disturbance: minor to catastrophic. 5. Ecosystem resilience. 6. Invasive species. 7. Ecosystem resistance.

Skills: 1. Graph and analyze data. 2. Identify and describe trends in data. 3. Communicate and defend a scientific argument. 4. Identify evidence. 5. Identify and weigh trade-offs when making a decision.

Essential Questions: How is balance achieved?

Textbook and Resource Materials:

SEPUP - Ecology unit 2: Act. 1, 4, 17, 18, 19 Teacher pdf of other sources Act. 1 Ecosystems and Change Te. P.71 - 85 Sp. 45 - 56 Act. 4 Invasive Species Te. P.107 - 120 S p. 70 – 79 Act. 17 Ecosystem Change and Resiliency Te. P.217 - 223 S p. 134 -1138 Act. 18 Fishery Case Studies Te p. 224-232 S p. 139-144 Act.19 Making Sustainable Fishery Decisions Te p.233-242 S p.145-147

Evidence of Learning: Oral presentations Group created food webs Quiz - Problem solution based on pictures 18.1; 19.1; 19.2

Capstone Connection: Consider ecosystem impact of the Capstone design

SEC Topic & Code: HSS-BI.1.06, HSS-BI.1.04 (HSS-BI.1.06, HSS-BI.1.04)

### [assignment](#)

- BI.1.15 - Analyze an ecosystem in Egypt that has become unbalanced and suggest...[expand\\_morelink](#)

Week 12 - Week 12

Comment(s): Student presentations should be limited so that all students can give their presentations within the week or this may become a group activity to limit the number of presentations requiring class time.

Learning Outcome: Analyze an ecosystem in Egypt that has become unbalanced and suggest effective interventions.

Key Concepts: Restoration of ecosystems

Skills: 1. Research 2. Analysis 3. Presentation

Essential Questions: What is the relationship between balance, unbalance and rebalance?

Textbook and Resource Materials:

Online links to make presentations (Self-study)

Evidence of Learning: Students prepare a presentation which demonstrates their knowledge of ecosystems as it applies in Egypt

Capstone Connection: Dwellings and developments impact ecosystems.

SEC Topic & Code: HSS-BI.1.06 (HSS-BI.1.06)

### [assignment](#)

## Biology Grade 2

Genetically Modified Food (2019)

### folder

- BI.2.01 - Use evidence to evaluate the trade-offs of using genetically modified food to...[expand\\_morelink](#)

#### Week 01 - Week 01

Comment(s): This unit begins with questioning the use of genetically modified food as a reason for learning the details of genetics. The last lessons of the unit will require that students use the information they have learned in order to make well-informed decisions about the trade-offs involved with the use of GMO's.

Learning Outcome: Use evidence to evaluate the trade-offs of using genetically modified food to support economic, social and environmental sustainability. Describe the trade-offs of the use of genetically modified food Explain the intended and unintended consequences of the use of GMO's

Key Concepts: 1. Genetically modified organisms. 2. Beneficial characteristics (example, disease resistance, drought tolerance and higher nutritional value). 4. Unintended consequences for humans and ecosystems.

Skills: 1. Evidence-based debate. 2. Identify and describe trade-offs. 3. Argue a stance and support it with evidence.

Essential Questions: Should people engineer organisms?

Textbook and Resource Materials:

SEPUP Book - Unit 4 - Genetics: Feeding the World Students p. 260-268 Teachers p. 407- 418; SS 1.1

Evidence of Learning: (BA); Explain the intended and unintended consequences of genetic modification (ST): Solve Analysis ques.4 in student book P. 286 (ST) Did your initial ideas about Bt corn change? Explain your initial ideas. If they have changed, explain how and why. What arguments made you change your mind? If they have not changed, explain why not.

Capstone Connection: Some plant species, such as rice, can be modified to grow under different conditions of water availability impacting water needs for irrigation.

SEC Topic & Code: HSS-Bi 2.02.04; HSS-Bi 2.02.05 (HSS-Bi 2.02.04; HSS-Bi 2.02.05)

### assignment

- BI.2.02 - Create a model to show the process of genetically modifying organisms and how...[expand\\_morelink](#)

#### Week 02 - Week 03

Comment(s): This includes a very important laboratory in which students actually genetically modify an organism Students will have received an introduction to mitosis in Grade 1 so their preexisting knowledge should be assessed before doing all the parts of Act 2. It may be that only one part will serve as enough of a review. I have removed meiosis from this LO. In my experience, students were confused when I introduced mitosis and meiosis together. THE SEPUP materials are designed to give students the experience of seeing the results of different

kinds of crosses and THEN the mechanism which enables those crosses (meiosis) is introduced in detail. If the teacher believes meiosis needs to be introduced before doing the crosses then I would recommend the Use of Act, 13 & 14 to do so. I have left Act 13 & 14 under LO 2.06.

Learning Outcome: Create a model to show the process of genetically modifying organisms and how the new genetic material is inherited: 1) conduct experiments on the process of creating GMO's; and 2) model inheritance by mitosis.

Key Concepts: 1. Bacterial transformation technique. 2. Plasmids. 3. Genes and chromosomes (definition only). 4. Mitosis.

Skills: 1. Use good laboratory technique (sterilization technique). 2. Make and record observations. 3. Identify and describe trends in data. 4. Make predictions. 5. Develop conclusions based on evidence.

Essential Questions: How can GMO's affect our lives?

Textbook and Resource Materials:

SEPUP Genetic: Activity 2 (student p. 269-277) ,(teacher p.419-434) Act 2 SS 2.1; 2.2; and 2.3 Activity 3: (Students p 278-281) ,(teacher p 435-439) Act 3 SS 3.1

Evidence of Learning: Q1 & 4 in SEPUP student book p.277 (BA) Students are going to read the case study on biofuel to define the type of modification, benefits, risks, status of development and other solutions in the case study on GMOs and should answer the Analysis question (Q 4) page 277 (ST) : Analyze your work in this activity and that of the other groups, according to your teacher's instructions. Analysis should include a summary of the data collected and conclusions you and your group draw from the data about the bacteria on the plates. Explain possible sources of experimental error. (Q1) page 277

Capstone Connection: Apply the process of genetic modification of organisms to support improved conditions of a water supply

SEC Topic & Code: HSS-Bi 2.02.6; HSS-Bi 2.0.7; HSS-Bi 2.0.8; HSS-Bi 2.01.11 (HSS-Bi 2.02.6; HSS-Bi 2.0.7; HSS-Bi 2.0.8; HSS-Bi 2.01.11)

## assignment

- BI.2.03 - Discuss how the chemical and structural properties of DNA and its replication...expand\_more

## Week 04 - Week 06

Learning Outcome: Discuss how the chemical and structural properties of DNA and its replication result in the creation of new genotypes: 1) design a model to show the structure of DNA; and 2) determine how DNA replicates 3) Gene expression and protein synthesis

Key Concepts: 1. Deoxyribonucleic acid (DNA). a. Macromolecule with nucleotide subunits. b. Double helix and complementary strands. c. Sugar-phosphate backbone and nitrogenous bases. (Adenine, guanine, cytosine, and thymine represented by A, G, C, and T). d. Nucleotide sequences (Coded instructions). 2. DNA replication by semi-conservative mechanism. 3. Transcription and translation. 4. RNA types and structure. 5. Protein Synthesis.

Skills: 1. Perform DNA isolation. 2. Make and record observations. 3. Identify, describe trends and Interpret data. 4. Develop claims based on evidence and reasoning. 5. Recognize and analyze alternative explanations and models. 6. Express and defend a scientific argument.

Essential Questions: How does DNA structure enable its function?

Textbook and Resource Materials:

Activity 9: SEPUP,Genetics,(student p.324- 327).(teacher p.500- 506) Activity 10:

SEPUP,Genetics. (student p.328-333).(teacher p.507-515) Activity 12: (student p.343-

345).(teacher p.528-531) Meselson and Stahl experiment : <http://highered.mcgraw-hill.com/olcweb/cgi/pluginpop.cgi?it=swf::535::535::sites/dl/free/0072437316/120076/bio22.swf::Meselson%20and%20Stahl%20Experiment> - Act 16 - (Protein Synthesis - Transcription and Translation (Te SEPUP 559-567, S SEPUP 366-375) Unit 4-Act 16 TR 16.1; TR 16.2  
 Evidence of Learning: Activity (9):Successful isolation of DNA during lab  
 SEC Topic & Code: HSS-Bi 2.01.01; HSS-Bi 2.01.02; HSS-Bi 2.01.03; HSS-Bi 2.01.04; HSS-Bi 2.01.05; HSS-Bi 2.01.07; HSS-Bi 2.01.08; HSS-Bi 2.01.09; HSS-Bi 2.01.10; HSS-Bi 2.01.11; HSS-Bi 2.01.12; HSS-Bi 2.01.13; HSS-Bi 2.01.15; HSS-Bi 2.01.16; HSS-Bi 2.02.01; HSS-Bi 2.02.12 (HSS-Bi 2.01.01; HSS-Bi 2.01.02; HSS-Bi 2.01.03; HSS-Bi 2.01.04; HSS-Bi 2.01.05; HSS-Bi 2.01.07; HSS-Bi 2.01.08; HSS-Bi 2.01.09; HSS-Bi 2.01.10; HSS-Bi 2.01.11; HSS-Bi 2.01.12; HSS-Bi 2.01.13; HSS-Bi 2.01.15; HSS-Bi 2.01.16; HSS-Bi 2.02.01; HSS-Bi 2.02.12)

## assignment

- BI.2.04 - Describe the key steps in the creation of genetic modifications and analyze...[expand\\_morelink](#)

### Week 07 - Week 08

Comment(s): Instead of a presentation about the steps in creating GMO's as evidence of learning, I made it a presentation of their data from the electrophoresis experiment and the conclusions they drew from that. I was thinking that all the presentations of steps in creating GMO's would be so similar that it would be too repetitive for students to listen to them during class? Your thoughts?

Learning Outcome: Describe the key steps in the creation of genetic modifications and analyze the DNA of organisms to determine whether they are modified or not using electrophoresis.

Key Concepts: 1. Genetically modified organisms. 2. Desirable traits (e.g., pest or disease resistance, drought tolerance, or enhanced nutritional qualities). 3. Genetic manipulation for new combinations of traits. 4. DNA electrophoresis. 5. Steps in GMO: a. identification of desirable gene; b. isolation of gene; c. preparation of a DNA construct - adding markers; d. delivery of the desired gene into target organism; and e. raising the transformed organisms using a selective medium. 6. DNA constructs insertion: a. shooting with gene gun; b. bacterial transformation; or c. viral delivery.

Skills: 1. Develop conclusions based on evidence and reasoning. 2. Consider and evaluate multiple perspectives on an issue. 3. Identify and describe trade-offs of decisions. 4. Argue a position and support it with evidence.

Essential Questions: Are GMO's the solution?

Textbook and Resource Materials:

SEPUP Science and Global Issues. Activity 15 (teacher p.549) (student p.361) Activity 18 (teacher p.583) (student p.385). Activity 19 (teacher p. 596) (students' 393) Modern Biology Ch 13 p 257-259 Campbell 9th edition, Ch 20 (p.399 ) +( from p.405 to 409)

Evidence of Learning: -Students produce a poster about one of the GMO organisms -The final arrangement of the 8 cards about the genetic modification of lettuce as done in class (Activity 19) (teacher p. 596) (students' 393). - Students answer Analysis Question 2 (p 391 SEPUP) in groups - Answer questions 1 and 3 p. 391 individually - SEPUP Analysis Questions p 399 - An exam (done on google form )

Capstone Connection: Students could use edible vaccines to improve the medicine industry.

SEC Topic & Code: HSS-Bi 2.02.02; HSS-Bi 2.02.03; HSS-Bi 2.02.11; HSS-Bi 2.02.12 (HSS-Bi 2.02.02; HSS-Bi 2.02.03; HSS-Bi 2.02.11; HSS-Bi 2.02.12)



## assignment

- BI.2.05 - Compare and contrast selective breeding and genetic modification to breed a...expand\_more

### Week 09 - Week 10

Learning Outcome: Compare and contrast selective breeding and genetic modification to breed a new type of wheat in Egypt with a minimum of two desired traits.

Key Concepts: 1. Distinguish between genes and alleles. 2. Use Punnett squares to predict outcomes of genetic crosses. 3. Phenotypic and genotypic results (Heterozygote -Homozygote). 4. Selective breeding. 6. Gregor Mendel's contributions to our understanding of genetics. 7. Patterns of inheritance a. Simple dominance (Laws of simple dominance- first and second Mendelian laws) b. Incomplete dominance. c. Codominance.

Skills: 1. Collect, record and interpret data. 2. Develop conclusions based on evidence

Essential Questions: How could genetic modification improve the agricultural wealth or food deficiency in Egypt?

Textbook and Resource Materials:

SEPUP Genetics Activity 4 (Breeding Corn) (student p. 282-289) (teacher p. 442-454) Act 4 SS 4.1 & 4.2 SEPUP Genetics. Activity 5. (Genes and Traits) (student p. 290-299). (teacher p. 453-463) SEPUP Genetics, Activity 6 (Breeding Corn for Two Traits ) (student p. 300-306). (teacher p. 464-476) Act 6 SS 6.1 & 6.2 SEPUP Genetics Activity 7 (Breeding Better Rice) (student p. 307--315). (Teacher p. 477-487) Act 7 SS 7.1

Evidence of Learning: - Students will solve all Analysis questions page 306 - Students will prepare a plan to breed of new type of wheat with a minimum of two desirable traits - Students are going to solve question Analysis 3 & 4 , page 314

SEC Topic & Code: HSS-BI 1.05.01; HSS-BI 1.05.02; HSS-BI 1.05.03; HSS-Bi 2.02.09; HSS-Bi 2.02.10; HSS-Bi 2.02.11 (HSS-BI 1.05.01; HSS-BI 1.05.02; HSS-BI 1.05.03; HSS-Bi 2.02.09; HSS-Bi 2.02.10; HSS-Bi 2.02.11)

## assignment

- BI.2.06 - Interpret how sex-linked chromosomes and abnormalities of chromosomes affect...expand\_more

### Week 11 - Week 12

Learning Outcome: Interpret how sex-linked chromosomes and abnormalities of chromosomes affect the inheritance of traits and solve problems about sex-linked traits.

Key Concepts: Student review all the previous concepts about meiosis and mitosis and chromosomes. 1. Genes. 2. Chromosomes. 3. Mitosis. 4. Crossing over. 5. Hybrid/Dihybrid crosses. 6. Haploid. 7. Diploid. 8. Gametes. 9. Fertilization. 10. Karyotype( definition and description). 11. Independent segregation. 12. Segregation and cross over. 13. Abnormalities



(chromosomal mutation).

Skills: Compare and contrast the two processes of reproduction

Essential Questions: Why and how there is variation among living organism?

Textbook and Resource Materials:

Activity 13. (student p.346-352).(teacher p.530-538) Act 13 SS 13.1; SS 13.2 Activity 14. (student p.353-360).(teacher p.539-547) Act 14 SS 14.1

Evidence of Learning: Act 13 - All Analysis Questions - Question 4 is (ST) Act 14- Students solve AQ.1, 3 & 7 p 359 , 14.1 student sheet

[https://docs.google.com/document/d/1saD9Ngq0iUgb6\\_QisKNnB22O6BjEb9L34ojONcM8csM/edit](https://docs.google.com/document/d/1saD9Ngq0iUgb6_QisKNnB22O6BjEb9L34ojONcM8csM/edit)

SEC Topic & Code: HSS-Bi 2.02.08; HSS-Bi 1.05.04; HSS-Bi 1.05.05; HSS-Bi 1.05.06; HSS-Bi 2.03.01; HSS-Bi 2.03.02 (HSS-Bi 2.02.08; HSS-Bi 1.05.04; HSS-Bi 1.05.05; HSS-Bi 1.05.06; HSS-Bi 2.03.01; HSS-Bi 2.03.02)

## assignment

Genetically Modified Food (part 2) (2019)

## folder

- BI.2.07 - Explain how genomics has the potential to contribute in solving...[expand\\_morelink](#)

Week 13 - Week 14

Learning Outcome: Explain how genomics has the potential to contribute in solving sustainability problems to infer the genetic mechanism of inheritance for a given trait.

Key Concepts: 1. Genomics 2. The Human Genome Project 3. Genomics and biodiversity, alternative energy, and human and animal health.

Skills: 1. Develop and test a hypothesis. 2. Analyze and interpret pedigrees. 3. Develop conclusions based on evidence. 4. Apply logic, knowledge and reasoning to construct explanations.

Essential Questions: How has genomics contributed to our understanding of inheritance mechanisms of traits and genetic diseases?

Textbook and Resource Materials:

Activity (8) SEPUP ,Genetics,. (student p.316 - 323). (teacher p.490-499) Act 8 SS 8.1

Evidence of Learning: Activity (11) (Exit ticket ) Students solve analysis question is 5 in SEPUP book p.342 (Homework) Solving the analysis questions in the book p 342 Activity (8): -Analysis Question 2 in page 321 is a Quick Check for you to monitor students understanding of pedigrees and the information they convey.

Capstone Connection: Apply the process of genetic modification of organisms to support improved conditions of a water supply

SEC Topic & Code: HSS-Bi 1.05.07; HSS-Bi 1.05.08; HSS-Bi 2.02.13; HSS-Bi 2.02.14; HSS-Bi 2.02.15; HSS-Bi 2.02.16 (HSS-Bi 1.05.07; HSS-Bi 1.05.08; HSS-Bi 2.02.13; HSS-Bi 2.02.14; HSS-Bi 2.02.15; HSS-Bi 2.02.16)

Human Sexual Reproduction (2019)

folder

- BI.2.08 - Compare and contrast the structures and functions of the human male and...expand\_more

Week 01 - Week 01

Learning Outcome: Compare and contrast the structures and functions of the human male and female reproductive systems: 1) identify analogous structures between the male and female organ systems; and 2) relate structures to their functions.

Key Concepts: 1. . Male and female reproductive structures. 2. Path and delivery of sperm. 3. Ovulation.

Skills: 1. List analogies between male and female reproductive structures. 2. Link form with function.

Essential Questions: How does human life continue?

Textbook and Resource Materials:

Modern Biology Chapter 51 Reproductive System p.1049-1060

Evidence of Learning: Analysis Questions from Section 1, 2 and 3 Reviews.

SEC Topic & Code: HSS-Bi 2.03.03; HSS-Bi 2.03.04; HSS-Bi 2.03.05 (HSS-Bi 2.03.03; HSS-Bi 2.03.04; HSS-Bi 2.03.05)

assignment

- BI.2.09 - Explain how the human reproductive system allows the variation needed for...expand\_more

Week 02 - Week 03

Learning Outcome: Explain how the human reproductive system allows the variation needed for natural selection and evolution and demonstrate an understanding of gametogenesis through the process of meiosis.

Key Concepts: 1. Spermatogenesis. 2. Structure of sperm. 3. Oogenesis. 4. Hormonal controls of cycles. 5. Menstrual cycle. 6. Ovarian and uterine cycles . 7. Fertilization. 8. Pregnancy. 9. Birth.

Skills: 1. Compare and contrast spermatogenesis and oogenesis. 2. Conclude analogies between male and female gametes.

Essential Questions: Is variation beneficial?

Textbook and Resource Materials:

Campbell Chapter 46 Animal Reproduction p. 1003-1018 with an emphasis on Concept 46.4 and Concept 46.5 (Diagram on p.1008-1009)

Evidence of Learning: Concept Check Questions 46.4 Concept Check Questions 46.5

## assignment

Evolution (2019)

## folder

- BI.2.10 - Cite evidence from the fossil record to support the theory of natural...expand\_more

Week 04 - Week 05

Comment(s): I'd recommend shortening Activity 6. Earth Science discusses radiometric dating and stratigraphy so talk with them so there is no duplication. But I think it's good to do Activity 5 because aren't there whale fossils in Fayoum? Didn't you take a field trip there? The more real connections that can be made to Egypt, the better!

Learning Outcome: Cite evidence from the fossil record to support the theory of natural selection and evolution: 1) describe Darwin's theory of evolution by natural selection; and 2) use fossil evidence to show that genetic makeup descends from common ancestors

Key Concepts: 1. Darwin's influence on the mechanism of evolution (natural selection.)

2. Influence of experts, society and culture during Darwin's time. 4. Evidence of evolution: geology, index fossil, biogeography, homologous structures, and vestigial organs

Skills: 1. Make accurate interpretations, inferences and conclusions from text. 2. Communicate and defend a scientific argument. 3. Develop conclusions from evidence.

Essential Questions: How did life evolve?

Textbook and Resource Materials:

SEPUP Activity 4 Darwin and the Development of a Theory - S (p 436-442), T (651-659) Activity 5 Using Fossil Evidence to Investigate Whale Evolution S (p 443-445) T (p 663-671) Activity 6 Evidence from the Fossil Record S p. 446-453 T p. 670-679 Modern Biology : unit 4 Evolution (p.297 -304)

Evidence of Learning: Activity sheet 4.1 An essay of a five to eight sentence summary about who influenced Darwin's thinking and how they did so. Students should cite at least two quotes from the readings to support your discussion. The essays should incorporate the concepts of natural selection principles. Produce a 5 min power point presentation to cite evidence using fossil records from an area to support the theories of natural selection and evolution. (Group work)

Venn diagram from Activity 5 Activity 6: presentation done within class about different topics of the activity

SEC Topic & Code: HSS-Bi 2.03.01; HSS-Bi 2.03.03; HSS-Bi 2.03.04 (HSS-Bi 2.03.01; HSS-Bi 2.03.03; HSS-Bi 2.03.04)

## assignment

- BI.2.11 - Based on similarities in modern biological classification, show how to...expand\_more

## Week 06 - Week 07

Comment(s): Activity 8 - Studying Hominids.

Learning Outcome: Based on similarities in modern biological classification, show how to determine the phylogeny of any organism from micro to macro.

Key Concepts: 1. Common ancestry. 2. Biological classifications and genealogical relationships. 3. Evidence of common ancestry. 4. Morphological evidence (Homology, Analogy, and Vestigial structure) 5. Criteria for scientific explanations: a. the application of appropriate evidence, b. consistently logical reasoning, and c. basis in accepted scientific knowledge 6. Theory of natural selection. 7. Evidence for evolution of hominids (Cranium measurements of skulls). 8. Transitional features in fossils. 9. Phylogenetic diversity.

Skills: 1. Interpret data. 2. Construct explanations based on knowledge and reasoning. 3. Communicate and defend a scientific argument. 4. Examine data to identify trends and relationships. 5. Develop conclusions from evidence.

Essential Questions: What affects evolution?

Textbook and Resource Materials:

SEPUP book Activity 7 -The Phylogeny of Vertebrates - S (p 454-458) T (p 683-691)

<http://tolweb.org/tree/home.pages/treehouses.html> Campbell 9th edition p.538; sorting homology from analogy p.340) Activity 8 - Studying Hominids - S (p 459-464) T (p 697-707) practical only

Evidence of Learning: Activity 7 - SS 7.1 and SS 3.1 Analysis Questions Activity 8: Participation within class about grouping different skulls and measuring them - Records in science lab notebooks Activity 9- Defend the decision you made about the four areas

SEC Topic & Code: HSS-BI 2.03.04; HSS-Bi 2.03.05; HSS-Bi 2.03.05a; HSS-Bi 2.03.05b; HSS-Bi 2.03.05c (HSS-BI 2.03.04; HSS-Bi 2.03.05; HSS-Bi 2.03.05a; HSS-Bi 2.03.05b; HSS-Bi 2.03.05c)

## assignment

- BI.2.12 - Compare and contrast microevolution and macroevolution and their...[expand\\_morelink](#)

## Week 08 - Week 09

Learning Outcome: Compare and contrast microevolution and macroevolution and their interrelationship: 1) define microevolution and macroevolution; and 2) explain the contribution of mutation, natural selection, genetic drift and gene flow in microevolution.

Key Concepts: 1. Speciation. 2. Biodiversity and evolution and extinction of taxa. 3.

Microevolution: a. mutation, b. natural selection, c. genetic drift, and d. gene flow 4. Adaptation and selection: a. physical traits, b. behaviors, c. biochemical processes, and d. enhance fitness 5. Macroevolution

Skills: 1. Communicate and defend a scientific argument. 2. Apply evidence and reasoning to formulate a logical claim for where populations are in the process of speciation. 3. Graph and analyze data.

Essential Questions: What affects biodiversity?

Textbook and Resource Materials:

Activity 10 What is a Species? S (p. 472-481) T (p. 717-731) Activity 13 The Processes and Outcomes of Evolution S (p. 489-497) T (p. 750-764) Modern Biology - unit Evolution Section 1 (p. 317- 318), Section 2 ( p.321-325) , Section 3 (p.326 -329)

Evidence of Learning: Activity 10: Student notebook entries during and after the activity about species separation on p. 474. Activity 13: Use SS 13.1. Answer the Analysis questions p.496

especially 2 & 3. Discuss SS 3.1 Ideas about Evolution. Also discuss: - Compare between macro and micro evolution. - What is meant by adaptation and explain two examples of adaptations. - What does the word mass extinction refer to? - What does the word fitness refer to?  
Capstone Connection: How does the industrial base affect evolution?  
SEC Topic & Code: HSS-Bi 2.03.05d; HSS-Bi 2.03.05f (HSS-Bi 2.03.05d; HSS-Bi 2.03.05f)

#### assignment

- BI.2.13 - Compare and contrast current work to genetically modify organisms and the...[expand\\_more](#)

Week 10 - Week 10

Comment(s): This is a nice synthesis of Semester 1 & 2!

Learning Outcome: Compare and contrast current work to genetically modify organisms and the theory of evolution over geologic time.

Key Concepts: 1. Causes of genetic variation 2. Natural selection vs genetic modification (GMO)

Skills: 1. Communicate and defend a scientific argument. 2. Apply evidence and reasoning to formulate genotype and phenotype of a hypothetical genetically modified organism.

Essential Questions: How could genetic modification affect the rate of evolution and biodiversity?

Textbook and Resource Materials:

A project done by students from different resources Computer simulation

Evidence of Learning: Create a model of an organism that was not successful in response to environmental changes. Students are going to provide a simulation and a presentation.

SEC Topic & Code: HSS-Bi 2.03.05d; HSS-Bi 2.03.06 (HSS-Bi 2.03.05d; HSS-Bi 2.03.06)

#### assignment

- BI.2.14 - Explain how human activities impact the sustainability of biodiversity.[expand\\_more](#)[link](#)

Week 11 - Week 12

Learning Outcome: Explain how human activities impact the sustainability of biodiversity.

Key Concepts: 1. Biodiversity. 2. Ecosystem services. 3. Protected areas. 4. Sustainability. 5. Impact of human activities on rates of natural change. 6. Three levels of biodiversity a. Ecosystem diversity, b. Species diversity c. Genetic diversity 7. Human activities often cause biodiversity to increase or decrease.

Skills: 1. Develop conclusions based on evidence and reasoning/ 2. Consider and evaluate multiple perspectives on an issue/ 3. Identify and describe trade-offs of decisions/ 4. Argue a position and support it with evidence/

Essential Questions: Can humans sustain their lifestyles and also sustain biodiversity?

Textbook and Resource Materials:

SEPUP Science and Global Issues Activity 1 Biodiversity and Sustainability (students p.415421)

(teacher p.621629) Activity 2 Human Activities and Biodiversity (students p.42131) (Teacher p.630-641) . Campbell 9th edition; Unit 8 Concept 56 ( p1238 to1244) and (p.1251 establishing a protected area)

Evidence of Learning: The results of the game during Activity 1 - Uses SS.1.01; SS.1.02; SS.1.03; SS.1.04. Especially sheet 1.4 which is the reflection sheet. The Analysis Questions in SEPUP from Act. 2- page 431 One case study on how man altered any of the three types of diversities (a paragraph only – you may use photos but not those in SEPUP) Exit Ticket

Capstone Connection: Students could use this information to discuss how industry affects ecosystem biodiversity

SEC Topic & Code: HSS-Bi 2.04.01; HSS-Bi 2.04.01a; HSS-Bi 2.04.01b (HSS-Bi 2.04.01; HSS-Bi 2.04.01a; HSS-Bi 2.04.01b)

[assignment](#)

## Biology Grade 3

Nervous System (2019)

### folder

- [BI.3.01 - Describe the relationship between structure and function of a neuron in its...expand\\_morelink](#)

Week 01 - Week 02

Learning Outcome: Describe the relationship between structure and function of a neuron in its role in cell communication.

Key Concepts: 1. Anatomy of the functional subunit of the nervous system (neuron). 2. Structural diversity of neurons. 3. Communication between neurons.

Skills: 1. Explain the relationship between the structure and function. 2. Predict the impact of a change in neuron structure (deterioration of myelin sheath, lack of neurotransmitter receptors) will have on its function (effective transmission of a nerve impulse). 3. Design a model that illustrates the key structural features of a neuron.

Essential Questions: How does the neuron structure reflect its function?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Chapter 48, Section 1(1045-1047 pp.)

Evidence of Learning: 1- Power point presentation illustrates the function of neuron. 2- Design a model for neuron. 3- Examine the nerve tissue to draw a label diagram for the nerve cell.

Capstone Connection: The role of the neuron to transfer the nerve message between neurons and from neurons to effectors in order to elicit a response.

SEC Topic & Code: HSS-BI3.01 (HSS-BI3.01)

### assignment

- [BI.3.02 - Describe how the structure of the neuron membrane facilitates its function...expand\\_morelink](#)

Week 02 - Week 03

Learning Outcome: Describe how the structure of the neuron membrane facilitates its function with a primary focus on how the neuron and the transmission of a nerve impulse allows communication within an organism and with the external environment.

Key Concepts: 1. The mechanism of impulse transmission correlating structure with function (ion channels, membrane potential, and electrochemical equilibrium) 2. The process that leads to release of neurotransmitter and transmission of the nerve impulse from one neuron to next.

Skills: 1. Explain the process that results in the generation of an action potential. 2. Predict how altered ion concentrations could influence an action potential. 3. Describe the action of neurotransmitters at a synaptic cleft. 4. Include a description of the structure and function of neurotransmitters, ligand-gated ion channels and voltage-gated calcium ion channels.

Essential Questions: How do ions and the neuron membrane integrate to transmit the nerve impulse?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Chapter 48, Section 2, 3 and 4

Evidence of Learning: - Doing presentation - Analysis of graphs \*\*\*\*\*More information and detail here is needed to explain what topics will be presented and what type of information will be analyzed in a graph. \*\*\*\*\*

Capstone Connection: Students will examine to find relation between the thickness of nerve fiber (axon) and propagation of nerve impulse and affecting human action.

SEC Topic & Code: HSS-BI3.01 (HSS-BI3.01)

### assignment

- BI.3.03 - Describe the major brain regions and their functions and predict the outcome...[expand\\_morelink](#)

### Week 04 - Week 05

Learning Outcome: Describe the major brain regions and their functions and predict the outcome of damage or disease to the major regions of the brain and how that damage or disease impacts communication between the brain regions.

Key Concepts: 1. One function of each major of brain region. 2. Biological clock regulation. 3. Arousal and sleep. 4. Emotion. 5. Cerebral cortex controls the voluntary movement and cognitive function. 6. Changes in the synaptic connections underlie memory and learning 7. Neural Plasticity. 8. Stem cells in the brain.

Skills: 1. Apply knowledge about brain regions to predict the symptoms that would result from damage to specific areas of the brain. 2. Describe how the various regions of the brain contribute to maintaining homeostasis.

Essential Questions: How can studying individuals with damage to a particular brain region provide insight into the normal function of that region?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Chapter 49, Section 2, Section 3, Section 4

Evidence of Learning: - Making a model to show the brain regions - Prepare a presentation \*\*\*\*\*More information required in terms of what is required in the presentation \*\*\*\*\*

Capstone Connection: How brain damage or disease impacts communication between different brain regions and the nervous system.

SEC Topic & Code: HSS-BI3.01 (HSS-BI3.01)

### assignment

- BI.3.04 - Relate the major components of the nervous system to their functions, and...[expand\\_morelink](#)

### Week 06 - Week 08



Learning Outcome: Relate the major components of the nervous system to their functions, and explain how they communicate and contribute to homeostasis.

Key Concepts: 1. The components of a reflex arc and how it functions. 2. The organization and the general function of the major parts of the nervous system (central, peripheral, somatic, autonomic, parasympathetic, and sympathetic) 3. The location and function of several types of sensory receptors. 4. The role of the nervous system in maintaining homeostasis.

Skills: 1. Compare and contrast the components of the nervous system. 2. Predict the damage symptoms of various components of the nervous system.

Essential Questions: How do the components of the nervous system integrate to contribute to homeostasis?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Chapter 49 Section 1 and chapter 50, Sections 1, 2, 3 and 4

Evidence of Learning: - Prepare presentation. - Solve Campbell test bank. \*\*\*\*\*More information, specifics required for preparing presentation and solving the Campbell test bank.

\*\*\*\*\*

Capstone Connection: How interactions and communication in the components of the nervous system contribute to /impact homeostasis.

SEC Topic & Code: HSS-BI3.01 (HSS-BI3.01)

## assignment

Muscular/Skeletal System (2019)

## folder

- BI.3.05 - Correlate the structure of both skeletal and muscular systems to their...[expand\\_morelink](#)

Week 09 - Week 10

Learning Outcome: Correlate the structure of both skeletal and muscular systems to their functions.

Key Concepts: 1. The structure and function of the skeleton, muscles, tendons and ligaments. 2. Muscle tissue (skeletal, cardiac and smooth) 3. Anatomy of the functional subunit of muscle (sarcomere). 4. Cellular events that lead to muscle contraction, including the interface with the nervous system. 5. The interaction of muscles and skeleton in the movement.

Skills: 1. Identify muscle tissue types (skeletal, smooth, and cardiac) in prepared histology slides and correlate their specific structures to their unique functions. 2. Describe, diagram and explain the structure and function of a sarcomere. 3. Design, develop and test a model depicting the interaction between a neuron and a sarcomere.

Essential Questions: How does the nervous system control the contraction of muscles?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Chapter 50, Section 5

Evidence of Learning: - Prepare presentation. - Solve the Analysis questions in the textbook. - Design a model to show the role of the regulatory protein and calcium ions in muscle contraction.

\*\*\*\*\*More information required regarding the prepare presentation evidence\*\*\*\*\* ????? 1.

Students will construct a model of a sarcomere that demonstrates the action of actin and myosin in muscle contraction.

Capstone Connection: How the nervous system and the muscular system communicate in an

organism.

SEC Topic & Code: HSS-BI3.06 (HSS-BI3.06)

### assignment

- BI.3.06 - Co-ordinate the structure of the skeletal system to its function and predict...[expand\\_morelink](#)

#### Week 11 - Week 12

Learning Outcome: Co-ordinate the structure of the skeletal system to its function and predict the damage in the skeletal system on movement.

Key Concepts: 1. Types of skeletal systems. 2. Bone and joint of the human skeleton. 3. Structure and types of joints. 4. Differentiate between bones and cartilage. 5. Diseases and disorder of the human skeletal system.

Skills: 1. Describe the relationship between structure and function regarding various types of joints and surrounding tissue. 2. Build a model accurately depicting structure and function of various types of joints.

Essential Questions: How can the integration between skeletal and muscular systems help in human movement?

Textbook and Resource Materials:

Human Biology: Unit 5 (p.102-120) Campbell 9th Edition: Unit 7: Ch. 50.6 from page 1112

Evidence of Learning: - Prepare presentation - Solve Analysis questions - Quizzes \*\*\*\*\* More information is needed regarding types of presentations. More details required for solving Analysis questions - from what texts, which questions? \*\*\*\*\*

Capstone Connection: Communication with body systems.

SEC Topic & Code: HSS-BI3.06 (HSS-BI3.06)

### assignment

#### Endocrine System (2019)

### folder

- BI.3.07 - Explain how the release of hormones facilitates communication of animals of...[expand\\_morelink](#)

#### Week 13 - Week 13

Learning Outcome: Explain how the release of hormones facilitates communication of animals of the same species.

Key Concepts: 1. The general stages of cell communication (reception, transduction, and response). 2. Two ways hormones affect target organs (protein and steroid hormones; cell surface and intracellular receptors with an emphasis on structure and function of ligands, membranes and receptors). 3. Positive and negative feedback mechanisms. 4. The role of the endocrine system in maintaining homeostasis.

Skills: 1. Describe the mechanisms of both positive and negative feedback mechanisms. Give an example of each. 2. Create a diagram to illustrate in two examples of the endocrine system's role in maintaining homeostasis. 3. Use evidence and data (for example, symptoms in a case study) to hypothesize possible explanations for endocrine disorders.

Essential Questions: How do hormonal signaling contribute to homeostasis?

Textbook and Resource Materials:

Campbell 9th Edition: Unit 7, Ch. 45 - Section 1, 2

Evidence of Learning: Quizzes Presentation Solve test banks of Campbell \*\*\*\*\* More information required for presentation topics and parameters. Specify Campbell test bank items.

\*\*\*\*\* ????? (More evidences of learning) 1. Students will apply their knowledge of neurotransmitters and hormones to answer essay questions requiring them to describe the stages of cell communication (reception, transduction and response) in both neurotransmitters and hormones. 2. Students will design a controlled experiment to investigate the rate of neurotransmitter uptake. 3. Students will design a controlled experiment to investigate the disruption of an endocrine negative feedback mechanism.

Capstone Connection: Describing the connection between the cell signaling processes of the neurotransmitters and hormones.

SEC Topic & Code: HSS-BI3.02 (HSS-BI3.02)

## assignment

- BI.3.08 - Predict the role of hormones in maintaining homeostasis.[expand\\_morelink](#)

## Week 14 - Week 14

Learning Outcome: Predict the role of hormones in maintaining homeostasis.

Key Concepts: 1. The coordination of endocrine and nervous system. 2. Hormones cascade pathway. 3. Endocrine positive and negative feedback mechanisms. 4. The posterior and anterior pituitary hormones. 5. Homeostasis of blood glucose level. 6. Homeostasis of blood calcium level. 7. Gonadal sex hormones.

Skills: 1. Predict the response of the endocrine system in response to changes in blood glucose level and changes in blood calcium levels. 2. Examine a microscopic slide of pituitary gland and pancreas 3. Describe both positive and negative feedback mechanisms in the endocrine system.

Essential Questions: How can hypothalamus regulate the performance of endocrine gland to maintain homeostasis?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Ch 45, Section 3 and Section 4.

Evidence of Learning: - Prepare presentation - Quizzes - Solve question - Brain map \*\*\*\*\* More information needed on presentation. Not clear what - solve question - refers. Need more information on brain map.\*\*\*\*\* ?????

1. Students will use their knowledge of feedback mechanisms in the hormonal control of blood glucose levels and blood calcium levels to answer essay questions requiring them to describe these processes and explain how they contribute to homeostasis. 2. Students will design a controlled experiment to investigate the impact low insulin levels would have on blood glucose levels under various conditions (for example, during exercise

or during fasting).

Capstone Connection: The role of hormones in the positive and negative feedback mechanisms

SEC Topic: Cell signaling and homeostasis, advanced.

SEC Topic & Code: HSS-BI3.02 (HSS-BI3.02)

[assignment](#)

Digestive System (2019)

[folder](#)

- BI.3.09 - Correlate how the structures of the human digestive system facilitate their...[expand\\_more](#)

Week 01 - Week 02

Learning Outcome: Correlate how the structures of the human digestive system facilitate their function in releasing nutrients from food

Key Concepts: 1. Organic essential nutrients. 2. Vitamins and minerals. 3. Dietary deficiency. 4. Major compartments of the alimentary canal and their function(s) in digestion. 5. Major digestive glands and their function(s) in digestion. 6. The process of chemical digestion of carbohydrates, lipids, proteins and nucleic acids.

Skills: 1. Analyze the role of the digestive system in maintaining homeostasis. 2. Develop connections between structure and function of the components of the digestive system.

Essential Questions: How do the various structures of the digestive system perform their functions?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Ch 4, Section 1, Section 3. Internet resources

Evidence of Learning: Quizzes Prepare Presentation Examine models of digestive system

Detection of the components??? \*\*\*\*\* More information is required in terms of what microscopic slides and models should be examined and what skills will be demonstrated. More explanation is needed for the detection of components. More information needed for presentations. \*\*\*\*\*

SEC Topic & Code: HSS-BI3.03 (HSS-BI3.03)

[assignment](#)

- BI.3.10 - Apply knowledge of the digestive system to predict the impact that disorders...[expand\\_more](#)

Week 03 - Week 03

Learning Outcome: Apply knowledge of the digestive system to predict the impact that disorders of the system have on the function of the system.

Key Concepts: 1. Regulation of digestion. 2. Regulation of appetite and consumption. 3.

Disorders of digestive system (e.g. obesity, acid reflux, gallstones, lactose intolerance, and inflammatory bowel disease)

Skills: Predict the impact of specific disorders on the function of the digestive system and on the human health

Essential Questions: How do disorders of the digestive affect its function?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Ch 41, Section 5. Internet resources

Evidence of Learning: Research paper about the digestive system disorders. \*\*\*\*\*More specifics regarding research paper would be helpful\*\*\*\*\*

SEC Topic & Code: HSS-BI3.03 (HSS-BI3.03)

[assignment](#)

Excretory System (2019)

[folder](#)

- BI.3.11 - Evaluate how the structure of the excretory system facilitates its function, expand\_more

Week 04 - Week 05

Learning Outcome: Evaluate how the structure of the excretory system facilitates its function,

Key Concepts: 1. Structures of the excretory system and associated arteries and veins and their functions. 2. Components of the nephron and their function(s), (glomerulus, Bowman's capsule, proximal convoluted tubule, descending Loop of Henle, Ascending Loop of Henle, distal convoluted tubule, and collecting duct) 3. Countercurrent exchange mechanism of the Loop of Henle. 4. Four stages of urine formation (filtration, reabsorption, secretion and excretion). 5. Hormonal influence on osmoregulation (ADH/antidiuretic hormone, aldosterone).

Skills: 1. Examine a model of the excretory system. 2. Predict how the selective permeability of the Loop of Henle facilitates the countercurrent exchange mechanism.

Essential Questions: How do the structures of the excretory system facilitate their function?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Chapter 44, Section 3, Chapter 44, Section 4.

Evidence of Learning: A. Draw a labelled diagram to show the structure of the nephron. B.

Examine a T.S. of the kidney to identify. C. Try to model an artificial kidney.

SEC Topic & Code: HSS-BI3.03 (HSS-BI3.03)

[assignment](#)

- BI.3.12 - Conclude the role of the excretory system in maintaining homeostasis,...expand\_more

## Week 06 - Week 07

Learning Outcome: Conclude the role of the excretory system in maintaining homeostasis, including the influence of ADH and aldosterone on osmoregulation.

Key Concepts: 1. Hormonal circuits link kidney function, water balance, and blood pressure 2. Antidiuretic Hormone. 3. The Renin-Angiotensin-Aldosterone System 4. Homeostatic Regulation of the Kidney.

Skills: 1. Describe the role of the excretory system in maintaining homeostasis. 2. Describe the role of ADH in osmoregulation.

Essential Questions: How does the excretory system contribute to homeostasis?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Chapter 44, Section 5.

Evidence of Learning: A. Research paper about the hormonal influence on osmoregulation. B. Quizzes

SEC Topic & Code: HSS-BI3.03 (HSS-BI3.03)

[assignment](#)

## Respiratory and Circulatory Systems (2019)

## folder

- BI.3.13 - Illustrate the relationship between the structure and function of the...expand\_more

## Week 08 - Week 09

Learning Outcome: Illustrate the relationship between the structure and function of the components of the circulatory and respiratory systems.

Key Concepts: 1. The structure and general function of the three main types of blood vessels. 2. Blood pressure and the variables that influence it. 3. Structure of the heart, pathway of blood through chambers. 4. Blood components and how erythrocytes demonstrate the relationship between structure and function.

Skills: 1. Describe how structure facilitates function in the circulatory system at the molecular and cellular levels (hemoglobin and erythrocytes). 2. Differentiate between the structural components of blood vessels that facilitate their function. 3. Explain the blood clotting process and its role in maintaining homeostasis. 4. Explain the significance of systolic and diastolic blood pressure measurements.

Essential Questions: How do the circulatory and respiratory systems function to maintain homeostasis?

Textbook and Resource Materials:

Campbell 9th edition: Unit 7, Chapter 42, Section 2. Chapter 42, Section 3.

Evidence of Learning: A. Draw a labelled diagram to show the structure of the heart. B. Draw a labelled diagram to compare the anatomy of the artery and veins. C. Quizzes. \*\*\*\*\*How about evidence of learning for the respiratory system? \*\*\*\*\* \*\*\*\*\*Evidence examples are not reaching the higher cognitive skills of learning we want to support\*\*\*\*\*

[assignment](#)

- BI.3.14 - Follow the pathway a molecule of oxygen takes as it enters the body from the...[expand\\_more](#)

Week 10 - Week 10

Learning Outcome: Follow the pathway a molecule of oxygen takes as it enters the body from the air, until it enters the mitochondria for cellular respiration.

Key Concepts: 1. Gas exchange occurs across specialized respiratory system. 2. Mechanisms and control of breathing in humans. 3. The structure of the mammalian respiratory system and its functions. 4. Coordination of circulation and gas exchange. 5. General characteristics of respiratory surfaces. 6. Structure and function of human respiratory system. 7. The pathway a molecule of oxygen takes as it enters the body from the air, until it enters the mitochondria.

Skills: 1. Draw a flowchart to illustrate the journey of oxygen molecule inside the human body. 2. Predict the impact that disruptions to various structures (alveoli, hemoglobin protein, and capillary) will have on the function of the system. 3. Describe how the structure of the respiratory system facilitates its function (large surface area, moist, proximity to environment and access to circulatory system).

Essential Questions: How do multiple systems work together to maintain homeostasis?

Textbook and Resource Materials:

Campbell 9th Ed: Unit 7, Ch. 42, Sec. 5, 6, 7

Evidence of Learning: Quiz Analysis of graphs Drawlabeled diagrams of the human respiratory system. \*\*\*\*\*More information is needed regarding the analysis of graphs.\*\*\*\*\* \*\*\*\*\*A general question whether drawing and labeling are reaching the higher cognitive skills of learning we want to support\*\*\*\*\*???

SEC Topic & Code: HSS-BI3.04 (HSS-BI3.04)

[assignment](#)

# Chemistry Grade 1

Matter and its Properties (2019)

## folder

- CH.1.01 - Describe what characterizes science and its methods and use a quantitative...[expand\\_morelink](#)

Week 01 - Week 02

Comment(s):

Learning Outcome: Describe what characterizes science and its methods and use a quantitative observations with measurement by SI units.

Key Concepts:

- 1. Science.
- 2. Scientific methods.
- 3. Scientific law.
- 4. Scientific theory.
- 5. Relations between variables.
- 6. Uncertainty.
- 7. SI units.
- 8. Instrumentation (precision, accuracy, significant figures).
- 9. Types of variables.
- 10. Density.
- 11. Specific gravity.

Skills: 1. Use laboratory equipment to get measurement data 2. Represent data on data tables and graphs correctly 3. Differentiate scientific from non-scientific reasoning 4. Develop a chart of main processes in scientific thinking 5.

Demonstrate proper use of quantitative instrumentation 6. Conduct and analyze series of measurements 7. Evaluate scientific reports as to their use of quantitative instruments reporting and analysis of findings. 8. Determine number of significant figures 9. Measure and calculate densities of materials 10. Compare densities of solids, regular and irregular and liquid materials by their behavior and gross observation

Essential Questions: What if everyone in the government used the scientific method to analyze and solve society's problems, and politics were never involved in the solutions? How would this be different from the present situation, and would it be better or worse?

Textbook and Resource Materials: What if everyone in the government used the scientific method to analyze and solve society's problems, and politics were never involved in the solutions? How would this be different from the present situation, and would it be better or worse?

Evidence of Learning: R: Students will ABLE TO GIVE DEFINITION FOR SCIENCE. BA: Represent in graph the relation between pressure and volume of the gas at the room temp. BA: How chemistry can help in digging tunnels and collapse old buildings quickly and safely. ST: Students will read two brief articles and develop an argument using examples to justify their decision as to which is based on scientific and which is based on non-scientific reasoning. BA: Zumdahl Chemistry (exercise page 32 and 4 to 5) Lab Write-up



Capstone Connection: Use of measurement and use of scientific method to make decisions in design

Relations: ME.1.01; (Study the scientific concepts and graph parameters. MA.1.05; (Variables) BIO.1.02; (Measurement and SI units) PH. 1.01; () PH. 1.05; ()

SEC Topic & Code: HSST-CH 1.01 (HSST-CH 1.01)

### assignment

- CH.1.02 - Demonstrate understanding of atomic structure, subatomic particles, their...[expand\\_morelink](#)

Week 03 - Week 04

Comment(s):

Learning Outcome: Demonstrate understanding of atomic structure, subatomic particles, their arrangements and the evidence that scientists that enabled scientists to discover them.

Key Concepts:

- 1. Atoms.
- 2. Atomic Structure.
- 3. Isotopes.
- 4. Isobar.
- 5. Isotones.
- 6. Alpha.
- 7. Beta.
- 8. Gamma.

Skills: 1. Explore 2. Measure 3. Measure and filter 4. Compare data 5. Test theory 6. Apply concept to data 7. Determine behavior of cathode ray 8. Develop historical story of the discovery of current atomic theory

Essential Questions: How is an atom similar to and different from a solar system?

Textbook and Resource Materials: How is an atom similar to and different from a solar system?

Evidence of Learning: Lab BA: design a model for the atom SA: Compare and contrast contemporary understanding of the atom with the solar system

Capstone Connection:

Relations: ES.1.02; (Chemical structure, mixture, parameters of compounds like minerals, chemical reactions and intermolecular and intramolecular forces, respectively.) ES.1.04; () ES.1.05; () ES.1.06; (Chemical structure, types of bonds and parameters of mixtures.) ES.1.08; (The stoichiometry of mineral ores.) BIO.1.02; (Structure and Functions) MA.1.05; (Structure and Functions)

SEC Topic & Code: HSST-CH 1.02; HSST-CH 1.11 (HSST-CH 1.02; HSST-CH 1.11)

## assignment

- CH.1.03 - Demonstrate their understanding of the electromagnetic spectrum and the...[expand\\_morelink](#)

Week 05 - Week 06

Comment(s):

Learning Outcome: Demonstrate their understanding of the electromagnetic spectrum and the particle nature of light by explaining how atoms of different elements are able to produce light of different colors.

Key Concepts:

- 1. Electron configuration.
- 2. Valence numbers.
- 3. Quantum numbers.
- 4. Electromagnetic spectrum.
- 5. Frequency.
- 6. Wavelength.
- 7. Photon Absorption.
- 8. Emission.
- 9. Energy, frequency and wavelength relations.
- 10. Photoelectric phenomenon.
- 11. Flame test.
- 12. Excited state.

Skills: 1. Conduct spectral analysis 2. Use correct laboratory procedures to conduct flame test to identify metal ions 3. Explain emission of light by electrons in terms of ground and excited states

Essential Questions: How do fireworks create different colors?

Textbook and Resource Materials: How do fireworks create different colors?

Evidence of Learning: Conduct flame tests to determine the identity of different elements. Explain photoelectric effect

Capstone Connection: Material properties of building materials (and paints and other surface treatments) impact how light energy is reflected or absorbed, impacting the thermal properties of the dwelling.

Relations:

SEC Topic & Code: HSST-CH 1.02 (HSST-CH 1.02)

## assignment

- CH.1.04 - Through laboratory investigations develop operational definitions of chemical...[expand\\_morelink](#)

Comment(s):

Learning Outcome: Through laboratory investigations develop operational definitions of chemical elements, differentiate between metals/nonmetals and chemical and physical properties of unknown elements based on their position and atomic structures in the periodic table.

Key Concepts:

- 1. Structure of the periodic table.
- 2. Trends and Periodicity.
- 3. Atomic Radius.
- 4. Ionization Energy.
- 5. Electronegativity.
- 6. Electron Affinity.
- 7. Metal, nonmetal and metalloid.
- 8. Electron affinity.

Skills: 1. Draw and describe simple electronic configuration. 2. Describe the basis of the arrangement of elements 3. Use the periodic table to predict the properties of elements 4. Distinguish between metals and non-metals according to appearance

Essential Questions: What are the ways that people can sort a variety of things?

Textbook and Resource Materials: What are the ways that people can sort a variety of things?

Evidence of Learning: R: Students can describe how elements are named R: Students can describe how elements are grouped R: Students can differentiate between atomic mass and atomic number R: Differentiate between metals and nonmetals, and chemical and physical properties and can identify regions on the periodic table where different types of elements are located BA: Relate laboratory observations of chemical and physical properties of elements to their position in the Periodic Table. BA: Experimentally determine the chemical properties of the oxides of metals and non-metals and relate to electron configuration and placement in the periodic table. ST: Students can identify the application of metals in real life and explain how properties relate

Capstone Connection: Differentiate between chemical and physical properties, metals and non-metals when thinking about construction materials for structure.

Relations: MA.1.05; (Using step function way in the trends of the periodic table)

SEC Topic & Code: HSST-CH 1.02 (HSST-CH 1.02)

[assignment](#)

- CH.1.05 - Describe how to determine chemical behavior according to valence electrons...[expand\\_morelink](#)

## Week 09 - Week10

Comment(s): Zumdahl Ch 8 may be a good reference for the teacher, but not for students. Section 6, for instance, talks about electronegativity, but that is referred to in section 8.2. Zumdahl Ch 22 Section 1 is ok as long as this does not turn into simply a memorization activity. Section 4 is far too technical for students at this point and goes way beyond the learning outcome. I don't know what the reference is to Sec 29, as there is no chapter or section of this number. Again, I think this resource is better for the teacher as a resource and not for students

Learning Outcome: Describe how to determine chemical behavior according to valence electrons and how and why atoms interact with each other.

### Key Concepts:

- 1. Chemical bond.
- 2. Ionic and Covalent bond.
- 3. Electron dot diagram.
- 4. Nomenclature of alkanes (IUPAC common name).
- 5. Isomers of alkanes.
- 6. Cis and Trans.
- 7. Structure Isomers and Chains.

Skills: 1. Correlate electron configuration with ionization energies and chemical properties 2. Determine valence numbers from electron configuration 3. Compare organization of the periodic table according to valence numbers with physical and chemical properties and predict formulas for binary compounds 4. Contrast ionic bonding and covalent bonding 5. Draw electron-dot diagrams for simple molecules with covalent bonding and ionic bonding 6. Student can compare between organic and inorganic substance 7. Detect practically C and H in organic substance 8. Distinguish between molecular, structural and empirical formula 9. Draw formulas for isomers of a compound. (structure chain, cis and trans) 10. Name simple alkanes according to IUPAC nomenclature rules

Essential Questions: Why and how do things react?

Textbook and Resource Materials: Why and how do things react?

Evidence of Learning: -Students can describe and give explanations for the chemical behaviors of elements. -Students are able to explain which element of a pair has the more stable electron arrangement. -Students can explain relative sizes of first, second, and third ionization energies of an element. -Students are able to explain the difference between ionic and covalent bonding. -Students are able to draw electron-dot diagrams for several compounds. -Exercise in Zumdahl Chemistry (22.1 - 22.2 - 22.3 - 22.4 - 22.5 - 22.6)

Capstone Connection: Organic materials have unique chemical and physical properties based on molecular bonding

Relations: ES.1.10; (Principles of organic chemistry and use it in the minerals and rocks.) ES.1.04; () ES.1.05; () ES.1.06; (Chemical structure, types of bonds and parameters of mixtures.)

SEC Topic & Code: HSST-CH 1.03; HSST-CH 2.09 (HSST-CH 1.03; HSST-CH 2.09)

Nuclear Chemistry (2019)

## folder

- CH.1.06 - Select and use data to construct an argument for the existence of strong...[expand\\_morelink](#)

Week 11 - Week 12

Comment(s):

Learning Outcome: Select and use data to construct an argument for the existence of strong nuclear forces.

Key Concepts:

- 1. Radioactive.
- 2. Unstable Atoms.
- 3. Fusion reaction.
- 4. Fission reaction.
- 5. Half-life.
- 6. Nuclear forces.

Skills: 1. Research the properties of major nuclear particles 2. Explain what isotopes are and why some are stable and some not 3. Interpret and use symbolic representation of isotopes 4. Calculate the average atomic mass of an element from the percent abundance of its isotopes 5. Define half-life and use decay rates to solve simple decay problems 6. Draw inference of nuclear forces based on the repulsion of like charges.

Essential Questions: What makes things radioactive?

Textbook and Resource Materials: What makes things radioactive?

Evidence of Learning: R: Students use examples and explanation to differentiate fission and fusion BA: Students are able to calculate average atomic mass and explain why atomic masses are not always whole numbers. ST: Students create a data-based argument for the presence of the strong nuclear force

Capstone Connection: Students understand that attractive and repulsive forces are at work in all materials and are responsible for the physical and chemical properties of materials.

Relations: ME.1.05; () Me.1.09; (Acceleration of particles and using it in different fields such as Nuclear Chemistry.)

SEC Topic & Code: HSST-CH 1.11 (HSST-CH 1.11)

## folder

- CH.1.07 - Explain how the physical properties of different types of elements, compounds...[expand\\_morelink](#)

Week 13 - Week 14

Comment(s):

Learning Outcome: Explain how the physical properties of different types of elements, compounds and groups of elements (in both normal and nanosize) can be used to identify them and can be used in commercial applications.

Key Concepts:

- 1. Element.
- 2. Compound.
- 3. Electrolysis.
- 4. Chemical formula.
- 5. Chemical equation.
- 6. Law of Conservation of Mass.
- 7. Temperature.
- 8. Kinetic energy.
- 9. Vaporization.
- 10. Sublimation.
- 11. Heating Curve of Water.

Skills: 1. Decompose water by electrolysis a. Test elements to determine identity b. Determine chemical formula by relative volume of gases produced 2. Compare properties of elements with compounds 3. Burn measured quantity magnesium and determine chemical formula of magnesium oxide 4. Write and interpret chemical formulas 5. Demonstrate safe laboratory practices 6. Describe the States of Matter: Solid, Liquid, and Gas 7. Explain the purpose of balancing a chemical equation. 8. Relate balancing an equation to the Law of Conservation of Matter. 9. Differentiate chemical from mathematical equations - how similar, how different 10. Balance a chemical equation.

Essential Questions: Why are chemical symbols like letters and compounds like words? How is a chemical equation like a sentence?

Textbook and Resource Materials: Why are chemical symbols like letters and compounds like words? How is a chemical equation like a sentence?

Evidence of Learning: -Students isolate hydrogen and oxygen products by electrolysis of water in expected ratio and analyze findings. -Students conduct appropriate tests to identify hydrogen and oxygen. -Students are able to create flipbooks that depict particle movement. Animations of solid and liquid match description required. -Students collect data and correctly graph a heating curve for water. -Students observe and identify various changes of state and can explain the causes of phase change in terms of addition or removal of heat energy. -Students correctly identify the energy transformations occurring in different segments of a heating curve for a material. -Students are able to explain how the addition of heat changes the volume of air and why the piston moves.

Capstone Connection: Material properties at Nano and Macro levels impact effectiveness for different roles of different building needs (eg. support material vs.

connectors, roof vs. foundation, conductors vs. insulators vs. crystalline vs. transparent, etc.).

Relations: MA.1.05; (Using function and relation from math in the gas law studies.)

SEC Topic & Code: HSST-CH 1.03; HSST-CH 1.08; HSST-CH 3.04. (HSST-CH 1.03; HSST-CH 1.08; HSST-CH 3.04.)

[assignment](#)

Introduction to Chemical Reactions (2019)

## folder

- CH.1.08 - Explain how the chemical and physical properties of solutions, suspensions,...[expand\\_morelink](#)

Week 01 - Week 02

Learning Outcome: Explain how the chemical and physical properties of solutions, suspensions, colloids and Nano substances can be used in water treatment.

Key Concepts:

- 1. Pure substance.
- 2. Solution.
- 3. Solute.
- 4. Solvent.
- 5. Colloid.
- 6. Tyndall Effect.
- 7. Suspension.

Skills: 1. Separate mixtures by evaporation and filtration 2. Use laboratory techniques to differentiate colloids from true solutions 3. Differentiate suspension, solution, colloid 4. Explain how particle size influences physical and chemical properties

Essential Questions: What are mixtures?

Textbook and Resource Materials: Active Chemistry: Ch. 1, Sec. 3

Evidence of Learning: -Students reflect on the properties of mayonnaise and make reasonable suggestions for the use of emulsions. -Students reflect on how the properties of different metals affect mixtures of these metals and alter their usefulness. -Students describe one characteristic of non-potable water and design a laboratory procedure to treat it.

Capstone Connection: One feature of house design may be treating household waste water.

Relations: ES.1.02; (Chemical structure, mixtures, parameters of compounds like minerals, chemical reactions and intermolecular and intramolecular forces, respectively) BIO.1.03; (Mixtures and their properties)

SEC Topic & Code: HSST-CH 1.04. (HSST-CH 1.04.)

### assignment

- CH.1.09 - Explain how the physical properties of different types of elements contribute...[expand\\_morelink](#)

Week 03 - Week 04

Learning Outcome: Explain how the physical properties of different types of elements contribute to the properties of alloys, emulsions and composite materials.

Key Concepts:

- 1. Texture.
- 2. Uniformity.
- 3. Strength.
- 4. Elasticity.
- 5. Bounce.
- 6. Malleability.

Skills: 1. Compare properties of emulsions to those of composites 2. Explore and analyze industrial uses of materials

Essential Questions: How do properties of matter relate to building and art?

Textbook and Resource Materials: Active Chemistry: Ch. 1, Sec. 4

Evidence of Learning: -Students are able to list useful properties of new mixtures. - Students use the concepts of physical properties to describe their selection of materials for their sustainable structures in their capstone project.

Capstone Connection: Material properties at Nano and macro levels impact effectiveness for different roles of different building needs (eg. structure vs. connector, roof vs. foundation, conductors vs. insulators vs. crystalline vs. transparent, etc.).

Relations: ES.1.02; (Chemical structure, mixtures, parameters of compounds like minerals, chemical reactions and intermolecular and intramolecular forces, respectively.) ES.1.04; () ES.1.05; () ES.1.06; (Chemical structure, types of bonds and parameters of mixtures.) BI.1.03; (Mixtures and their properties)

SEC Topic & Code: HSST-CH 1.04. (HSST-CH 1.04.)

### assignment



- CH.1.10 - Calculate quantities of products formed from known quantities of reactants...[expand\\_morelink](#)

Week 05 - Week 06

Learning Outcome: Calculate quantities of products formed from known quantities of reactants and be able to discuss their precision and accuracy

Key Concepts:

- 1. Stoichiometry.
- 2. Mole.
- 3. Molar mass.
- 4. Standard temperature and pressure (STP).
- 5. Dimensional analysis (unit conversions).
- 6. Percentage yield.
- 7. Limiting reagent.

Skills: 1. Use basic laboratory techniques (to the accepted tolerance of instruments) to determine the amount, mass, or volume of a substance produced or required in a chemical reaction. 2. Precision, accuracy, experimental error

Essential Questions: How can chemists use fruit salad as a model for how to predict quantities of atoms?

Textbook and Resource Materials: Active Chemistry: Ch. 4, Sec. 3 Zumdahl Chemistry: Ch. 3, Sec. 11 p.114 Zumdahl Chemistry: ex. 3.18 p.12

Evidence of Learning: Presentation - group Written quiz - individual Students are able to effectively play the Equivalent Measures game and answers match those provided in this Teacher's Edition

Capstone Connection: Measurement precision used for effective empirical analysis of chemistries is analogous to measurement precision for building specifications, including energy uses, flow etc.)

Relations: ES.1.08; (The stoichiometry of mineral ores.) PH. 1.01; ()

SEC Topic & Code: HSST-CH 1.08; HSST-CH 2.05 (HSST-CH 1.08; HSST-CH 2.05)

[assignment](#)

- CH.1.11 - Investigate four types of chemical reactions, generate and test for hydrogen,...[expand\\_morelink](#)

Week 07 - Week 07

Learning Outcome: Investigate four types of chemical reactions, generate and test for hydrogen, oxygen and carbon dioxide and determine the most effective ratio of hydrogen to oxygen for propulsion of a small rocket.

### Key Concepts:

- 1. Synthesis reaction.
- 2. Decomposition reaction.
- 3. Single-replacement reaction.
- 4. Double-replacement reaction.

Skills: 1. Conduct laboratory tests to identify three different gases. 2. Use chemical reactions to make gases for propulsion. 3. Investigate different types of chemical reactions involve gases.

Essential Questions: How do chemists study quantities of atoms and molecules when they are too small to be measured?

Textbook and Resource Materials: Active Chemistry: Ch. 5, Sec. 5

Evidence of Learning: "Written quiz - individual Presentation - group Answers to questions in Part A are similar to those presented in this Teacher's Edition. Ideas proposed are reasonable. Answers to questions are similar to those presented in this Teacher's Edition. Answers match those shown in this Teacher's Edition

\*\*\*\*\*Are you planning to do this activity?

<http://serc.carleton.edu/sp/mnstep/activities/26400.htm>

Capstone Connection: Roles of hydrogen, oxygen and carbon dioxide in various forms of alternative energy

Relations: ES.1.02; (Chemical structure, mixtures, parameters of compounds like minerals, chemical reactions and intermolecular and intramolecular forces, respectively.)

SEC Topic & Code: HSST-CH 2.05 (HSST-CH 2.05)

### assignment

- CH.1.12 - Use two and three dimensional models and their understanding of bond polarity...[expand\\_morelink](#)

### Week 08 - Week 08

Learning Outcome: Use two and three dimensional models and their understanding of bond polarity to illustrate polar and non-polar inter-molecular forces.

### Key Concepts:

- 1. Intermolecular forces.
- 2. London dispersion force.
- 3. Dipole-dipole force.
- 4. Electronegativity.
- 5. Polarity.
- 6. VESPR theory.

Skills: 1. Describe how the size and shape of molecules affect their physical state. 2. Classify molecules as polar and non-polar. 3. Describe how molecules stay together and how their bonding affects their physical properties.

Essential Questions: What holds molecules together?

Textbook and Resource Materials: Active Chemistry: Ch. 5, Sec. 2;  
<https://phet.colorado.edu/en/simulation/molecule-polarity> plus analysis questions

Evidence of Learning: "Written quiz - individual Presentation - group Four pages of molecular representations are similar to those shown in this Teacher's Edition. Students make informed guesses as to which molecules are solids, liquids, or gases and explain their reasoning. Answers match those found in this Teacher's Edition. Conclusions match those found in this Teacher's Edition. Answers in students' Active Chemistry logs match those found in this Teacher's Edition."

Capstone Connection: Apply to selection of materials to use when considering alternative energy designs

Relations: ME.1.06; (Acceleration of particles and using it in different fields such as Nuclear Chemistry) ES.1.02; (Chemical structure, mixtures, parameters of compounds like minerals, chemical reactions and intermolecular and intramolecular forces, respectively.) PH. 1.02; ()

SEC Topic & Code: HSST-CH 1.03; HSST-CH 3.03 (HSST-CH 1.03; HSST-CH 3.03)

[assignment](#)

Electrochemistry (2019)

## folder

- CH.1.13 - Use understanding of the metal activity series to explain why metals are...[expand\\_morelink](#)

Week 09 - Week 10

Learning Outcome: Use understanding of the metal activity series to explain why metals are found as they are in nature and discuss considerations (such as exposure to different kinds of solutions) for the use of metals in industry, construction and jewelry.

Key Concepts:

- 1. Metals.
- 2. Oxidation-reduction (redox) reaction.
- 3. Oxidation.
- 4. Reduction.

Skills: 1. Test the chemical reactivity of metals 2. Use metals to light an LED and explain the procedure and how this can happen

Essential Questions: What enables metals to have the properties that they have?

Textbook and Resource Materials: Active Chemistry: Ch. 4, Sec. 4

Evidence of Learning: Written quiz - individual Presentation - group Students are

able to create an electrical circuit that lights an LED and provide answers that match those in this Teacher's Edition. Students successfully complete the Investigate steps and provide answers that match those in this Teacher's Edition.

Capstone Connection: Metal properties help to explain the choices made by builders for metals in dwellings (Eg. why not copper structural beams and steel electrical wires). Apply information to possible alternative forms of energy.

Relations: ES.1.09; (Using redox reaction that used in energy like solar cells.)  
MA.1.05; (Using function and relation from math in the study of LED.)

SEC Topic & Code: HSST-CH 1.06 (HSST-CH 1.06)

### [assignment](#)

- CH.1.14 - Examine a variety of commercial batteries and use their understanding of...[expand\\_morelink](#)

## Week 11 - Week 11

Learning Outcome: Examine a variety of commercial batteries and use their understanding of electrochemistry to explain how they work and why the manufacturers used the materials they did.

### Key Concepts:

- 1. Oxidation-reduction (redox) reaction.
- 2. Half-reactions.
- 3. Electrochemical cell.
- 4. Galvanic cell.
- 5. Spectator ions.

Skills: The student can design his own battery

Essential Questions:

Textbook and Resource Materials: Active Chemistry: Ch. 5, Sec. 1

Evidence of Learning: Students use the activity series to build an electrochemical cell with the greatest voltage. Students are able to carry out the investigation and draw conclusions about voltage from their data.

Capstone Connection: Battery properties can be analyzed to explain why batteries are an impractical energy storage approach at the whole-house level.

Relations:

SEC Topic & Code: HSST-CH 1.06 HSST-CH 3.06 (HSST-CH 1.06 HSST-CH 3.06 )

### [assignment](#)

## folder

- CH.1.15 - Determine, explain and illustrate how energy and disorder change during...[expand\\_morelink](#)

Week 12 - Week 12

Learning Outcome: Determine, explain and illustrate how energy and disorder change during physical and chemical processes.

Key Concepts:

- 1. System.
- 2. Thermodynamic.
- 3. Kinetics.
- 4. Energy.
- 5. Heat.
- 6. Maximum work.
- 7. Law of conservation of energy.
- 8. Endothermic.
- 9. Exothermic.
- 10. Heat content.
- 11. Enthalpy change.
- 12. Energy diagram.
- 13. Activation energy.
- 14. Activated complex.
- 15. Entropy(S).
- 16. Spontaneity.
- 17. Gibbs free energy.
- 18. Catalyst.

Skills: 1. Determine the relation between the system and environment 2.

Differentiate between thermodynamics and kinetic 3. Apply the law of conservation of energy in many systems 4. Compare between endothermic and exothermic system 5. Find  $\Delta H$  and calculate it in physical and chemical change 6. Draw the energy diagram for endothermic and endothermic system 7. Determine the activated complex position in energy diagram 8. Determine the Gibbs free energy in endothermic and exothermic system 9. Explain the effect of surface areas and use of a catalyst on reaction rate

Essential Questions: What holds things together and how does thermodynamics effect on sustainable system?

Textbook and Resource Materials: Active Chemistry: Ch. 4, Sec. 1 and 8 Zumdahl Chemistry: Ch. 6, Sec. 1, 2, 4 and Ch. 17. Sec. 1, 3, 4, 5, 6, 9

Evidence of Learning: Written quiz - individual Presentation - group Students are able to generate CO<sub>2</sub> gas using four different methods. Students use data they recorded from the various methods of CO<sub>2</sub> gas production to select one that best achieves the desired results.

Capstone Connection: Energy and disorder change during various steps of the

building process (from alloy forming for rebar to cement mixing and curing). Apply knowledge and understanding of energy and disorder to alternative energy designs.

Relations: PH.1.07; () PH.1.10; () PH.1.11; ()

SEC Topic & Code: HSST-CH 1.08 (HSST-CH 1.08)

[assignment](#)

Gases (2019)

## folder

- CH.1.16 - Use the Gas Laws to explain the principles of SCUBA diving.  
[expand\\_morelink](#)

Week 13 - Week 13

Learning Outcome: Use the Gas Laws to explain the principles of SCUBA diving.

Key Concepts:

- 1. Gas.
- 2. Natural law.
- 3. Pressure.
- 4. Atmosphere.
- 5. Barometers.
- 6. Boyle's Law.
- 7. Charles's Law.
- 8. Absolute Zero.
- 9. Kinetic Theory of Matter.
- 10. Idea Gas.

Skills: 1. Investigate the relationship between the volume and pressure of gases at constant temperature. 2. Use data concerning gas, volume, and pressure generate a mathematical relationship between. 3. Investigate the relationship between temperature and volume of a gas. 4. Plot temperature and pressure data to extrapolate absolute zero. 5. Create an explanation for the importance of using the Kelvin scale for gases. 6. Apply Charles's Law to ballooning 7. Predict what will happen when SCUBA tanks are filled.

Essential Questions: What does it mean when something is under pressure?

Textbook and Resource Materials: Active Chemistry: Ch. 5, Sec. 3, 4;  
<https://phet.colorado.edu/en/simulation/gas-properties> plus analysis questions

Evidence of Learning: Written quiz - individual Presentation - group Explanation of observations and answers to questions in Active Chemistry logs match those listed in this Teacher's Edition. Explanation of observations and answers to questions in Active Chemistry logs match those listed in this Teacher's Edition. Explanation of observations and answers to questions in Active Chemistry logs match those listed in this Teacher's Edition. Answers match those presented in this Teacher's Edition. Answers to questions in Part A are similar to those presented in this Teacher's

Edition. Answers match those shown in this Teacher's Edition. Proposed ideas and solutions correctly apply the principle of Charles's law. Proposed ideas are reasonable. Answers to questions in Part A are similar to those presented in this Teacher's Edition. Answers match those shown in this Teacher's Edition. Explanation includes correct application of Charles's law

Capstone Connection: Consider properties of gas in an alternative energy design for Egypt--how is the design affected by Egyptian climate?

Relations: MA.1.05; (Study the variables in the Gas Law) PH.1.08; ()

SEC Topic & Code: HSST-CH 1.07 (HSST-CH 1.07)

#### assignment

- CH.1.17 - Determine the effect of molecular size on molecular motion. Use pictorial and...expand\_morelink

Week 14 -

Learning Outcome: Determine the effect of molecular size on molecular motion. Use pictorial and physical models to determine the effect of mass on gas effusion rates. Describe the history, processes and economic impact of the scented oil industry in Egypt.

Key Concepts:

- 1. Diffusion.
- 2. Effusion.
- 3. Graham's Law of Effusion.

Skills: 1. Determine the effect of molecular size on molecular motion. 2. Research the scented oil industry in Egypt

Essential Questions: Why do colognes and aftershave lotions smell so strong, but perfumes do not?

Textbook and Resource Materials: Active Chemistry: Ch. 5, Sec. 7;  
<https://phet.colorado.edu/en/simulation/molecule-shapes-basics> plus analysis questions

Evidence of Learning: Written quiz - individual Presentation - group Answers from students are similar to those in this Teacher's Edition. Answers from students are similar, if not identical, to those in this Teacher's Edition.

Capstone Connection: Understanding molecular properties of gases can inform the design of a gas-phase indicator of a gas leak for improve safety in the home.

Relations: PH.1.08; ()

SEC Topic & Code: HSST-CH 1.07 (HSST-CH 1.07)

#### assignment

## Chemistry Grade 2

Water in our lives (2019)

### folder

- CH.2.01 - Outline the purification of the water supply. Describe two different...[expand\\_morelink](#)

Week 01 - Week 02

Comment(s):

Learning Outcome: Outline the purification of the water supply. Describe two different processes whereby sea water can be converted into drinkable water.

Key Concepts:

- 1. Solutions and aqueous solutions.
- 2. Solubility of salts (temperature impact).
- 3. Solubility curves.
- 4. Quantitative analysis.
  - a. ppm.
  - b. molarity.
  - c. molality.
  - d. normality.
  - e. mole fraction.
  - f. mass percentage.
  - g. TDS.
- 5. The different ion percentages which the human body needs daily.
- 6. Resins.
- 7. EDTA (including ion exchange).
- 8. Electrodialysis.
- 9. Reverse osmosis.
- 10. Dissolved oxygen (DO).
- 11. Qualitative analysis.

Skills: 1. Use simple distillation to separate soluble salt 2. Use filtration to separate in soluble salt 3. Use carbon to remove tastes and colors 4. Calculate rates of chlorination to disinfect the water 5. Compare between chemical, biological and physical treatment 6. Determine the concentration of solutes by different methods 7. Compare between qualitative and qualitative analysis. 8. Use analytically equipment correctly 9. Interpret the analytical data and results  
Essential Questions: How can you get a pure drinkable water?

Textbook and Resource Materials: How can you get a pure drinkable water?

Evidence of Learning: 1. Use litmus paper for determination of pH 2. Determine pH by use of meter 3. Experimentally demonstrate multiple methods of analysis of pH

Capstone Connection: Because water is such a good solvent it creates special challenges in terms of pollution and water supply.

Relations: MA.2.01; () BI.2.02; () ES.2.04; ()

SEC Topic & Code: HSST-CH 2.05 (HSST-CH 2.05)



- CH.2.02 - Demonstrate that water is a good solvent, that it contains different...[expand\\_more](#)[link](#)

Week 03 - Week 04

Comment(s):

Learning Outcome: Demonstrate that water is a good solvent, that it contains different varieties of dissolved substances, and identify environmental sources and the effect on water purity.

Key Concepts:

- 1. Water in the environment.
- 2. Properties and types.
- 3. Measuring densities, conductivity, pH, boiling points.
- 4. Effect of solutes on physical properties.
- 5. Colligative properties.

- a. elevation in B.P.
- b. depression in F.P.
- c. osmotic pressure.

Skills: 1. Identify naturally occurring dissolved and suspended materials in water sources (mineral salts; oxygen; organic matter) 2. Describe pollutants, their origins and the chemical interactions that make them harmful (metal compounds; sewage; nitrates from fertilizers; phosphates from fertilizers and detergents; harmful microbes) 3. Develop chemical explanation for the role of beneficial chemicals in water (e.g. oxygen and mineral salts for aquatic life)  
Essential Questions: Why do we add ethylene glycol to water in car's radiator?

Textbook and Resource Materials: Why do we add ethylene glycol to water in car's radiator?

Evidence of Learning: 1. Experimentally analyze physical and chemical properties of water from different sources.

Capstone Connection: Impact of dissolved substances in the treatment of water

Relations: MA. 2.07; ()

SEC Topic & Code: HSST-CH 2.04 HSST-CH 2.05 (HSST-CH 2.04 HSST-CH 2.05 )

- CH.2.03 - Describe characteristic properties of acids and bases and preparation of...[expand\\_morelink](#)

Week 05 - Week 06

Comment(s):

Learning Outcome: Describe characteristic properties of acids and bases and preparation of salts

Key Concepts:

- 1. acids
  - a. nature of acids.
  - b. acid strength.
  - c. pH scale.
- 2. Polyprotic acid.
- 3. Bases.
- 4. Acid-base properties of salts.
- 5. The Effect of Structure on.
  - a. acid–base properties.
  - b. acid–base properties of oxides.
- 6. The Lewis Acid–Base Model

Skills: 1. Describe the techniques used in the preparation, separation and purification of salts as examples of some of the techniques specified in the previous LO (methods for preparation should include precipitation and titration together with reactions of acids with metals, insoluble bases and insoluble carbonates) 2.

Describe the general rules of solubility for common salts to include nitrates, chlorides (including silver and lead), sulfates (including barium, calcium and lead), carbonates, hydroxides, Group I cations and ammonium salts 3. Suggest a method of preparing a given salt from suitable starting materials, given appropriate information 4. Solving acid- base problems

Essential Questions: How do acids, bases and salts affect our lives?

Textbook and Resource Materials: How do acids, bases and salts affect our lives?

Evidence of Learning: 1. Experimentally analyze titrations of mono-, di- and tri-protic acids 2. Describe the ionization of strong acids in water and the dissociation of strong bases in water. 3. Distinguish between solutions of weak acids or bases and solutions of strong acids or bases. 4. Relate pH to the concentration of hydronium ions and hydroxide ions in a solution. - Write ionic equations for neutralization reactions. 5. Identify the products of a neutralization reaction. 6. Describe the composition of a salt."

Capstone Connection: Role of acids and bases in water treatment or measurement

Relations: ES.2.13; ()

SEC Topic & Code: HSST-CH 2.04 (HSST-CH 2.04)

## folder

- CH.2.04 - Describe the effect of concentration, pressure, surface area, temperature and...[expand\\_morelink](#)

Week 07 - Week 08

Comment(s):

Learning Outcome: Describe the effect of concentration, pressure, surface area, temperature and catalysis (including enzymes) on the rates of reactions and explain these effects in terms of collisions between reacting particles.

Key Concepts:

- 1. Order.
- 2. Molecularity.
- 3. Rate of chemical reaction.
- 4. Law of mass action.
- 5. Determination of rate of reaction.

Skills: 1. Determine the rate of chemical reaction by monitoring: a. change of concentration of reactant or product. b. volume of gas evolved c. change in PH d. change of weight of the reactants.

Essential Questions: why the food spoils outside the fridge in hot days?

Textbook and Resource Materials: why the food spoils outside the fridge in hot days?

Evidence of Learning: Sample Exercise Zumdahl, 12.2 - Students must understand how the study of the rates of chemical reactions and the structures of the products of these reactions can lead to knowledge of the detailed atomic-level behavior of chemical substances and elucidation of their chemical and physical properties.

Capstone Connection: Effect of these parameters on water treatment for potable water applications

Relations: MA.2.05; ()

SEC Topic & Code: HSST-CH 2.05 (HSST-CH 2.05)

## assignment

- CH.2.05 - Explain how catalysts (transition metals, nanoparticles, and biological...[expand\\_morelink](#)

Week 09 - Week 10

Comment(s):

Learning Outcome: Explain how catalysts (transition metals, nanoparticles, and biological enzymes) lower activation energy and increase reaction rates, and suggest a suitable method for investigating the effect of a given variable on reaction rate.

Key Concepts:

- 1. Catalyst.
  - 2. Activation energy.
  - 3. Activated molecules.
  - 4. Effects of different variables on the rate of chemical rate.
- Skills: Interpret data obtained from experiments concerned with rate of reaction  
Essential Questions: how does the catalyst impact in our life?

Textbook and Resource Materials: how does the catalyst impact in our life?

Evidence of Learning: Suggest a suitable method for investigating the effect of a given variable on the rate of the reaction.

Capstone Connection: Catalysts and rates of reaction in water treatment

Relations:

SEC Topic & Code: HSST-CH 3.05 (HSST-CH 3.05)

[assignment](#)

Chemical Equilibria (2019)

[folder](#)

- CH.2.06 - Explain the meaning of reversible reaction, dynamic equilibrium, and state Le...[expand\\_morelink](#)

Week 11 - Week 12

Comment(s):

Learning Outcome: Explain the meaning of reversible reaction, dynamic equilibrium, and state Le Châtelier's Principle. Apply these concepts to predict the change that will occur when a stress is applied to system at equilibrium.

Key Concepts:

- 1. Chemical equilibria.
- 2. Reversible reactions.
- 3. Dynamic equilibrium.
  - a. factors affecting chemical equilibria.
  - b. equilibrium graphing.
  - c. equilibrium constants
  - d. the Haber process.

- e. the Contact process.  
Skills: 1. Illustrate and explain whether changes in concentration, pressure or temperature or the presence of a catalyst affect the value of the equilibrium constant for a reaction. 2. Deduce expressions for equilibrium constants in terms of concentrations,  $K_c$  and partial pressures,  $K_p$  3. Calculate the values of equilibrium constants in terms of concentrations or partial pressures from appropriate data 4. Calculate the quantities present at equilibrium, given appropriate data  
Essential Questions: How does equilibrium impact in our daily life?

Textbook and Resource Materials: How does equilibrium impact in our daily life?

Evidence of Learning: - Write equilibrium law expressions from balanced chemical equations for heterogeneous and homogeneous systems. Include: mass action expression - Perform a laboratory activity to determine the equilibrium constant of an equilibrium system. - Use Le Châtelier's principle to predict and explain shifts in equilibrium. - Written quiz - individual Presentation - teamwork."

Capstone Connection: Chemical reactions in water treatment

Relations: ME.2.06; () PH.1.03; ()

SEC Topic & Code: HSST-CH 3.05. (HSST-CH 3.05.)

### assignment

- CH.2.07 - Explain qualitatively the extent of dissociation of strong and weak acids and...[expand\\_morelink](#)

Week 13 - Week 14

Comment(s):

Learning Outcome: Explain qualitatively the extent of dissociation of strong and weak acids and bases. Use the common ion effect to explain buffers in terms of pH,  $K_a$ ,  $pK_a$ ,  $K_w$  and  $K_{sp}$ . Calculate related quantities.

Key Concepts:

- 1. Ionic equilibria.
  - 2. Brønsted-Lowry theory of acids and bases.
    - a. acid dissociation constants,  $K_a$  and the use of  $pK_a$ .
    - b. the ionic product of water,  $K_w$ .
    - c. pH: choice of pH indicators.
    - d. buffer solutions.
    - e. solubility product.
    - f. the common ion effect.
- Skills: 1. Calculate  $[H^+(aq)]$  and pH values for strong and weak acids and strong bases 2. Explain the choice of suitable indicators for acid-base titrations, given appropriate data 3. Describe the changes in pH during acid-base titrations and explain these changes in terms of the

strengths of the acids and bases 4. Use equations to illustrate the common ion effect 5. Explain how buffer solutions control pH and describe and explain the uses of buffers, including the role of  $\text{HCO}_3^-$  in controlling pH in blood 6. Calculate the pH of buffer solutions, given appropriate data 7. Explain and illustrate the use of solubility product,  $K_{sp}$  8. Calculate  $K_{sp}$  from concentrations and vice versa  
Essential Questions: How could you analyze the data of water treatment?

Textbook and Resource Materials: How could you analyze the data of water treatment?

Evidence of Learning: Describe by the equation the activation energy for the forward direction and the activation energy for the reverse direction. - Written quiz - individual Presentation - teamwork. Which is more soluble MX or  $\text{MX}_2$  where  $K_{sp} = 1.8 \times 10^{-6}$

Capstone Connection: Role of pH in potable water measurement and treatment

Relations: ME.2.07; () PH.1.03; ()

SEC Topic & Code: HSST-CH 3.05 HSST-CH 2.05 (HSST-CH 3.05 HSST-CH 2.05 )

[assignment](#)

Introduction to Industrial Chemistry (2019)

## folder

- CH.2.08 - Calculate oxidation numbers and use them to explain redox processes and...[expand\\_morelink](#)

Week 01 - Week 03

Learning Outcome: Calculate oxidation numbers and use them to explain redox processes and balance chemical equations. Explain electron-transfer reactions, including electrode reactions and industrial applications.

Key Concepts:

- 1. Oxidation number.
- 2. Redox processes.
- 3. Electron transfer.
- 4. Electrolysis.
- 5. Electrolytes and non-electrolyte.

- 6. Factors affecting the types of substance liberated, deposited or formed during electrolysis (electrode - types of electrolyte).
- 7. Electroplating.
- 8. Corrosion.

Skills: 1. The electrolysis of brine, using a diaphragm cell 2. The extraction of aluminum from molten aluminum oxide/cryolite 3. The electrolytic purification of copper 4. Electroplating of metals to protect it from corrosion

Essential Questions: How can chemical reactions be considered as electron transfers?

Textbook and Resource Materials: HOLT Chemistry, Ch. 17, Sec. 1 Zumdahl Chemistry, Ch. 4, Sec. 9; Ch. 18, Sec.9

Evidence of Learning: - Determine the charge on a monatomic ion in an ionic formula. - Determine the formulas, including the charges, for common polyatomic ions. - Identify a chemical formula as representing an element, a binary ionic compound, an ionic compound with one or two polyatomic ions, or a molecular compound. - Written quiz - individual Presentation - teamwork. Zumdahl Chemistry: exercises p. 877 – 889

Capstone Connection:

Relations: BI.2.04; () PH.2.02; ()

SEC Topic & Code: HSST-CH 1.06 HSST-CH 2.06 HSST-CH 3.06 (HSST-CH 1.06 HSST-CH 2.06 HSST-CH 3.06 )

### assignment

- CH.2.09 - Use half reaction in electrochemical cells to define standard electrode...[expand\\_morelink](#)

Week 04 - Week 06

Learning Outcome: Use half reaction in electrochemical cells to define standard electrode potential using standard hydrogen electrode. Calculate the emf (Ecell). Construct a battery and develop other batteries.

Key Concepts:

- 1. Solutions that conduct electricity.
  - 2. Electrolytic solution.
  - 3. The path of electricity in a battery.
  - 4. Why does a battery eventually “die”?
  - 5. Electrode potentials
    - a. standard electrode (redox) potentials,  $E^\circ$  of the redox series.
    - b. standard cell potentials,  $E^\circ_{\text{cell}}$ , and their uses.
- Skills: 1. Describe methods used to measure the standard electrode potentials of: a. metals or non-metals in contact with their ions in aqueous solution b. ions of the same element in different oxidation states 2. Calculate a standard cell potential by combining two standard electrode potentials 3. Use standard cell potentials to: a.

explain/deduce the direction of electron flow from a simple cell b.  
predict the feasibility of a reaction c. construct redox equations using  
the relevant half-equations

Essential Questions: What makes batteries work?

Textbook and Resource Materials: Active Chemistry: Ch. 4, Sec. 6  
HOLT Chemistry: Ch. 17, Sec. 3

Evidence of Learning: Construct several electrochemical cells to study  
oxidation – reduction reactions and their use in voltaic cells. - Written  
quiz - individual Presentation - teamwork. Zumdahl Chemistry ex. 18.3

Capstone Connection: Role of batteries in Egypt's industrial base OR  
new business in Capstone

Relations: PH.2.02; ()

SEC Topic & Code: HSST-CH 2.06 HSST-CH 1.06 (HSST-CH 2.06  
HSST-CH 1.06 )

[assignment](#)

Fuels and Fire (2019)

## folder

- CH.2.10 - Explain (i) combustion reactions for alkanes (i.e. methane in oxygen)  
(ii)...[expand\\_morelink](#)

Week 07 - Week 11

Learning Outcome: Explain (i) combustion reactions for alkanes (i.e. methane in oxygen) (ii)  
addition/substitution reactions for alkanes and alkenes (iii) polymerization (addition and  
condensation)

Key Concepts:

- 1. Empirical, molecular, structural, displayed and skeletal formulae.
- 2. Functional groups and the naming of organic compounds.
- 3. Shapes of organic molecules;  $\sigma$  and  $\pi$  bonds.
- 4. Isomerism: structural and stereoisomerism.
- 5. IUPAC name.
- 6. Optical and geometrical isomerism.
- 7. Classification of hydrocarbons.
  - a. aliphatic.
  - b. aromatic.
- 8. Alkanes (exemplified by methane and ethane).
  - a. combustion.
  - b. halogenation.
  - c. free-radical reactions.
  - d. crude oil and 'cracking'.



- 9. Alkenes (exemplified by ethylene).
  - a. addition and oxidation reactions.
  - b. industrial importance.

- 10. Chemistry of fire.

- 11. Aromaticity.

Skills: 1. Distinguish between alkane alkene and alkyne in re-activity 2. Recognize characteristic reactions of alkanes, alkenes and alkynes

Essential Questions: How can you decide the best type of fuel that you will use in your car?

Textbook and Resource Materials: HOLT Chemistry: Ch. 19, Sec. 1, 2, 3 Zumdahl Chemistry: Ch. 22 Sec. 1, 2, 5, 6 internet resources

Evidence of Learning: - Explain how the structure and bonding of carbon lead to the diversity and number of organic compounds. - Compare the use of molecular and structural formulas to represent organic compounds. Distinguish among the structures of alkanes, alkenes, alkynes, and aromatic hydrocarbons. -Relate properties of different types of hydrocarbons to their structures Identify alcohols, alkyl halides, ethers, aldehydes, ketones, carboxylic acids, esters, and amines based on the functional group present in each. Explain the relationships between the properties and structures of compounds with various functional groups -Written quiz - individual Presentation - teamwork." -Describe and distinguish between the organic reactions: substitution, addition, condensation, and elimination. -Relate some functional groups to some characteristic reactions. -Identify the two main types of polymers and the basic reaction mechanisms by which they are made. - Written quiz - individual Presentation - teamwork."

Capstone Connection:

Relations: BI.2.02; ()

SEC Topic & Code: HSST-CH 2.09 (HSST-CH 2.09)

### assignment

- CH.2.11 - Describe (a) cracking of crude oil (b) the use of resulting molecules as fuel...[expand\\_morelink](#)

Week 12 - Week 14

Learning Outcome: Describe (a) cracking of crude oil (b) the use of resulting molecules as fuel via combustion (c) environmental consequences of CO, NOx, VOCs, and greenhouse gases. Overcome environmental challenges with alternative fuels and increased efficiency.

Key Concepts:

- 1. Hydrocarbons as fuels.
  - 2. Greenhouse effect.
  - 3. Crude oil and 'cracking.
- Skills: Identification of hydrocarbon as fuels for machines and humans  
Essential Questions: How can you use crude oil in industry?

Textbook and Resource Materials: Zumdahl Chemistry: Ch. 22 Sec. 3 - 4  
[http://www.bbc.co.uk/schools/gcsebitesize/science/aqa\\_pre\\_2011/oils/polymersrev1.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/aqa_pre_2011/oils/polymersrev1.shtml)"

Evidence of Learning: - Explain the advantages and disadvantages of making ethanol using non-renewable or renewable resources - Give Examples of polymers and their uses - Explain how Polymers have properties that depend on the chemicals they are made from, and the conditions in which they are made. - Written quiz - individual Presentation - teamwork.

Capstone Connection: Role of petroleum products and process in Egypt's industrial base

Relations: BI.2.03; ()

SEC Topic & Code: HSST-CH 2.09 (HSST-CH 2.09)

[assignment](#)

# Chemistry Grade 3

Introduction to Investigative Processes and Concepts (2019)

## folder

- CH.3.01 - Differentiate: law and theory; theory and experiment; qualitative and...[expand\\_morelink](#)

Week 01 - Week 02

Comment(s): In this unit the emphasis should be on learning the ways in which scientists do their work, the importance of evidence and the limitations of scientific research. Scientific experiments rely primarily on quantitative measurement. Students should be used to this by now. A natural implication of the limits of scientific experimentation is uncertainty in measuring. Students should be familiar with this already and should apply it to the process of designing experiments or reviewing the results of other experiments.

Learning Outcome: Differentiate: law and theory; theory and experiment; qualitative and quantitative; and hypothesis and theory.

Key Concepts:

- 1. The fundamental laws of chemistry are the laws of:
  - a. Conservation of Mass.
  - b. Conservation of Energy.
  - c. Definite Proportion.
  - d. Multiple Proportion.
- 2. Quantitative analysis.
- 3. Qualitative analysis.
- 4. Scientific methodology.
- 5. Uncertainty.
- 6. Instrumentation.
  - a. precision.
  - b. accuracy.

Skills: 1. Read scientific reports and analyze for methodology 2.

Differentiate between findings, analysis and conclusion 3.

Demonstrate proper use of quantitative instrumentation 4. Conduct and analyze series of measurements 5. Evaluate scientific reports as to their use of quantitative instruments, reporting and analysis of findings

Essential Questions: How are scientific reports and findings different from others? This should be a central question in this section. What do we mean by uncertainty in the scientific sense?

Textbook and Resource Materials: Zumdahl Chemistry Chapter 1 Section 1 Chapter 1 Section 2 Chapter 1 Section 3 Chapter 2 Section 2 Chapter 1 Sections 4 - 10 Lab Handbook: The difference between reading volume by graduated cylinder and burette Zumdahl Experimental Chemistry: Labs 1, 2 and 3. Dr. Robert McComas - Theories and Laws

<http://coehp.uark.edu/pase/TheMythsOfScience.pdf>

Evidence of Learning: R: what are the scientific steps of an experiment BA: problem p14 R: mention 4 instruments to use in treatment with volumes BA: problem p1 ST: example 1.2 ST: before

the scanning tunneling microscope what evidence u will give to support the theory of atoms and molecules.

Capstone Connection: Describe theories associated with the chosen communication technique. Apply uncertainty of measurement to communication capstones and hardware or software prototypes

Relations: PH.1.01; ()

SEC Topic & Code: HSST-CH 3.05 HSST-CH 3.01 (HSST-CH 3.05 HSST-CH 3.01 )

### assignment

- CH.3.02 - Design and conduct a laboratory investigation to demonstrate the Law of...[expand\\_morelink](#)

### Week 03 - Week 03

Comment(s): This is a very important LO, but the details in this section do not seem to follow. Are students required to design a lab? This entire unit should focus on the methods of predicting 1) the composition of substances; 2) the calculation of reactants and products in a balanced chemical reaction and 3) the underlying chemical mechanisms that guide the proportions in a reaction.

Learning Outcome: Design and conduct a laboratory investigation to demonstrate the Law of Conservation of Mass. Design a laboratory experiment to demonstrate the composition of compounds can be predicted from the structure of the constituent elements and can be confirmed experimentally.

### Key Concepts:

- 1. Law of Conservation of Mass.
  - 2. Elements of robust experimental design.
- Skills: 1. Experimental Design 2. Analytical methodology 3. Laboratory reporting  
Essential Questions: What makes a good experimental design?

Textbook and Resource Materials: Student 3 Lab Handbook Experiment #1: By Precipitation and Filtration Experiment \*\*\*\*\***without knowing the details of this experiment, it seems out of place. How does it fit here? The title does not seem to describe what the experiment is about**\*\*\*\*\* Zumdahl Chemistry Chapter 4 Sections 1 - 7 Zumdahl Laboratory Handbook Experiment #14 and 16 Student 3 Lab Handbook Experiment: Volumetric and gravimetric analysis

Evidence of Learning: R: define the density. \*\*\*\*\*How does this fit here?\*\*\*\*\*  
BA:example1.14 ST: What is the difference bet the simple and the fractional distillation? \*\*\*\*\*How does this fit here? \*\*\*\*\* Experimentally demonstrate the Law of Conservation of Mass **Students will be able to either 1) determine the formula of a compound, given mass data; or 2) design a simple experiment that produces mass data that allows the student to determine the formula.**

Capstone Connection: **Apply conservation of mass to your communication capstone**

Relations:

SEC Topic & Code: **HSST-CH 3.05 (HSST-CH 3.05)**

[assignment](#)

- **CH.3.03 - Offer a simple set of observations about what they see in the laboratory,...[expand\\_morelink](#)**

#### **Week 04 - Week 04**

Comment(s): **This LO is important in that it connects the microscopic level with the macroscopic and the representational**

Learning Outcome: **Offer a simple set of observations about what they see in the laboratory, write a balanced equation and explain in terms of atoms, molecules, collisions between them and electron interactions.**

Key Concepts:

- **1. Kinetic Molecular Theory.**
- **2. Nano and molecular level interactions.**
- **3. Particle collisions.**
- **4. Chemical formulae.**
- **5. Balancing equations.**
- **6. Naming conventions.**

Skills: **1. Inferring molecular processes from macroscopic observations 2. Developing a particle model to explain macroscopic observations**

Essential Questions: **How can chemists tell about atomic level interactions from gross laboratory observations?**

Textbook and Resource Materials: **Zumdahl Chemistry Chapter 2 Section 8 Chapter 3 Section 8 and Section 9 Chapter 4 Sections 8 - 10 Student 3 Lab Handbook Experiment: Redox Reactions and Titration \*\*\*\*\*Check this experiment. What reactions are used?**

Evidence of Learning: **Quiz on valid and invalid inferences from laboratory observations \*\*\*\*\*This seems like a very basic way of determining what students have learned. 1) Are students able to translate from macroscopic to microscopic and then represent the microscopic in an equation? 2) Are they able to do the reverse of #1? 3) Are they able to do #1 and #2 for a variety of types of reactions, e.g., reactions with precipitates, gases produced, color changes and other indications that a reaction is occurring? \*\*\*\*\***

Capstone Connection: **Role of atoms and molecules in your communication technique**

Relations: **ES.3.04; () ES.3.06; () ME.2.07; ()**

SEC Topic & Code: **HSST-CH 3.05 (HSST-CH 3.05)**

- **CH.3.04 - Identify and apply stoichiometric relationships to mass data to identify or...expand\_morelink**

## **Week 05 - Week 06**

**Comment(s): The mathematical routines used in this LO are in reality mathematical models that describe the behavior of substances in chemical reactions. Limiting and excess reagents can be applied to a number of environmental issues. What are the by-products of chemical reactions and how can we minimize these? How do we measure quantities present in very small concentrations?**

**Learning Outcome: Identify and apply stoichiometric relationships to mass data to identify or infer the composition of pure substances and/or mixtures and relate mathematical processes to the analysis of the conservation laws and mechanisms of chemical reactions.**

**Key Concepts:**

- **1. Scientific laws are derived from observational data.**
  - **2. Limiting Reagent.**
  - **3. Stoichiometric relationships.**
- Skills: 1. Mathematical analysis of quantitative data 2. Selection and application of appropriate scientific laws to quantitative data. 3. Use appropriate instrumentation to accurately measure mass of substances, volumes of solutions, or volumes and pressures of gases as reactants and as products**
- Essential Questions: How do chemists use mathematical processes to analyze reactions?**

**Textbook and Resource Materials: Zumdahl Chemistry Chapter 4 Section 10 Student Laboratory Handbook: Experiment Heat of Crystallization \*\*\*\*\*????? This is a physical change. Is it best lab for this LO? \*\*\*\*\* Zumdahl Chemistry Chapter 3 Sections 1 - 10 Chapter 5 Sections 1 - 4 Zumdahl Laboratory Handbook Experiment #13**

**Evidence of Learning: Experimentally determine the mass of barium in a sample of barium chloride salt and compare experimental results to the theoretical. Experimentally indicate the proportions in which substances reacts by measuring temperature change as index of the extent of the reaction. \*\*\*\*\*????????????\*\*\*\*\* Perhaps an alternative: present students with a variety of equations and the mass or volume of one of the reactants or products and ask them to calculate the quantities of the remaining species. And as an application of this, present students with an actual reaction and a mass of one reactant or product and ask them to calculate and measure out the quantities required to completely react. \*\*\*\*\***

**Capstone Connection: The mathematical routines involved here are ways of communicating about the behavior of matter.**

**Relations:**

[assignment](#)

## Gases (2019)

### folder

- **CH.3.05 - Use experimental data to derive the Ideal Gas Law. Determine the volume of...**[expand\\_morelink](#)

#### Week 07 - Week 08

Comment(s): **This unit should build on the gas laws unit from year 2 which considered Charles' Law, Boyle's Law, Combined Law, etc. It is placed here in the curriculum because it is quantitative in nature (and thus, follows the stoichiometry unit). However, it is conceptually related to CH. 3.13 and CH. 3.14 by means of the Kinetic Molecular Theory.**

Learning Outcome: **Use experimental data to derive the Ideal Gas Law. Determine the volume of one mole of a gas.**

Key Concepts:

- **1. Ideal gas.**
- **2. Intermolecular forces.**
- **3. Ideal Gas Law.**
- **4. Universal gas constant.**

Skills: **1. Determine the volume of one mole of a gas. 2. Using laboratory data, calculate the gas-law constant "R." 3. Derive the Ideal Gas Law equation.**

Essential Questions: **What makes something "ideal?"**

Textbook and Resource Materials: **Active Chemistry Ch. 3 Sec. 6 Resource for Activity Interactive Simulations - Gas Properties**  
<https://phet.colorado.edu/en/simulation/gas-properties> **Ideal Gas Law Simulation** [http://highered.mheducation.com/olcweb/cgi/pluginpop.cgi?it=swf::100%::100%::/sites/dl/free/0023654666/117354/Ideal\\_Nav.swf::Ideal%20Gas%20Law%20Simulation](http://highered.mheducation.com/olcweb/cgi/pluginpop.cgi?it=swf::100%::100%::/sites/dl/free/0023654666/117354/Ideal_Nav.swf::Ideal%20Gas%20Law%20Simulation) **Intermolecular Forces** <https://www.wisc-online.com/learn/natural-science/chemistry/gch6804/intermolecular-forces>

Evidence of Learning: **See Exercises 5.37,38, 43-125**

Capstone Connection:

Relations: **PH.1.08; () PH.3.13; ()**

SEC Topic & Code: **HSST-CH 1.07 HSST-CH 3.07 (HSST-CH 1.07 HSST-CH 3.07 )**

[assignment](#)

## Electrons and the Periodic Table (2019)

### folder

- **CH.3.06 - Explain and represent the distribution of electrons in an atom using...**[expand\\_morelink](#)

#### Week 09 - Week 09

Comment(s): **These LOs should be re-ordered: 3.10, 3.13, 3.11, and 3.12**

Learning Outcome: **Explain and represent the distribution of electrons in an atom using Coulomb's Law and the position of the element on the periodic table.**

Key Concepts:

- **1. Coulomb's Law.**
- **2. Electron pairing.**
- **3. Electron spin.**
- **4. Orbitals.**
- **5. Energy levels and sub-levels.**

Skills: **Application of Coulomb's Law**

Essential Questions: **What determines how an element will react?**

Textbook and Resource Materials: **Zumdahl sections 7.6 - 7.11 Online chemistry textbook (not identified)**

[http://www.oneonta.edu/faculty/viningwj/Chem111/Chapter%208\\_5\\_SY.pdf](http://www.oneonta.edu/faculty/viningwj/Chem111/Chapter%208_5_SY.pdf)

\*\*\*\*\***Michigan State University department of chemistry**

<http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro2.htm>

**University of California Davis ChemWiki**

[http://chemwiki.ucdavis.edu/Physical\\_Chemistry/Quantum\\_Mechanics/09.\\_The\\_Hydrogen\\_Atom/Atomic\\_Theory/Electrons\\_in\\_Atoms/Connecting\\_Electronic\\_Configurations\\_to\\_the\\_Periodic\\_Table](http://chemwiki.ucdavis.edu/Physical_Chemistry/Quantum_Mechanics/09._The_Hydrogen_Atom/Atomic_Theory/Electrons_in_Atoms/Connecting_Electronic_Configurations_to_the_Periodic_Table) **Linus Pauling and Nature of the Chemical Bond**

<http://scarc.library.oregonstate.edu/coll/pauling/bond/index.html>\*\*\*\*\*

Evidence of Learning: **Write an explanation, including diagrams and the use of Coulomb's Law, to compare and contrast the distribution of electrons in two elements either in the same family or the same period.**

Capstone Connection:

Relations: **PH.2.01; ()**

SEC Topic & Code: **HSST-CH 3.03 (HSST-CH 3.03)**

### assignment



- **CH.3.07 - Determine types of bonding based on Coulomb's Law and the position of the...**[expand\\_morelink](#)

## Week 10 - Week 10

Comment(s):

Learning Outcome: **Determine types of bonding based on Coulomb's Law and the position of the elements on the periodic table.**

Key Concepts:

- **1. Chemical bonds.**
- **2. Inter-nuclear distance.**
- **3. Electronegativity.**
- **4. Bond polarity.**
- **5. Dipole moments.**

Skills: **Application of Coulomb's Law**

Essential Questions: **How can like charges show any attraction?**

Textbook and Resource Materials: **Zumdahl sections 8.1 - 8.3**

Evidence of Learning: **Draw the electrostatic potential map**

Capstone Connection:

Relations: **ME.3.01; () ME.3.02; ()**

SEC Topic & Code: **HSST-CH 3.03 (HSST-CH 3.03)**

[assignment](#)

- **CH.3.08 - Use Lewis diagrams and VSEPR to predict the geometry of molecules, identify...**[expand\\_morelink](#)

## Week 11 - Week 12

Comment(s): **LO CH. 3.11 and LO CH. 3.12 are two sides of the same coin. The two LOs should enable students to follow this learning arc: given two or more elements on the Periodic Table, determine if the two elements will react, construct a Lewis diagram, use VSEPR to predict shape of resulting molecule and predict properties of the compound using knowledge of intermolecular forces.**

Learning Outcome: **Use Lewis diagrams and VSEPR to predict the geometry of molecules, identify hybridization, and make predictions about polarity.**

Key Concepts:

- **1. Localized electron.**
- **2. Lewis structures.**
- **3. Exception to octet rule.**

- **4. Resonance.**

- **5. VSEPR.**

- **6. Hybrid orbitals.**

Skills: **3-Dimensional modeling**

Essential Questions: **How can chemists predict molecular shape and polarity?**

Textbook and Resource Materials: **Zumdahl sections 8.9 - 8.13 , 9.1 , 9.5; Zumdahl Laboratory Handbook Experiment #23 University of California Davis ChemWiki**

**[http://chemwiki.ucdavis.edu/Inorganic\\_Chemistry/Molecular\\_Geometry/VSEPR](http://chemwiki.ucdavis.edu/Inorganic_Chemistry/Molecular_Geometry/VSEPR) University of California Davis ChemWiki**

**[http://chemwiki.ucdavis.edu/Theoretical\\_Chemistry/Chemical\\_Bonding/Lewis\\_Theory\\_of\\_Bonding/Geometry\\_of\\_Molecules](http://chemwiki.ucdavis.edu/Theoretical_Chemistry/Chemical_Bonding/Lewis_Theory_of_Bonding/Geometry_of_Molecules) University of Wisconsin**

**department of chemistry**

**<https://www.chem.wisc.edu/deptfiles/genchem/sstutorial/Text7/Tx73/tx73.html>**

Evidence of Learning: **Experimentally use the VSEPR theory to predict the 3-dimensional of some simple molecules.**

Capstone Connection:

Relations:

SEC Topic & Code: **HSST-CH 3.03 (HSST-CH 3.03)**

[assignment](#)

- **CH.3.09 - Describe, explain and represent the ways in which molecular architecture...[expand\\_morelink](#)**

### **Week 13 - Week 14**

Comment(s): **LO CH. 3.11 and LO CH. 3.12 are two sides of the same coin. The two LOs should enable students to follow this learning arc: given two or more elements on the Periodic Table, determine if the two elements will react, construct a Lewis diagram, use VSEPR to predict shape of resulting molecule and predict properties of the compound using knowledge of intermolecular forces.**

Learning Outcome: **Describe, explain and represent the ways in which molecular architecture relates to the properties of substances.**

Key Concepts:

- **1. Intermolecular bonds.**

- **2. Molecular and ionic crystals.**

Skills: **1. 3-Dimensional modeling 2. Use of physical properties to determine intermolecular bonding**

Essential Questions: **Why is molecular architecture important?**

Textbook and Resource Materials: **Zumdahl sections 10.1-10.7**

Evidence of Learning: **Research on the internet \*\*\*\*\* Topic(s) for this research? Suggestions below \*\*\*\*\* Chemguide**

<http://www.chemguide.co.uk/atoms/bonding/vdw.html> Chem455  
<https://chem455.files.wordpress.com/2009/06/chem-45-june-29.pdf> Master  
organic Chemistry <http://www.masterorganicchemistry.com/2010/10/01/how-intermolecular-forces-affect-boiling-points/> McGraw Hill  
<http://www.udel.edu/chem/sametz/101Fall09/ch12temp.pdf>

Capstone Connection:

Relations: **ES.1.02;** () **PH.1.02;** ()

SEC Topic & Code: **HSST-CH 3.03 (HSST-CH 3.03)**

[assignment](#)

## Solids, Liquids, and Solutions (2019)

### [folder](#)

- **CH.3.10 - Use his/her understanding of particle interaction in solutions to explain and...[expand\\_morelink](#)**

#### Week 14 - Week 14

Comment(s): I have one additional LO in my notes for this unit. See following: Students will be able to explain and visually represent the differences between solids, liquids and amorphous solids. Did this LO refocus to just solutions?

Learning Outcome: Use his/her understanding of particle interaction in solutions to explain and illustrate both quantitatively and visually colligative properties of solutions. Explain and visually represent observations regarding the solubility of ionic solids and molecules in water and other solvents on the basis of particle views that include intermolecular interactions and entropic effects.

Key Concepts:

- 1. Boiling point elevation.
- 2. Freezing point depression.
- 3. Osmotic pressure.
- 4. Reverse osmosis.
- 5. Colloids.
- 6. Physical properties of solids and liquids as reflected by their inter particle bonding (molecular or ionic)

Skills: 1. Measurement of phase change temperatures 2. Calculation of molality 3. Visual representation of molecular level interactions during phase changes and dissolving 4. Use of macro observational data to communicate particulate level information. 5. Selection of appropriate tests to determine bond type 6. Develop diagrams to explain particulate level phenomena  
Essential Questions: How does water-based antifreeze work in sub-zero environments? How are salt and sugar similar/different as solutes?

Textbook and Resource Materials: Zumdahl sections 11.5-11.8; Zumdahl

Laboratory Handbook Experiment #28 How Stuff Works  
<http://auto.howstuffworks.com/cooling-system3.htm> Interactive Simulations -  
Salt and Sugar <https://phet.colorado.edu/en/simulation/sugar-and-salt-solutions> Colligative properties - <http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/collig.html> Colligative properties -  
<http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch15/colligative.php>  
Zumdahl Laboratory Handbook Experiment #27 PhET Interactive Simulations  
- Salts and Solubility <http://phet.colorado.edu/en/simulation/soluble-salts>  
PhET Interactive Simulations - Sugar and Salt Solutions  
<http://phet.colorado.edu/en/simulation/sugar-and-salt-solutions>

Evidence of Learning: Experimentally determine the depression of the freezing point of unknown substance in naphthalene will be used to calculate its molar mass. Experimentally apply two common procedures applied to water resources to test their fitness for human consumption will be examined: the conc. of chloride ion and calcium ion present in water sample will be determined.

Capstone Connection:

Relations: **ES.2.08**; () **BI.3.01**; () **BI.3.02**; () **BI.3.09**; ()

SEC Topic & Code: **HSST-CH 3.04 (HSST-CH 3.04)**

[assignment](#)

Rate of Chemical Reactions from Kinetics (2019)

## folder

- CH.3.11 - Use his/her understanding to determine rate law of chemical reactions by...[expand\\_morelink](#)

Week 01 - Week 02

Comment(s): It is important for students to understand concepts related to the rates of chemical reactions in order to understand the following LOs involving equilibrium and acids and bases.

Learning Outcome: Use his/her understanding to determine rate law of chemical reactions by using kinetics and be able to apply factors affecting on the rate of chemical reactions

Key Concepts: Rate determining from kinetics, order molecularity: zero, 1st, and 2nd order from data analysis,

Skills: 1. Reaction rates 2. Rate law 3. Determine the form of the rate law 4. Methods of initial rates 5. Determine the rate of chemical reaction by monitoring: a. change of concentration of reactant or product. b. volume of gas evolved c. change in PH d. change of weight of the reactants.

Essential Questions: How does the rate of reaction depend on concentration?

Textbook and Resource Materials: Zumdahl Ch 12 sections 1-3 PhET Interactive Simulations - Reactions and Rates <http://phet.colorado.edu/en/simulation/reactions-and-rates>

Evidence of Learning: Zumdahl Laboratory Handbook Experiment #30

Capstone Connection:

Relations: MA.3.01; () MA.3.05; () MA.3.09; ()

SEC Topic & Code: HSST-CH 3.05 (HSST-CH 3.05)

assignment

Equilibrium (2019)

## folder

- CH.3.12 - Describe a dynamic equilibrium and explain the effect of concentration,...[expand\\_morelink](#)

Week 03 - Week 04

Comment(s): This is an important unit. It should be viewed conceptually as a continuation of CH. 3.16. Many natural systems exist as equilibria and so this concept is central to interdisciplinary understanding.

Learning Outcome: Describe a dynamic equilibrium and explain the effect of concentration, pressure, surface area, temperature, and catalysts on the rates of the reaction in terms of collisions between reacting particles.

Key Concepts:

- 1. Reversible and irreversible reactions.
- 2. Le Châtelier's Principle.
- 3. Equilibrium constants.
- 4. Rate determining from kinetics.

Skills: Determine the change of equilibrium by changing the concentration, pressure, temperature, or catalyst

Essential Questions: How does equilibrium impact in our daily life?

Textbook and Resource Materials: Zumdahl Chemistry: \*\*\*\*needs page Ch. 13

<https://www.youtube.com/watch?v=1jF6yOzZbws>

<https://www.youtube.com/watch?v=mBTSwJnZ6Sk>

<http://exploration.grc.nasa.gov/education/rocket/TRCRocket/antacid2.html>

<https://www.youtube.com/watch?v=BBTcz60CNtM> PhET Interactive Simulations - Reversible Reactions <http://phet.colorado.edu/en/simulation/reversible-reactions>

Evidence of Learning: Quiz Homework Experiments Exit Ticket \*\*\*\*\*Specifically, what should student do for each of these?\*\*\*\*\*

Capstone Connection:

Relations: ME.3.01; (); ME.3.02; () ES.3.08; ()

SEC Topic & Code: HSST-CH 3.05 (HSST-CH 3.05)

[assignment](#)

Acid Base Equilibrium (2019)

[folder](#)

- CH.3.13 - Know that acid and base equilibria are another form of equilibrium reactions...[expand\\_morelink](#)

Week 05 - Week 06

Comment(s):

Learning Outcome: Know that acid and base equilibria are another form of equilibrium reactions that deserve special mention.

Key Concepts:

- 1. Define weak acids and weak bases in terms of equilibrium.  $K_a$  and  $K_b$  to determine acid and base strength.
- 2. Use  $K_a$  and  $K_b$  in acid/base equilibrium problems.  
Skills: 1. Acid base equilibrium, Solutions of Acids or Bases Containing a Common Ion 2. Equilibrium Calculations 3. Buffered Solutions 4. Buffering: How Does It Work? 5. Buffering Capacity Titrations and pH Curves 6. Strong Acid–Strong Base Titrations Calculation of  $K_a$  and  $K_b$  7. Acid–Base Indicators  
Essential Questions: How do buffering solutions working in our body?

Textbook and Resource Materials: Zumdahl CH 15 section 15.1-5 \*\*\*\*\*PhET Interactive Simulations - Acids and Bases  
<http://phet.colorado.edu/en/simulation/acid-base-solutions>\*\*\*\*\*  
(<http://www.chemistry.wustl.edu/~edudev/LabTutorials/Buffer/Buffer.html>) , ocean acidification  
([http://oceanservice.noaa.gov/education/pd/climate/teachingclimate/acid\\_base\\_chemistry\\_student.pdf](http://oceanservice.noaa.gov/education/pd/climate/teachingclimate/acid_base_chemistry_student.pdf))

Evidence of Learning: Guiding problems in Zumdahl \*\*\*\*\* CH 15 section 15.1-5\*\*\*\*\*

Capstone Connection:

Relations: PH.1.03; () BI.3.01; () BI.3.02; ()

SEC Topic & Code: HSST-CH 3.05 (HSST-CH 3.05)

Electrochemistry (2019)

## folder

- CH.3.14 - Describe redox reactions, Faraday's law, and relate their understanding to...[expand\\_morelink](#)

Week 07 - Week 08

Comment(s): Remembering that this course is cyclical, this LO returns to an examination of chemical reactions and the mechanism that underlies them. The industrial applications are important for several Grand Challenges

Learning Outcome: Describe redox reactions, Faraday's law, and relate their understanding to different industrial application of electrolytic and galvanic cell also able to protect metals against corrosion

Key Concepts:

- 1. Redox processes: electron transfer and changes in oxidation number.
- 2. Faraday laws and Faraday constant.
- 3. Standard e.m.f calculations.
- 4. Differentiate between anode and cathode.
- 5. Electroplating application.

Skills: 1. Balance redox half reactions 2. Dependence of cell potential and cell concentration 3. The Nernst Equation, Ion selective electrodes, calculation of equilibrium constants for redox reactions

Essential Questions: What industrial applications use electrochemistry? What is the impact of corrosion on metal industries?

Textbook and Resource Materials: Zumdahl Chapter 18

<https://www.youtube.com/watch?v=AktF-vwTYo8>

<https://www.youtube.com/watch?v=sZ8Z54E4WXI>

[https://www.youtube.com/watch?v=4DK0go1\\_u4Y](https://www.youtube.com/watch?v=4DK0go1_u4Y)

<https://www.youtube.com/watch?v=Mm7gfKLzI7I> \*\*\*\*\*PhET Interactive Simulations

- Faraday's Law <http://phet.colorado.edu/en/simulation/faradays-law> PhET

Interactive Simulations - Faraday's Electromagnetic Lab

<http://phet.colorado.edu/en/simulation/faraday>\*\*\*\*

Evidence of Learning:

Capstone Connection:

Relations: MA.3.09; ()

SEC Topic & Code: HSST-CH 3.06 (HSST-CH 3.06)

## folder

- CH.3.15 - Distinguish practically between organic and inorganic compounds- molecular...[expand\\_morelink](#)

Week 9 - Week 10

Comment(s): This LO provides an opportunity to integrate organic chemistry with other advanced topics from biology and to create the basis for understanding advanced materials like polymers and composites. It also allows students to review electron configurations, bonding and molecular geometry.

Learning Outcome: Distinguish practically between organic and inorganic compounds- molecular and structural formulas, different isomers, and IUPAC nomenclature. Experimentally determine the carbon and hydrogen in organic material, and identify aromatic compounds.

Key Concepts:

- 1. Isomers (geometric and optical).
- 2. Simple preparation of methane (dry distillation of sodium acetate).
- 3. Reactions of hydrocarbons:
  - a. combustion in limited and excess amount of oxygen for hydrocarbons.
  - b. halogenation of alkane and alkene by free radical mechanism (Methane and propane).
  - c. catalytic hydration of alkene.
  - d. addition of HX (alkene only).
  - e. polymerization of ethylene.
  - f. catalytic hydration of alkyne.
  - g. polymerization- dimerization, aromaticity, and benzene structure.
  - h. preparation of aromatic benzene (from acetylene –hexane).
- 4. Reactions of Benzene:
  - a. mono substituted benzene.
  - b. di-substituted benzene.
- 5. Distinguish practically between Ethane, Ethylene and Acetylene.  
Skills: 1. Model organic molecules 2. Set up the apparatus used in preparing methane (i.e. dry distillation 3. Choose a suitable catalyst for the catalytic hydration reaction  
Essential Questions: What do detergents, proteins and digestion have in common?

Textbook and Resource Materials: Zumdahl – Ch: 22- Section 22.1 to 22.4 8th Ed. Organic Chemistry, L.G.WADE JR. 4th Ed. Chemistry, McMurry Fay 2nd Ed. IB National Chemistry Book Organic Chemistry for JEE/ISEEET Dr. K. S. Verma  
<https://www.youtube.com/watch?v=x7z0P7yRFZk>  
<https://www.youtube.com/watch?v=pMoA65Dj-zk&list=PL7305D1BC80498DA6>  
<https://www.youtube.com/watch?v=bmjg7lq4m4o>  
[https://www.youtube.com/watch?v=6yeVMd\\_ly1k](https://www.youtube.com/watch?v=6yeVMd_ly1k)  
<https://www.youtube.com/watch?v=hZpzvG9A6OM>  
<https://www.youtube.com/watch?v=C5ZK6nPPAbo>  
[http://chemwiki.ucdavis.edu/Organic\\_Chemistry](http://chemwiki.ucdavis.edu/Organic_Chemistry)



Evidence of Learning: 5 presentations exit ticket ???????

Capstone Connection:

Relations: BI.3.02; () BI.3.07; () BI.3.09; ()

SEC Topic & Code: HSST-CH 2.09 (HSST-CH 2.09)

### assignment

- CH.3.16 - Connect functional groups with chemical and physical properties of organic...[expand\\_morelink](#)

Week 11 - Week 12

Comment(s): This LO exposes students to the diversity of organic structures via a study of functional groups. Many of the functional groups are associated with various classes of organic compounds which students will need to understand.

Learning Outcome: Connect functional groups with chemical and physical properties of organic compounds. Identify and describe aliphatic alcohols and will be able to prepare them and test for their presence. Conduct research on their industrial applications.

Key Concepts:

- 1. Nomenclature.
  - 2. Classification of alcohols according to the functional group, and according to carbonyl group.
  - 3. Prepare experimentally by fermentation.
  - 4. Preparation theoretically from alkanes and alkyl halides.
  - 5. Oxidation reactions to determine the presence of ethanol.
  - 6. Industrial application of:
    - a. methanol.
    - b. ethanol.
    - c. glycerol.
    - d. ethylene glycol.
  - 7. Differentiate between phenols and methanol by using NaOH.
- Skills: Students will go to the University to learn the detection of functional groups by spectral analysis.
- Essential Questions: How can rice straw be converted from an environmental disaster to an economic value?

Textbook and Resource Materials: 8th Ed. Organic Chemistry, L.G. WADE JR. 4th Ed. Chemistry, McMURRY, FAY 2nd Ed. IB National Chemistry Book Organic Chemistry for JEE/ISEET Dr. K. S. Verma

Evidence of Learning: 5 presentations exit ticket

Capstone Connection:

Relations: BI.3.03; ()

assignment

- CH.3.17 - Study esters and will be able to prepare esters, determine their presence....[expand\\_morelink](#)

Week 13 - Week 14

Comment(s): Since there are such a wider variety of esters and since many of these are or have been important in Egyptian culture and commerce, the selection of this topic to complete the organic chemistry section is very appropriate.

Learning Outcome: Study esters and will be able to prepare esters, determine their presence. Conduct research on their industrial application.

Key Concepts:

- 1. Nomenclature according to the origin.
- 2. Preparation of aspirin.
- 3. Reactions:
  - a. acidic hydrolysis of ethyl acetate.
  - b. alkaline hydrolysis- preparation of saponification.
- 4. Application of esters in perfumes and food industry.  
Skills: Students will produce an ester in the laboratory, write the formula and structure and create a three-dimensional model of the molecules.  
Essential Questions: How are flavors, food, oils, polymers, fabrics, plastics related and what do they have to do with Egyptian industry?

Textbook and Resource Materials: 8th Ed. Organic Chemistry, L.G.WADE JR. 4th Ed. Chemistry, McMURRY, FAY 2nd Ed. IB National Chemistry Book Organic Chemistry for JEE/ISEET Dr. K. S. Verma ChemGuide - Esters <http://www.chemguide.co.uk/organicprops/esters/background.html> American Chemical Society - Flavor chemists <http://cenblog.org/just-another-electron-pusher/2011/12/flavor-chemistry-the-science-of-deliciousness/> YouTube - Aspirin synthesis <https://www.youtube.com/watch?v=Y4NMpO1xI8U> Pharmaceutical Journal - History of Aspirin Timeline <http://www.pharmaceutical-journal.com/publications/previous-issues/cp-september-2014/a-history-of-aspirin/20066661.article> Chemical Heritage Foundation - Discovery of Aspirin <http://www.chemheritage.org/discover/online-resources/chemistry-in-history/themes/pharmaceuticals/relieving-symptoms/hoffmann.aspx>

Evidence of Learning: Write a paper describing the role of esters in Egyptian industry.

Capstone Connection:

Relations:

assignment

# Geology Grade 1

## Introduction to Geology and Its Branches (2019)

- ES.1.01 - Deduce the interrelationships between the different branches of earth science...[expand\\_morelink](#)

### Week 01 - Week 01

#### Comment(s):

This is an opportunity to introduce the idea of Earth Science as a course since it is not normally taught as a separate course in Egyptian traditional schools. It underlies all of the Grand Challenges which serve as the basis for the STEM schools, so it is very important to us. In this first class the teacher can pre-assess what students have learned about the branches of Earth Science and can have a discussion which will provide an overview to the course in Grades 1, 2 and 3. This class period would just be a pre-assessment and an overview for the new students because a deep understanding of this LO can only arise out of student work in grades 1, 2, and 3.

Learning Outcome: Deduce the interrelationships between the different branches of earth science and the integration of geology within other sciences

Key Concepts: The contribution of geology to the different domains in our lives

Skills: Writing

Essential Questions: What in our lives is not geology?

Textbook and Resource Materials: What in our lives is not geology?

Evidence of Learning: Concept map showing different geology branches and how they are related

Capstone Connection: Geology impacts dwelling designs; understand the impact of geology and the varied dwellings

Relations:

SEC Topic & Code: HSST-ES1.01 (HSST-ES1.01)

[assignment](#)

## Earth Materials (2019)

- ES.1.02 - Examine common minerals and identify them and differentiate them from other...[expand\\_morelink](#)

## Week 01 - Week 04

### Comment(s):

The LO was modified to refer to student abilities rather than to instructional practices. Although crystal systems are present in every geology textbook, they are not appropriately treated at the high school level and they are not relevant to Grand Challenges.

Learning Outcome: Examine common minerals and identify them and differentiate them from other common minerals.

### Key Concepts:

- 1. Minerals are homogeneous solid earth materials.
- 2. Minerals have distinct physical properties that enable them to be distinguished from one another.
- 3. For most common minerals, the most useful properties for hand sample identification include hardness, cleavage or fracture patterns, translucency, and color.
- 4. Metallic minerals are uncommon, but economically important.
- 5. For metallic minerals, the additional properties of streak and magnetism are useful for hand sample identification.
- 6. Completely unambiguous identification of minerals often requires sophisticated laboratory analysis.
- 7. Some construction materials are highly refined from the original Earth material, while others are used in the original state.

Skills: Writing

Essential Questions: What are the rocks I see around me made of?

Textbook and Resource Materials: What are the rocks I see around me made of?

Evidence of Learning: Students can reliably identify quartz, calcite, feldspar, mica, amphibole, pyroxene, olivine and clay in rock samples as well as in laboratory mineral samples. Students can reliably identify magnetite, pyrite, hematite, chalcopryite, and native copper and sulfur in laboratory mineral specimens. Students produce and use a reliable and accurate dichotomous key for identifying these minerals.

Capstone Connection: Knowledge of properties of building materials will be helpful in the design of a building

Relations: CH.1.02; CH.1.09; CH.1.12; CH.1.13; PH.1.01; PH.1.09; ME.1.03  
MA.1.03; BI.1.02

SEC Topic & Code: HSST-ES.1.02 (HSST-ES.1.02)

[assignment](#)

Egyptian Building Materials (2019)

- ES.1.03 - Analyze and identify the earth materials that are used as a resource for...[expand\\_morelink](#)

## Week 05 - Week 05

Comment(s):

Learning Outcome: Analyze and identify the earth materials that are used as a resource for modern building and integrate design criteria and material properties in choosing materials for engineering design.

Key Concepts: Different Earth materials and different manufactured materials have different engineering properties, such as their behavior under stress, making them suitable for different uses in construction.

Skills: Vocabulary Structure

Essential Questions: How can we use earth materials effectively and efficiently in building construction?

Textbook and Resource Materials: How can we use earth materials effectively and efficiently in building construction?

Evidence of Learning: -Clearly identify the benefits and drawbacks of a variety of different construction materials for use in Egypt. -Make and defend a proposal for building materials to be used in safe, energy-efficient, cost-efficient housing development in Egypt. -Identify differences in building materials that might be necessary in coastal versus interior locations in Egypt.

Capstone Connection: Connects to question of building energy efficient structure

Relations:

SEC Topic & Code: HSST-ES.1.02 (HSST-ES.1.02)

[assignment](#)

## Earth Materials (part 2) (2019)

- ES.1.04 - Examine and interpret the textural and compositional characteristics of...[expand\\_morelink](#)

## Week 06 - Week 08

Comment(s):

Learning Outcome: Examine and interpret the textural and compositional characteristics of igneous rocks and interpret igneous rock textures and mineral composition.

Key Concepts:

- 1. Rocks are heterogeneous mixtures of minerals and (rarely) other earth materials.
- 2. Igneous rocks cooled from melts are found in association with volcanoes and also as rocks that cooled underground.
- 3. Different cooling histories produce different igneous textures.
- 4. Differences in magma composition and eruption location create differences in eruption explosivity that affect volcanic rock textures.

Skills: Vocabulary Structure

Essential Questions: What role does Geology play in meeting Egypt's Grand Challenges?

Textbook and Resource Materials: What role does Geology play in meeting Egypt's Grand Challenges?

Evidence of Learning: Successfully differentiate between intrusive and volcanic rocks in hand samples or in outcrops. Successfully interpret cooling history from a hand specimen or outcrop observations. Successfully identify and differentiate granite, diorite, gabbro, and peridotite in hand specimens. Successfully identify rhyolite, andesite, and basalt based on silica composition. Successfully interpret eruption explosivity from igneous rock hand sample or silica composition. Successfully locate igneous rocks on a geologic map of Egypt.

Capstone Connection: Knowledge of the properties of rock types will help making decisions about building materials

Relations: CH.1.02; CH.1.05; CH.1.09; PH.1.01; PH.1.09; MA.1.03

SEC Topic & Code: HSST-ES.1.02 (HSST-ES.1.02)

[assignment](#)

- ES.1.05 - Examine and interpret the textural and compositional characteristics of...[expand\\_morelink](#)

Week 09 - Week 10

Comment(s):

Learning Outcome: Examine and interpret the textural and compositional characteristics of sedimentary rocks and interpret sedimentary rock textures, mineral composition and depositional environments.

Key Concepts:

- 1. Sedimentary rocks that accumulate from particles can be formed in a wide range of environments on Earth's surface.
- 2. Some sedimentary rocks form from particles of older rocks that are removed from their original location and deposited in a new one.
- 3. The environment of deposition and the source material both contribute to differences in texture and composition among these sedimentary rocks.
- 4. Some sedimentary rocks are made of particles from once living organisms.

- 5. The types of organisms determine much about the texture and mineral composition of such rocks. Such rocks are often only deposited under special conditions.
- 6. Sedimentary rocks often contain pore spaces that make them important reservoirs of fluids in the upper part of Earth's crust.
- 7. Sedimentary rocks sometimes contain organic material that may become part of Earth's energy resources.
- 8. Limestone and cement materials derived from limestone are essential Egyptian building resources due both to their abundance and to the lack of alternative building materials.

Skills: 1. Identifying and differentiating sedimentary rocks. 2. Using hand specimen and microscopic scale features to classify different types of sedimentary rocks. 3. Using sedimentary textures to interpret depositional environment. 4. Interpreting geological maps that describe the geology of Egypt.

Essential Questions: What is the history told by sedimentary rocks in Egypt?

Textbook and Resource Materials: What is the history told by sedimentary rocks in Egypt?

Evidence of Learning: A) Successfully identifying and differentiating among conglomerate, sandstone, siltstone, shale, limestone, and chert in hand specimens and outcrops. B) Successfully interpreting the depositional environment of sedimentary rocks from evidence in hand specimens or outcrops C) Successfully locating sedimentary rocks on a geologic map of Egypt

Capstone Connection: building materials

Relations: CH.1.02; CH.1.05; CH.1.09; PH.1.01; PH.1.09; ME.1.03

SEC Topic & Code: HSST-ES.1.02 (HSST-ES.1.02)

### [assignment](#)

- ES.1.06 - Examine and interpret the textural and compositional characteristics of...[expand\\_morelink](#)

Week 11 - Week 12

Comment(s):

Learning Outcome: Examine and interpret the textural and compositional characteristics of metamorphic rocks and interpret textures and factors that affect metamorphic processes.

Key Concepts:

- 1. Changes in temperature, pressure, or composition in Earth's subsurface can change the texture and mineral composition of pre-existing rocks, creating metamorphic rocks.
- 2. Deformation during metamorphism produces foliated textures and may destroy original textures.
- 3. Deformation (change in shape) and stresses (distribution of forces) are related, but maximum deformation and maximum stress are not always parallel.



- 4. The metamorphic texture and mineralogy observed in metamorphic rocks are most commonly related to the conditions when the rock experienced its maximum temperature.  
Skills: 1. Identifying and differentiating slate, phyllite, schist, gneiss, hornfels, marble, and quartzite in hand specimens and outcrops according to texture and mineral composition. 2. Using microscopic scale features to interpret and classify different types of metamorphic rocks. 3. Using metamorphic rock texture to infer the presence or absence of deformation at the time of metamorphism 4. Interpreting geological maps that describe the geology of Egypt.  
Essential Questions: What do metamorphic rocks reveal about the geologic history of Egypt?

Textbook and Resource Materials: What do metamorphic rocks reveal about the geologic history of Egypt?

Evidence of Learning: A) Successfully identify and differentiate among slate, phyllite, schist, gneiss, hornfels, marble, or quartzite in hand specimen and outcrop. B) Successfully identify the presence of foliation in hand sample and interpret foliation as a product of deformation. C) Successfully locate metamorphic rocks on a geologic map of Egypt.

Capstone Connection: Building materials

Relations: CH.1.02; CH.1.05; CH.1.09; PH.1.01; PH.1.09

SEC Topic & Code: HSST-ES.1.02 (HSST-ES.1.02)

### [assignment](#)

- ES.1.07 - Interpret the relationships among sedimentary, igneous, and metamorphic rocks...[expand\\_morelink](#)

Week 13 - Week 14

Comment(s):

Learning Outcome: Interpret the relationships among sedimentary, igneous, and metamorphic rocks in terms of Earth processes and the rock cycle and use their understanding of the rock cycle to explain the Egyptian cross section.

Key Concepts:

- 1. The rock cycle is a group of processes that act on the different types of rocks and change rocks from one form to another over geologic time.
- 2. Rock composition and texture provides evidence that can be interpreted to yield a geologic history.
- 3. Most of the current surface rocks of Egypt record sedimentary deposition, but there is also evidence of igneous and metamorphic processes in the past.  
Skills: 1. Interpreting rock types and textures in terms of the rock cycle. 2. Integrating interpretations of process into a geologic history. 3. Interpreting cross sections to study the age relationships of different rock units. 4. Interpreting different geological maps that show outcrops of different rocks of Egypt.

Essential Questions: What is the geologic history of Egypt and surrounding areas?

Textbook and Resource Materials: What is the geologic history of Egypt and surrounding areas?

Evidence of Learning: Successfully identify rock cycle processes from hand specimens, outcrops, or geologic map or cross section evidence. Successfully interpret cross sections or maps to infer a geologic history. Successfully identify important rock cycle processes in the geologic history of Egypt. Successfully identify modern examples of rock cycle processes in Egypt.

Capstone Connection: Apply understanding of the rock cycle to enable identifying a location for the dwelling and building materials

Relations: BI.1.13

SEC Topic & Code: HSST-ES.1.02 (HSST-ES.1.02)

[assignment](#)

Earth's Natural Resources - Energy (2019)

## folder

- ES.1.08 - Analyze and identify common ore minerals that are used as a resource for...[expand\\_morelink](#)

Week 01 - Week 02

Comment(s):

Learning Outcome: Analyze and identify common ore minerals that are used as a resource for modern industries.

Key Concepts:

- 1. Different earth materials and ore minerals have different chemical, physical and engineering properties making them suitable for different economic industries.
- 2. Common ore minerals include both relatively oxidized ( some oxides, hydroxides, carbonates) and relatively reduced (some oxides, sulfides) compounds of metals as well as native elements.
- 3. Ore minerals must become concentrated by some geologic process to produce an economic mineral deposit. Igneous, sedimentary, and metamorphic processes can all produce ore deposits.
- 4. Modern electronics technologies require new materials, such as rare earth elements, that must also be extracted from earth materials, creating new ores and new industries.

Skills: 1. Identify and discriminate among common Fe-ores (magnetite, hematite, pyrite), common Cu-ores (chalcopyrite, malachite, native Cu), Pb-ores (sphalerite, galena), and precious metals (native Au and native Ag) as well as other important Egyptian ore minerals. 2. Interpret geologic processes from textural evidence in ore deposit hand samples or outcrops. 3. Identify and use different tools to measure physical properties of minerals. 4. Using microscopic scale features to interpret and classify different types of ore minerals. 5. Use different geologic maps that show occurrences of ore minerals in Egypt.

Essential Questions: What is the relationship between ore minerals and Egyptian history?

Textbook and Resource Materials: What is the relationship between ore minerals and Egyptian history?

Evidence of Learning: Successfully identify and differentiate common ore minerals in hand samples. Successfully connect different types of metals and their ores to different uses (e.g. Cu for piping in construction and for wires in electronics and consumer goods, Fe in automobiles, construction, appliances, etc) Know and describe important historical and modern ore deposits in Egypt. Know and describe important global sources of commonly used metal ores (e.g Cu from Chile and western US, rare earth elements from China, etc.)

Capstone Connection: Application of knowledge and understanding the different earth materials and ore applies to possible alternative energy designs and materials to use

Relations: CH.1.11; CH.1.14; BI.1.13

SEC Topic & Code: HSST-ES.1.03 (HSST-ES.1.03)

### assignment

- ES.1.09 - Compare and contrast the different resources used by different countries to...[expand\\_morelink](#)

Week 03 - Week 04

Comment(s):

Learning Outcome: Compare and contrast the different resources used by different countries to meet their energy needs.

Key Concepts: Electrical energy and transportation fuels come from a variety of natural resources.

Skills: 1. Use the statistical studies to analyze the data for different energy resources in Egypt and calculate the future needs as a function of the exponential growth of population. 2. Compare the use of energy resources for electricity generation in Egypt to those used in other countries using different statistical charts and visualization figures. 3. Students will conduct an analysis of the socioeconomic and environmental impacts of the Aswan High Dam and explore the potential of tidal generation. 4. Arrange the energy resources according to different factors (current and future availability, current and future needs, cost of production..., etc.).

Essential Questions: What are energy resources?

Textbook and Resource Materials: What are energy resources?

Evidence of Learning: Describe different energy resources available in Egypt

Capstone Connection: This relates directly to the Capstone which is about designing alternative energy systems.

Relations: MA.1.08; MA.1.01; BI.1.14

SEC Topic & Code: HSST-ES.1.03 (HSST-ES.1.03)

### assignment

- ES.1.10 - Evaluate potential renewable energy sources in Egypt to replace dependence...[expand\\_morelink](#)

Week 05 - Week 06

Comment(s):

Learning Outcome: Evaluate potential renewable energy sources in Egypt to replace dependence upon fossil fuels.

Key Concepts:

- 1. Electrical energy and transportation fuels come from a variety of natural resources.
- 2. Directly capturing the sun's energy through solar panels or wind energy through turbines, is a renewable way to provide heat, hot water, and electricity.
- 3. Electrical energy could be generated by hydroelectric - from dams or by tidal movement of water.

Skills: 1. Investigate the use of solar energy by constructing a solar water heater and determining its maximum energy output. 2. Investigate the use of wind energy by constructing an anemometer to measure wind speeds and calculating how much power can be generated by wind.

Essential Questions: What resources could be developed in Egypt to provide more sources of energy?

Textbook and Resource Materials: What resources could be developed in Egypt to provide more sources of energy?

Evidence of Learning: The efficiency of the solar water heater The precision of measurement of the anemometer and calculations of wind generated power

Capstone Connection: This relates directly to the Capstone which is about designing alternative energy systems.

Relations: CH.1.05; PH.1.10

SEC Topic & Code: HSST-ES1.03 (HSST-ES1.03)

### assignment

- ES.1.11 - Recognize the processes by which fossil fuels (coal) are extracted and...[expand\\_morelink](#)

Week 07 - Week 08

Comment(s):

Learning Outcome: Recognize the processes by which fossil fuels (coal) are extracted and processed for human use.

Key Concepts:

- 1. Coal is a source of trapped energy from the sun, accessible by mining, with extensive reserves.
  - 2. Reserves of coal are limited and are distributed in unequal ways, geographically.
  - 3. Impact of the use of coal on the environment
- Skills: 1. Examine coal samples to understand the physical properties of different types of coal. 2. Read and interpret different maps that show the distribution of coal in Egypt. 3. Use data on trends of different fossil fuels production and consumption to extrapolate into the future.
- Essential Questions: How does nature store energy?

Textbook and Resource Materials: How does nature store energy?

Evidence of Learning: Understanding and Applying questions

Capstone Connection: Apply knowledge and information to alternative energy  
Capstone Challenge

Relations: MA.1.08

SEC Topic & Code: HSST-ES.1.03 (HSST-ES.1.03)

### assignment

- ES.1.12 - Recognize the processes by which fossil fuels (petroleum and natural gas) are...[expand\\_morelink](#)

Week 09 - Week 10

Comment(s):

Learning Outcome: Recognize the processes by which fossil fuels (petroleum and natural gas) are extracted and processed for human use.

Key Concepts:

- 1. Petroleum and natural gas are fluid resources that accumulate in natural reservoirs and can be extracted by drilling.
- 2. Reserves of petroleum and natural gas are limited and are distributed in unequal ways, geographically.

Skills: 1. Examine Petroleum samples to understand the chemical and physical properties of different types of Petroleum. 2. Read and interpret different maps that show the distribution of fossil fuels (Petroleum and Natural gas) in Egypt. 3. Design investigations to explore the porosity and permeability of rock bodies and to consider how these factors affect the volume and rate of production in oil and gas fields. 4. Use data on trends in different fossil fuels production and consumption to extrapolate into the future. 5. Explore new methods to decrease significantly our dependence on the use of fossil fuels.

Essential Questions: How does nature store energy?

Textbook and Resource Materials: How does nature store energy?

Evidence of Learning: Understanding and Applying questions

Capstone Connection: Apply knowledge and information to alternative energy  
Capstone Challenge

Relations: MA.1.08

SEC Topic & Code: HSST-ES.1.03 (HSST-ES.1.03)

[assignment](#)

- ES.1.13 - Evaluate environmental impacts of fossil fuel resource use and suggest...[expand\\_morelink](#)

Week 11 - Week 12

Comment(s):

Learning Outcome: Evaluate environmental impacts of fossil fuel resource use and suggest innovative alternatives.

Key Concepts: Burning fossil fuels to extract energy has a number of environmental effects one of which is acid rain

Skills: 1. Examine maps that show the acidity of rainfall across Egypt and correlate the pattern of rainwater pH to the distribution of fossil fuel producing and consuming regions. 2. Examine the effect of the acidity of water on different rock units. 3. Explore new methods to decrease significantly the environmental impact as a result of using the fossil fuel.

Essential Questions: What is pollution?

Textbook and Resource Materials: What is pollution?

Evidence of Learning: Analysis questions

Capstone Connection: Apply knowledge and information to alternative energy Capstone Challenge

Relations:

SEC Topic & Code: HSST-ES.1.03 (HSST-ES.1.03)

[assignment](#)

## Geology Grade 2

Water (2019)

- ES.2.01 - Analyze how the unusual properties of water contribute to its pathways...[expand\\_morelink](#)

Week 01 - Week 02

Comment(s):

Learning Outcome: Analyze how the unusual properties of water contribute to its pathways through earth's systems.

Key Concepts:

- 1. The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics.
- 2. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.
- 3. The oceans contain 97 percent of Earth's water. This means that only three percent of Earth's water is fresh water. Fresh water is an important resource for many purposes. Most fresh water is locked up and frozen in ice caps and glaciers at high latitudes and altitudes.

Skills: 1. Measure and calculate different physical properties of water 2. Use models to understand how water is distributed in various reservoirs on Earth. 3. Set up a simple experiment to model the flow of surface and underground water between reservoirs. 4. Measure, calculate and manage the water supply in an area and represent the data using tables, graphs and 3D diagrams 5. Students will analyze how different environmental changes would impact the water cycle and availability of water in Egypt.

Essential Questions: How does water determine the nature of Earth?

Textbook and Resource Materials: How does water determine the nature of Earth?

Evidence of Learning: -Students will be able to diagram the water cycle, explain the different parts of it and factors that affect it. Student will conduct and interpret experiments modelling water flow Student will create a water supply management plan (simplified) that demonstrated their understanding of sources and sinks for fresh water

Capstone Connection: This directly informs and connects the Capstone which is about water, its chemical and physical properties, and the challenge of how to supply clean water to communities. Apply knowledge and information to the Capstone Challenge of making potable water

Relations: MA.1.01; PH.1.03; PH.1.06; CH.1.01

SEC Topic & Code: HSST-ES.2.01 (HSST-ES.2.01)



## [assignment](#)

- ES.2.02 - Model factors which affect water reservoirs and associated costs.  
expand\_morelink

Week 03 - Week 04

Comment(s):

Learning Outcome: Model factors which affect water reservoirs and associated costs.

Key Concepts: Water is a vital earth resource that flows through the Earth system and can be stored in natural or human constructed reservoirs, either on the surface, or as groundwater.

Skills: 1. Model factors which affect water stored on the surface and in groundwater reservoirs. 2. Collect data about the water use different areas, compare them and measure domestic water use. 3. Determine the amount of water used for different purposes (industry, irrigation, drinking...). 4. Collect and interpret water analysis data for different surface and subsurface samples

Essential Questions: How does water determine the nature of communities?

Textbook and Resource Materials: How does water determine the nature of communities?

Evidence of Learning: Students will prepare a PowerPoint Presentation with an analysis of fresh water resources in Egypt and their uses.

Capstone Connection: Apply knowledge and information to the Capstone Challenge of making potable water

Relations: BI.1.03

SEC Topic & Code: HSST-ES.2.01 (HSST-ES.2.01)

## [assignment](#)

- ES.2.03 - Investigate human and natural factors that control water resources  
and...expand\_morelink

Week 05 - Week 05

Comment(s):

Learning Outcome: Investigate human and natural factors that control water resources and options for water conservation.

### Key Concepts:

- 1. Many processes transfer water between stores.
- 2. Most water supplies are withdrawn from either surface water or groundwater.
- 3. Water management methods attempt to distribute freshwater resources more evenly through the use of dams, aqueducts, and wells.

Skills: Use the collected and available data sets to explore different methods to conserve water.

Essential Questions: How does the availability of fresh water impact local areas?

Textbook and Resource Materials: How does the availability of fresh water impact local areas?

Evidence of Learning: Students will describe a way to conserve water and will explain what factors need to be put into place in order for this method to work

Capstone Connection: Apply knowledge and information to the Capstone Challenge of making potable water

Relations: CH.1.01

### [assignment](#)

- ES.2.04 - Create innovative methods to supply fresh water to areas of Egypt by applying...[expand\\_morelink](#)

### Week 06 - Week 07

#### Comment(s):

This is in direct alignment with the Capstones and occurs early enough in the semester to genuinely support students in their Capstone work!

Learning Outcome: Create innovative methods to supply fresh water to areas of Egypt by applying the knowledge of the movement of pollutants in to aquifer and water treatment methods.

### Key Concepts:

- 1. Pollutants released into the environment can contaminate both surface water and groundwater supplies.
- 2. Surface water generally has more varied pollutants.
- 3. Many kinds of substances can pollute water. Most of these fall into one of two categories: organic or inorganic.
- 4. Evaporation, condensation and bacterial activities are naturally occurring processes of water purification.
- 5. Waste water treatment involves a series of steps which can vary by locality.

Skills: 1. Investigate the vulnerability of water resources to pollution by both human use and natural cycles or processes. 2. Construct models of water-treatment processes. 3. Construct a groundwater model to infer how pollutants reach the groundwater table and move with groundwater flow. 4. Investigate how extracting water from a groundwater well influences the movement of pollution in groundwater.

Essential Questions: How can water pollution problems be solved in Egypt?

Textbook and Resource Materials: How can water pollution problems be solved in Egypt?

Evidence of Learning: Students will describe a variety of ways of controlling water pollutants.

Capstone Connection: Apply knowledge and information to the Capstone Challenge of making potable water

Relations: CH.1.02; BI.1.03

SEC Topic & Code: HSST-ES.2.01 (HSST-ES.2.01)

[assignment](#)

Surface Processes (2019)

- ES.2.05 - Interpret topographic maps of river systems to create a definition of a...[expand\\_more](#)link

Week 08 - Week 09

Comment(s):

I removed Section 1 Chap 4 from resources because it was used for Learning Outcome 2.01. Students will know the water cycle at this point so focused on the stream system.

Learning Outcome: Interpret topographic maps of river systems to create a definition of a drainage basin.

Key Concepts:

- 1. A river system is a network of streams. River systems are important in the hydrologic cycle.
  - 2. River systems are made up of different parts with differing forms and functions.
  - 3. Regionally these local stream networks create a drainage basin.
- Skills: 1. Identify factors affecting stream drainage which lead to landforms 2. Make inferences using topographic maps and satellite images 3. Identify how the form of a part of the river system aligns with its function (structure and function within systems)
- Essential Questions: How does water interact with landforms?

Textbook and Resource Materials: How does water interact with landforms?

Evidence of Learning: Students will create their own definition of a drainage basin Students will identify a drainage basin and drainage divides on a topographic map Students will predict the effect of slope of rivers on river velocity and on landforms and explain their reasoning.

Capstone Connection: Apply knowledge and information to the Capstone Challenge of making potable water

Relations:

SEC Topic & Code: HSST-ES.2.02 (HSST-ES.2.02)

[assignment](#)

- ES.2.06 - Infer how the features of a river system in Egypt has affected the lives of...[expand\\_morelink](#)

Week 10 - Week 11

Comment(s):

This learning outcome was broadened to serve as closure for the river system section.

Learning Outcome: Infer how the features of a river system in Egypt has affected the lives of local residents.

Key Concepts:

- 1. Rivers are most effective in causing erosion and deposition of land.
  - 2. High and Low gradient streams have very different features.
- Skills: 1. Calculate and measure the slope of a river and its effect on water velocity. 2. Interpret the effect of river velocity on the shape and size of sediments. 3. Construct a model of a high gradient stream. 4. Identify and interpret stream channel forms and features on a topographic map, aerial photograph, or satellite image.
- Essential Questions: What affects river flow change and how does that affect communities?

Textbook and Resource Materials: What affects river flow change and how does that affect communities?

Evidence of Learning: Students will identify and explain the difference between sediments according to their sizes. Quality of stream model that was created.

Capstone Connection: Apply knowledge and information to the Capstone Challenge of making potable water

Relations: ME.1.03

SEC Topic & Code: HSST-ES.2.02 (HSST-ES.2.02)

[assignment](#)

- ES.2.07 - Explore factors which affect the movement and deposition of loose sediments...[expand\\_morelink](#)

Week 11 - Week 12

Comment(s):

This is an important opportunity for students to create their own experiments and engage in experimental design.

Learning Outcome: Explore factors which affect the movement and deposition of loose sediments by wind.

Key Concepts:

- 1. Wind is one of the major factors that creates the physical properties of land forms and human-made features.
- 2. Particle size and wind speed are related.
- 3. Several factors affect wind erosion and sediment deposition.

Skills: 1. Interpret the effect of wind on rocks and loose sediments. 2. Recognize the deposition effect of wind. 3. Create an experiment using good experimental design techniques.

Essential Questions: What is the role of wind-blown materials in the geology and environment of Egypt?

Textbook and Resource Materials: What is the role of wind-blown materials in the geology and environment of Egypt?

Evidence of Learning: Describe the role of wind in erosion and deposition and relate to development in arid areas.

Capstone Connection:

Relations: ME.1.04

SEC Topic & Code: HSST-ES.2.02 (HSST-ES.2.02)

[assignment](#)

- ES.2.08 - Identify and explain the basic physical properties of soils by recognizing...[expand\\_morelink](#)

Week 13 - Week 14

Comment(s):

Naming the many different types of soils would be overly complex for a high school student to learn in two classes. They will be better served by learning the three main components of soils (rock fragments, clays, and organic matter) and the idea that soil properties are controlled by the relative amounts of those three components. This is also an excellent opportunity to explore compost and relate geologic materials and processes to biological materials and processes of decomposition –

Learning Outcome: Identify and explain the basic physical properties of soils by recognizing the major components of it.

Key Concepts:

- 1. Soils are the last product of different erosional and depositional factors
- 2. Soils generally contain rock and mineral fragments, clays, and organic matter in varying proportions
- 3. The proportions of these components determine many of the physical properties of soils
- 4. In arid regions, the interplay of precipitation and evaporation can create special soil conditions (i.e. caliche, salinized soil).

Skills: 1. Identify different components of soil 2. Identify basic properties of soil and the relationship of those properties to the proportion of soil components.

Essential Questions: Where does soil come from and what is the importance of soil in our lives?

Textbook and Resource Materials: Where does soil come from and what is the importance of soil in our lives?

Evidence of Learning: In groups students will prepare an information brochure explaining the value of soil and the need to protect soil in Egypt.

Capstone Connection: Apply knowledge and information to the Capstone Challenge of making potable water

Relations: ME.1.03

SEC Topic & Code: HSST-ES.2.02 (HSST-ES.2.02)

[assignment](#)

Earth System Evolution (2019)

## folder

- ES.2.09 - Explain the geologic development of the earth's crust, especially the...[expand\\_morelink](#)

Week 01 - Week 02 add 1 week

Comment(s):

Learning Outcome: Explain the geologic development of the earth's crust, especially the continental crust of Africa and the Middle East.

Key Concepts:

- 1. The evolution of Earth's spheres is a story of mega-scale systems that depend on one another.
- 2. Systems thinking provides a good approach is to apply systems thinking to different stages in the planet's evolution.

- 3. The geosphere, atmosphere, hydrosphere, and biosphere have been interacting for billions of years.
- 4. Earth began as a molten mass of rock and dissolved gases. The history of Earth, after it's early assembly and melting, is one marked by progressive chemical segregation and distillation of solid, Liquid, and gaseous components.
- 5. The young Earth formed as a proto-planet. At that time it was a much simpler system than it is today; however, Its mass was large enough for gravity to hold an atmosphere with certain gases to its surface.
- 6. The magnetic field of the earth created by the inner and outer cores is strong enough to deflect the solar wind. Without this shield, Earth's atmosphere would be slowly eroded and lost into space.

Skills: 1. Examine and interpret the maps of Earth's geologic provinces and their ages. 2. Apply the definitions and concepts to determine different geologic provinces of the North African belt, and other regions of the planet. 3. Draw maps and cross sections and construct models that describe the geological evolution of Egypt. 4. Use different geologic evidences (surface and subsurface), cross sections and maps to interpret and recognize the geologic history of Egypt.

Essential Questions: How have Earth's land, water, and air changed over time?

Textbook and Resource Materials: How have Earth's land, water, and air changed over time?

Evidence of Learning: Students will describe current thinking on the origins of the geosphere, hydrosphere, and atmosphere. Students will illustrate the geologic history of Egypt and northern Africa with maps and cross sections

Capstone Connection:

Relations: PH.1.10; ME.1.06; BI.1.08; BI.1.10

SEC Topic & Code: HSST-ES.2.03 (HSST-ES.2.03)

### assignment

- ES.2.10 - Explain the evolution of Earth's fluid spheres and their changes...[expand\\_morelink](#)

Week 03 - Week 04

Comment(s):

Learning Outcome: Explain the evolution of Earth's fluid spheres and their changes geographically through the geologic time.

Key Concepts:

- 1. The process of outgassing from Earth's cooling interior created a primitive atmosphere with a reducing composition that was completely different than today.
- 2. The evolution of photosynthetic life caused a dramatic shift in air and water chemistry, leading to our present, oxidizing world.
- 3. Surface temperatures on Earth are just right for water to exist as a liquid. A much hotter Earth would restrict water to a vapor state. A colder planet would remain in a deep freeze.

- 4. At times in the past, Earth's atmosphere and hydrosphere have been much warmer (hothouse Earth) and at times they have been much cooler (snowball Earth), but over millions of years, feedback mechanisms have returned the temperatures to more livable ranges.  
Skills: 1. Design an experiment that collects a gas dissolved in a liquid and model the process of outgassing. 2. Examine the relation of pressure/temperature conditions to the different phases of water. 3. Interpret geologic evidence of past temperature variations.  
Essential Questions: How have Earth's water, and air changed over time?

Textbook and Resource Materials: How have Earth's water, and air changed over time?

Evidence of Learning: Students correctly describe the origin of atmosphere and hydrosphere. Students successfully design and test a demonstration model of outgassing. Students correctly describe large scale feedback mechanisms that help regulate the temperature of Earth's atmosphere and hydrosphere.

Capstone Connection:

Relations: BI.1.14

SEC Topic & Code: HSST-ES.2.03 (HSST-ES.2.03)

#### assignment

- ES.2.11 - Explain the evolution and changes in life over time on Earth and the...[expand\\_morelink](#)

Week 05 - Week 05

Comment(s):

Learning Outcome: Explain the evolution and changes in life over time on Earth and the interaction of those changes with the Earth's spheres.

Key Concepts:

- 1. Life evolved very early in Earth's history and the original life on earth involved very simple unicellular organisms.
- 2. The building blocks of life were derived from the nebular disk that formed all the planets in the solar system.  
Skills: 1. Design an experiment or build a model to explore the origin and evolution of life and its changes through geologic time. 2. Use real rock samples, fossils and pictures to interpret the origin of life on the Earth. 3. Analyze, interpret and draw conclusions using chemical data sets of rock samples.  
Essential Questions: How has life evolved and changed over time?

Textbook and Resource Materials: How has life evolved and changed over time?

Evidence of Learning: Students will be able to describe the origin of biosphere and its relation with atmosphere.



Capstone Connection:

Relations:

SEC Topic & Code: HSST-ES.06.03 (HSST-ES.06.03)

[assignment](#)

- ES.2.12 - Apply different methods and principles of relative and absolute age dating of...[expand\\_morelink](#)

Week 06 - Week 07

Comment(s):

Learning Outcome: Apply different methods and principles of relative and absolute age dating of different rock units and geologic formations to explain geologic history.

Key Concepts: A variety of lines of evidence point to an age for Earth of  $4.6 \times 10^9$  years.

Skills: 1. Calculate the absolute ages of different rock samples using equations and given data. 2. Explore the Laws of relative age dating. 3. Solve the problems of relative and absolute age dating. Interpret the geological models and cross sections in order to relative and absolute dates of processes and formations. 4. Arrange the geologic events and rock units according to their relative ages by applying some geological principles and keys

Essential Questions: How has Earth's life changed over time?

Textbook and Resource Materials: How has Earth's life changed over time?

Evidence of Learning: Students will construct a geologic timescale.

Capstone Connection:

Relations:

SEC Topic & Code: HSST-ES.06.04 (HSST-ES.06.04)

[assignment](#)

- ES.2.13 - Analyze the development and structure of the Geological Time Scale.  
[expand\\_morelink](#)

Week 08 - Week 09

Comment(s):

Learning Outcome: Analyze the development and structure of the Geological Time Scale.

Key Concepts: Geologic time is subdivided into Eras and Periods (and many smaller subdivisions; for this course, those subdivisions should not be taught, except for the Epochs of the Tertiary, which are directly relevant to Egyptian geology) by the appearance or disappearance of major groups of living organisms. Thus, the boundaries between Periods or Eras represent major events in the history of Earth and life.

Skills: Create simplified models of the geologic time scale using major events that have occurred through geologic time.

Essential Questions: How has Earth's life changed over time?

Textbook and Resource Materials: How has Earth's life changed over time?

Evidence of Learning: Students will be able to identify the biggest events in the history of life on earth, those that define Eons, and Eras (i.e Cambrian explosion, dinosaur extinction, etc.) Students will describe the difference between Eon, Eras, Periods and Epochs. Students will correctly place the rocks of Egypt onto a geologic time scale.

Capstone Connection:

Relations:

SEC Topic & Code: HSST-ES.06.05 (HSST-ES.06.05)

#### assignment

- ES.2.14 - Use fossil evidence to understand changes in the environment of Egypt over...[expand\\_morelink](#)

Week 10 - Week 11 decrease 1 week

Comment(s):

Learning Outcome: Use fossil evidence to understand changes in the environment of Egypt over time as well as changes in the nature of life over time.

Key Concepts:

- 1. Remnants of ancient life are preserved in sedimentary rocks (and sometimes metamorphic rocks) as fossils.
  - 2. Fossilization and types of fossils.
  - 3. Fossils and other lines of evidence show that life on earth has evolved over time, with existing organisms undergoing changes that cause the branching of new species.
- Skills: 1. Collect different types of fossils and rock samples to use them to interpret

the paleoenvironmental conditions of an area 2. Organize a fossil collection by geologic Period

Essential Questions: What can we learn from fossils?

Textbook and Resource Materials: What can we learn from fossils?

Evidence of Learning: Students will describe fossil as an evidence of evolution. Students will collect and curate fossils and interpret geologic history from those fossils (If field trips are not possible, teachers should supply samples and a map of locations)

Capstone Connection:

Relations: BI.1.10

SEC Topic & Code: HSST-ES.06.05 (HSST-ES.06.05)

### assignment

- ES.2.15 - Investigate the lines of evidence and hypotheses about the K-T boundary...[expand\\_morelink](#)

Week 12 - Week 12

Comment(s):

Learning Outcome: Investigate the lines of evidence and hypotheses about the K-T boundary extinction and understand the global implication of an asteroid impact (including a K-T boundary section at Wadi Qena).

Key Concepts:

- 1. Several major changes in Earth's climate have affected organisms throughout geologic time. Severe ecological disruptions alter the history of life, resulting in extinction followed by the evolution and appearance of new organisms.
- 2. As new species appear and old species go extinct, the forms of life on Earth change, sometime slowly and subtly, sometimes rapidly and dramatically. The newly evolved organisms develop similar body features that allow them to use the same resources as those organisms that became extinct.
- 3. There is a significant relationship between the physical environmental factors in different places on Earth's surface and the communities of organisms that live on the earth.

Skills: 1. Use the Internet to collect data about the paleoclimate before and after the Mesozoic–Cenozoic boundary event. 2. Apply the fossil evidences to understand how climate change can cause extinctions. 3. Compare photographs of skulls of organisms from before and after the boundary event to seek clues about which species survive. 4. Collect, analyze and interpret data of the K-T boundary in Egypt. Essential Questions: How has Earth been impacted by asteroids and meteors?

Textbook and Resource Materials: How has Earth been impacted by asteroids and meteors?

Evidence of Learning: Students will write an essay which uses fossil evidence to discuss extinction and evolution.

Capstone Connection:

Relations: BI 1.010

SEC Topic & Code: (THERE IS NO CODE)

[assignment](#)

# Geology Grade 3

Plate Tectonics (2019)

## folder

- ES.3.01 - Show understanding of the link between volcanoes and earthquakes and the...[expand\\_morelink](#)

Week 01 - Week 02

Comment(s):

Learning Outcome: Show understanding of the link between volcanoes and earthquakes and the theory of plate tectonics by using earthquake and volcano data to draw plate boundaries.

Key Concepts:

- 1. Description of the interior structure of Earth.
- 2. The geographical distribution of volcanoes and earthquakes form patterns that coincide with some continents' boundaries, with some other patterns aligned along the middle areas of oceans.
- 3. Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.

Skills: 1. Trace and construct maps of volcanoes and earthquakes using USGS data and satellite images. 2. Use maps to examine and describe the distribution of volcanoes and earthquakes at global, regional, and local scales. 3. Interpret patterns of volcanoes and earthquakes in terms of plate tectonic theory.

Essential Questions: How do plate motions and interactions shape the landscape and geology of Egypt? What are the controlling and driving forces of volcanoes, Earthquakes and plate motions?

Textbook and Resource Materials: How do plate motions and interactions shape the landscape and geology of Egypt? What are the controlling and driving forces of volcanoes, Earthquakes and plate motions?

Evidence of Learning: Students can identify and interpret map patterns of volcanism and seismicity in terms of interactions between tectonic plates. Students can predict relative risk of earthquakes and volcanic eruptions based on plate tectonic setting.

Capstone Connection: Students could be asked to design a plan to communicate the tectonics of Egypt to the public.

Relations:

SEC Topic & Code: HSST-ES.3.01 (HSST-ES.3.01)

[assignment](#)

- ES.3.02 - Analyze data sets that provide evidence for plate motions, including GPS...[expand\\_morelink](#)

Week 03 - Week 03

Comment(s):

Learning Outcome: Analyze data sets that provide evidence for plate motions, including GPS data.

Key Concepts:

- 1. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of mantle's materials.
  - 2. The plates are moving continuously in different average rates and directions, those movements can be tracked by the Earth-observing satellites.
- Skills: 1. Use a Global Positioning System (GPS) device to collect geographic coordinate data and track students' own movements. 2. Use the data from (GPS) satellites to determine the direction and rate of motion of the African Plate and represent the results on maps and graphs. 3. Determine the average direction of movement of different plates based on the analysis and interpretation of graphically represented and/or mapped data
- Essential Questions: Are the plates moving? What are the evidence for their movement?

Textbook and Resource Materials: Are the plates moving? What are the evidence for their movement?

Evidence of Learning: Successful use of (GPS) device to collect reliable location data. Successful mapping and interpretation of GPS data showing movement

Capstone Connection: Communications

Relations:

SEC Topic & Code: HSST-ES.3.01 (HSST-ES.3.01)

[assignment](#)

- ES.3.03 - Identify the causes of the movement of lithospheric plates.  
[expand\\_morelink](#)

Week 04 - Week 05

Comment(s):

I revised skills to reflect outcomes rather than instructional strategies

Learning Outcome: Identify the causes of the movement of lithospheric plates.

### Key Concepts:

- 1. The convection currents produced by the magma circulation in the upper mantle are the main sources for forces that control the patterns of volcanism, earthquakes and plate motions.
  - 2. Temperature affects density and temperature gradients combined with gravitational and buoyant forces can lead to circulation of fluids.
- Skills: 1. Students accurately carry out laboratory procedures and measurements 2. Students can accurately determine the density of rock samples. 3. Students can construct and interpret simple dynamic models of plate tectonics. 4. Students can interpret global plate tectonic maps in terms of patterns of convection and histories of plate motions.
- Essential Questions: What is the plate tectonic setting of Egypt?

Textbook and Resource Materials: What is the plate tectonic setting of Egypt?

Evidence of Learning: Students can describe and interpret the patterns of convection currents in Earth's mantle Students can interpret the role of convection in plate tectonics Students can draw parallels between the patterns of convection in the geosphere, hydrosphere, and atmosphere.

Capstone Connection:

Relations:

SEC Topic & Code: HSST-ES.3.01 (HSST-ES.3.01)

### assignment

- ES.3.04 - Describe and account for patterns in the global distribution of volcanoes and...[expand\\_morelink](#)

Week 06 - Week 07

Comment(s):

Learning Outcome: Describe and account for patterns in the global distribution of volcanoes and earthquakes to interpret plate motion, how plate tectonics processes form continents, formation of Egypt and the motions of it over time.

### Key Concepts:

- 1. There are patterns to the geographical distribution of volcanoes, earthquakes, and topography.
  - 2. The geographical distribution of volcanoes and earthquakes is related to larger plate tectonic features.
- Skills: Trace and construct maps of volcanoes and earthquakes using USGS data and satellite images.
- Essential Questions: How do plate motion and interactions shape the landscape and geology of Egypt?

Textbook and Resource Materials: How do plate motion and interactions shape the landscape and geology of Egypt?

Evidence of Learning: Students are able to identify large-scale features of plate tectonic systems Students are able to explain large scale patterns in earthquakes, volcanoes, and topography on Earth

Capstone Connection:

Relations: CH.1.03

SEC Topic & Code: HSST-ES.3.01 (HSST-ES.3.01)

### assignment

- ES.3.05 - Explain how energy is released in different types of volcanic eruptions and...[expand\\_morelink](#)

Week 08 - Week 09

Comment(s):

If we had more time, we might want to consider including a lab on the use of a total station (laser surveying instrument) to construct a local topographic map. This is a directly job-applicable skill.

Learning Outcome: Explain how energy is released in different types of volcanic eruptions and assess volcanic risk to their communities

Key Concepts:

- 1. Magma originates from essentially solid rock of the crust and mantle. In addition to a rock's composition, its temperature, depth (confining pressure), and water content determine whether it exists as a solid or liquid.
- 2. The nature of volcanic eruptions depend on several characteristics include the magma's composition, its temperature, and the amount of dissolved gases it contains.
- 3. Viscosity of fluids is affected by composition and temperature in both model and geologic systems.
- 4. The nature of volcanic eruptions directly controls the sorts of volcanic landforms that are produced.
- 5. Eruptions that produce ash affect larger areas than other types of volcanic eruptions and some large ash eruptions can have global effects.

Skills: 1. Construct contour maps from model landforms. 2. Interpret elevations and landform features from topographic maps. 3. Interpret maps and data tables 4.

Design and conduct experiments and interpret data.

Essential Questions: How do volcanoes affect the other parts of Earth's system? Where are the areas of high geothermal gradients in Egypt?

Textbook and Resource Materials: How do volcanoes affect the other parts of Earth's system? Where are the areas of high geothermal gradients in Egypt?

Evidence of Learning: Students are able to identify volcanic risks in Egypt by both location and expected type. Students are able to create valid topographic maps from a model Students are able to interpret topographic maps Students are able to



share and justify evidence and interpretations that relate viscosity to other factors in a model system

Capstone Connection:

Relations: MA.1.05

SEC Topic & Code: HSST-ES.3.01 (HSST-ES.3.01)

### assignment

- ES.3.06 - Explain how energy is released in earthquakes and assess the earthquake...[expand\\_morelink](#)

Week 10 - Week 11

Comment(s):

Learning Outcome: Explain how energy is released in earthquakes and assess the earthquake threat in their communities.

Key Concepts:

- 1. Earthquakes are vibrations of Earth produced by the rapid release of stored elastic energy from ruptures in rocks, called faults, that absorb and then release energy repeatedly in stick-slip cycles.
- 2. This energy release produces waves, which radiate in all directions from the earthquake's origin.
- 3. Characteristic forms and speeds of waves allow earthquakes to be accurately located by computers seconds to minutes after they happen. This also allows early-warning systems to be constructed.

Skills: 1. Use and interpret models to explore Earth processes 2. Interpret seismograms to determine arrival times of the two types of seismic waves and determine the distance to the epicenter of an earthquake from the seismometer. 3. Interpret firsthand reports of earthquake effects. 4. Make and interpret felt-intensity maps of an earthquake.

Essential Questions: How could scientists use the characteristics of seismic activity to understand the Earth's interior? Where are the most probable regions in Egypt that may show severe seismic activities in the future?

Textbook and Resource Materials: How could scientists use the characteristics of seismic activity to understand the Earth's interior? Where are the most probable regions in Egypt that may show severe seismic activities in the future?

Evidence of Learning: Students successfully collect and interpret data from a model earthquake system Students successfully interpret earthquake seismograms Students successfully interpret historical accounts of earthquake shaking

Capstone Connection: Students might consider how to create an earthquake warning system that could shut down critical infrastructure (power plants, railways, bridges, etc.) in the event that strong earthquake waves are detected.

Relations: MA.1.07; CH.1.03

SEC Topic & Code: HSST-ES.03.01 (HSST-ES.03.01)

assignment

Structural geology (2019)

folder

- ES.3.07 - Explain in both words and diagrams the relationship between forces (stress)...[expand\\_morelink](#)

Week 12 - Week 14 note week 8,9 &10

Comment(s):

Unconformities are a result of erosion and sedimentation in a deforming environment, not a type of deformation itself. Classification is deemphasized in favor of deeper exploration of process. Stress and strain are deemphasized, to keep the material at an appropriate level for a high school student. Billings is unlikely to yield deep understandings in the high school study of structural geology and has been replaced with a unit from EarthComm that contains hands-on inquiry investigations of models of structures.

Learning Outcome: Explain in both words and diagrams the relationship between forces (stress) and deformations (strain) in rocks to explore different types of this deformation, including folds and faults.

Key Concepts:

- 1. Forces in rock units are distributed throughout the rock body, just as they are in fluids, and are described by pressure-like forces called stresses.
- 2. Unlike pressures in Newtonian fluids, the stresses in rocks can be different magnitudes in different directions.
- 3. Rocks may respond to stress by changing shape (deformation). Similarly, externally imposed deformations may give rise to new stresses in a body of rock.
- 4. Deformation can occur by elastic processes (recoverable), brittle processes (non-recoverable) or by plastic processes (non-recoverable).
- 5. Faults and joints form by brittle deformation of rocks. Brittle deformation due to tension forms joints. Brittle deformation due to shear forms faults.
- 6. Folds form by plastic deformation of rocks.
- 7. Motion of rock bodies over non-planar faults is a common mechanism of folding in upper crustal rocks.
- 8. Unconformities are surfaces separating rock sequences of non-contiguous ages.
- 9. Unconformities form due to the interaction of erosion, sedimentation and deformation.

Skills: 1. Examine diagrams, build models and interpret cross sections. 2. Read and interpret the world structure maps and satellite images to explore the different types of structures. 3. Examine diagrams showing cross section of different geological structures. 4. Construct models showing folds, faults, joints and unconformities.

Essential Questions: How do rock units respond to plate motions?

Textbook and Resource Materials: How do rock units respond to plate motions?

Evidence of Learning: Student is able to interpret simple geologic maps or cross sections of structures and identify and interpret folds and faults. Student is able to correctly interpret relationships of stress and deformation in model materials Student is able to identify joints in hand sample and outcrop Student is able to interpret fault surfaces in hand sample and outcrop Student is able to correctly interpret geologic history of cross sections or outcrops containing unconformities

Capstone Connection:

Relations:

SEC Topic & Code: HSST-ES.03.02 (HSST-ES.03.02)

[assignment](#)

Geophysics (2019)

## folder

- ES.3.08 - Given surface observations of the Earth, deduce the sub-surface features and...[expand\\_morelink](#)

Week 01 - Week 012 weeks

Comment(s):

Learning Outcome: Given surface observations of the Earth, deduce the sub-surface features and processes.

Key Concepts: Geophysical techniques measure physical phenomena. The sensitivity to sub-surface physical properties.

Skills: 1. Use geophysical techniques to measure physical phenomena such as gravity, magnetism, elastic waves, electricity and electromagnetic waves. 2. Determine the sub-surface physical properties as density, magnetic susceptibility, seismic wave velocity and density.

Essential Questions: How can you explore the subsurface ores and oil fields?

Textbook and Resource Materials: How can you explore the subsurface ores and oil fields?

Evidence of Learning: Geophysical methods survey.

Capstone Connection:

Relations:

SEC Topic & Code: HSST-ES.3.03 (HSST-ES.3.03)

## assignment

- ES.3.09 - Apply the passive natural fields measurement of the Earth such as gravity...[expand\\_morelink](#)

Week 02 - Week 03

Comment(s):

Learning Outcome: Apply the passive natural fields measurement of the Earth such as gravity field, magnetic field, radioactivity and seismic arrivals of earthquakes.

Key Concepts:

- 1. Gravity field.
- 2. Magnetic field. 3. Radioactivity.
- 3. Seismic waves (earthquakes).

Skills: 1. Analyses the data that received. 2. Interpret the data that received. 3. Application of data and convert it to maps.

Essential Questions: What the naturally occurring physical phenomena would be used in exploration oil and mineral ores?

Textbook and Resource Materials: What the naturally occurring physical phenomena would be used in exploration oil and mineral ores?

Evidence of Learning: The naturally geophysical phenomena.

Capstone Connection:

Relations:

SEC Topic & Code: HSST-ES.3.03 (HSST-ES.3.03)

## assignment

- ES.3.10 - Apply the active Geophysical methods to detect subsurface features such as...[expand\\_morelink](#)

Week 04 - Week 05

Comment(s):

Learning Outcome: Apply the active Geophysical methods to detect subsurface features such as 1-Seismic method (refraction-reflection) 2-Electric method 3-Electromagnetic method

### Key Concepts:

- 1. Seismic wave exploration.
- 2. DC Electric current measurement.
- 3. Electromagnetic (AM).

Skills: 1. Analyses and processes the measurement data. 2. Interpret the corrected data. 3. Converting data to geologic information in subsurface (mapping in cross section 3D)

Essential Questions: What the artificial physical methods would be used in exploration oil and mineral ores?

Textbook and Resource Materials: What the artificial physical methods would be used in exploration oil and mineral ores?

Evidence of Learning: The artificial geophysical methods.

Capstone Connection:

Relations:

SEC Topic & Code: HSST-ES.3.03 (HSST-ES.3.03)

[assignment](#)

### Remote Sensing and GIS Techniques (2019)

### folder

- ES.3.11 - Identify the general idea of remote sensing and its role in building a huge...[expand\\_morelink](#)

Week 06 - Week 06

Comment(s):

Learning Outcome: Identify the general idea of remote sensing and its role in building a huge informational base about different properties of Earth surface components and tracking the changes in ecosystems

### Key Concepts:

- 1. Remote sensing is the art of acquiring information about the Earth's surface without actually being in direct contact with it. This is done by sensing and recording emitted or reflected energy from different objects.
  - 2. Remote Sensing and GIS tools represent significant communications techniques that connect people, especially in vast and hard accessible regions.
- Skills: 1. Differentiate and classify several types of grey- scale and colored satellite and airplane photos. 2. Collect, organize, analyze and interpret several and variable types of satellites data sets.

Essential Questions: What is the difference between remote sensing and GIS techniques? What is the latest technology used in Remote sensing and GIS?

Textbook and Resource Materials: What is the difference between remote sensing and GIS techniques? What is the latest technology used in Remote sensing and GIS?

Evidence of Learning: Construct geological data base of an area.

Capstone Connection:

Relations: BI 1.0 1, 1.02 & 1.03

SEC Topic & Code: HSST-ES.3.04 (HSST-ES.3.04)

### assignment

- ES.3.12 - Use one of the software packages that are used the image processing and...[expand\\_morelink](#)

Week 07 - Week 08

Comment(s):

Learning Outcome: Use one of the software packages that are used the image processing and enhancement techniques.

Key Concepts:

- 1. Remote sensing technology has become a vital, significant and powerful tool for geological and geophysical investigations with very important role in many discoveries and developments of mineral and water resources all over the world.
- 2. Several Image processing and enhancement techniques by using different software packages help scientists to recognize different physical and chemical characteristics of Earth's materials.

Skills: 1. Deal with Image processing software. 2. Use statistical analysis to interpret the remotely sensed images. 3. Apply different image processing and enhancement techniques to produce false color images.

Essential Questions: What is the role of satellites in the processing of remote sensing and GIS techniques?

Textbook and Resource Materials: What is the role of satellites in the processing of remote sensing and GIS techniques?

Evidence of Learning: Produce digital topographic contour maps.

Capstone Connection:

Relations: BI.1.01; BI.1.02; BI.1.03

SEC Topic & Code: HSST-ES3.04 (HSST-ES3.04)

## assignment

- ES.3.13 - Use different data analysis and algorithms to interpret the characteristics...[expand\\_morelink](#)

Week 09 - Week 10

Comment(s):

Learning Outcome: Use different data analysis and algorithms to interpret the characteristics of objects and discriminate the Earth's surface components.

Key Concepts:

- 1. Remote sensing technology has become a vital, significant and powerful tool for geological and geophysical investigations with very important role in many discoveries and developments of mineral and water resources all over the world.
- 2. Several Image processing and enhancement techniques by using different software packages help scientists to recognize different physical and chemical characteristics of Earth's Materials.
- 3. Several geological investigations have been previously used satellites multispectral data in mineral exploration, lithological discrimination and mapping of different geological structures.

Skills: 1. Apply different image processing and enhancement techniques to produce false color images. 2. Interpret different raw and processed satellite's data. 3. Produce 3D perspective views of the earth's surface using the DEM (Digital Elevation Model) data. 4. Use images to differentiate between various components and rock units of the earth surface. 5. Apply the remote sensing analysis and interpretation to build geologic maps and models.

Essential Questions: How could scientists use remote sensing and GIS to explore different information and characteristics below the earth's surface?

Textbook and Resource Materials: How could scientists use remote sensing and GIS to explore different information and characteristics below the earth's surface?

Evidence of Learning: Produce digital geological maps.

Capstone Connection:

Relations: BI.1.0 1; BI1.02; BI.1.03

SEC Topic & Code: HSST-ES.3.04 (HSST-ES.3.04)

## assignment

## folder

- ES.3.14 - Recognize the contour maps and read the elevations and outcrops on a...[expand\\_morelink](#)

Week 11 - Week 12

Comment(s):

Learning Outcome: Recognize the contour maps and read the elevations and outcrops on a topographic map.

Key Concepts:

- 1. Read the elevations on topographic maps.
  - 2. The characteristics of outcrops of horizontal beds.
- Skills: 1. Drawing the outcrops of horizontal beds 2. Drawing a geological cross section. 3. Determine the elevations on the topographic map.
- Essential Questions: What are the contour lines of a topographic maps?

Textbook and Resource Materials: What are the contour lines of a topographic maps?

Evidence of Learning: Read a geological map and draw a legend of a map.

Capstone Connection:

Relations:

SEC Topic & Code: HSST-ESS.3.05 (HSST-ESS.3.05)

## assignment

- ES.3.15 - Recognize the outcrops of inclined beds and differentiate between true and...[expand\\_morelink](#)

Week 13 - Week 14

Comment(s):

Learning Outcome: Recognize the outcrops of inclined beds and differentiate between true and apparent dip in geological contour maps.

Key Concepts:

- 1. The characteristics of outcrops of inclined beds.
- 2. The map pattern of a fold and a fault.
- 3. Differentiate between contour lines and structural contour line (strike) in geologic contour map.



- 4. The map pattern of the geological structures.  
Skills: 1. Determine the geological structure through outcrops of inclined beds. 2. Differentiate between contour lines and structural contour line (strike) in geological contour map. 3. Read the map pattern of a fold and a fault. 4. Determine the displacement of beds. 5. Determine the true and apparent dip.  
Essential Questions: How can determine the structures of an area through geological contour map?

Textbook and Resource Materials: How can determine the structures of an area through geological contour map?

Evidence of Learning: Read a geological map and draw a legend of a map.

Capstone Connection:

Relations:

SEC Topic & Code: HSST-ES.3.05 (HSST-ES.3.05)

[assignment](#)

# Physics Grade 1

## Measurement And Units

### folder

- PH.1.01 - Make measurements precisely and accurately using a variety of measurement...[expand\\_morelink](#)

#### Week 01 - Week 02

Comment(s): Some time should be spent comparing fundamental units such as length with derived units such as velocity. "How can you measure the capacity (volume) of a regularly-shaped object such as a refrigerator? How can you measure the capacity (volume) of an irregularly-shaped object?"

Learning Outcome: Make measurements precisely and accurately using a variety of measurement tools.

Key Concepts:

- 1. Physics as experimental science
- 2. Systems of measurements and standards
- 3. International system of units
- 4. Prefixes of metric units
- 5. From Macro to Nanoscale
- 6. Measurement errors
- 7. Measurement accuracy vs. precision
- 8. Dimensional analysis

Skills:

- 1. Identify and describe systems of measurement
- 2. Convert units between different systems of measurement
- 3. Determine sources of measurement errors
- 4. Use basic measurement tools to measure/compute length, area, volume and time
- 5. Use dimensional analysis to verify or predict a physical law

Essential Questions:

- What are common sources of measurement error?
- What are the consequences of imprecise and/or inaccurate measurements?

Textbook and Resource Materials: Active Physics p 22-26 \*\*\*\*\*

Evidence of Learning: RECALL; ????? compare the units of SI system and GCS system BA; holt\_ch1 book -q2-pg 20 \*\*\*\*\* ST; holt\_ch1 book -q4-pg 20

Capstone Connection: Using measurements in all capstone project topics.

Applications: CH.3.02,

SEC Topic & Code: unitsmeasurementmeasurement erroraccuracy

### assignment

trending\_updrive\_etabusiness

## folder

- PH.1.02 - Use Newton's 3rd Law to identify the forces of interaction that exist between...[expand\\_morelink](#)

### Week 03 - Week 04

Comment(s): This is an interesting way of starting a description of forces, Instead of a force as something causing an acceleration, here a force is an interaction that opposes another interaction...with quantitative details put off for a while. This is a good place to begin classifying forces as Field vs Contact... but mention that even contact forces are ultimately field forces... and that there are 4 fundamental forces : gravity, EM, strong & weak nuclear

Learning Outcome: Use Newton's 3rd Law to identify the forces of interaction that exist between pairs of objects (Newtonian pairs)

Key Concepts:

- 1. Forces
- 2. Static equilibrium
- 3. Dynamic equilibrium
- 4. System of forces
- 5. Newton's third law
- 6. Free body diagram
- 7. Action-Reaction Pairs
- 8. Point particle

Skills:

- 1. Differentiate between physical systems in equilibrium and non-equilibrium.
- 2. Apply Newton's third law in physical systems (i.e. identify the action and reaction forces)
- 3. Draw a force diagram for objects in physical equilibrium
- 4. Recognize that force pairs between objects are equal and opposite, even if objects are of different mass.

Essential Questions:

- Can there be an odd number of total forces between objects in the universe?
- When you read your weight on a bathroom scale, what force is this reading?
- What is the nature of physical equilibrium?
- Can objects still be in equilibrium when forces are acting on them?
- What forces must exist on a rocket and the earth as the rocket is launched?

Textbook and Resource Materials: Active Physics p 199-209 \*\*\*\*\*

Evidence of Learning: RECALL: mention Newton's third law ????? BA; holbook t\_ch4\_sec1 -q3-pg 134 \*\*\*\*\* ST; holt\_ch4\_sec1 book -q5-pg 134 \*\*\*\*\*

Capstone Connection: Apply to your dwelling: A. Differentiate between physical systems in equilibrium and non-equilibrium. B. Apply Newton's third law in physical systems ( i.e. identify the action and reaction forces) C. Draw a force diagram for objects in physical equilibrium D. Recognize that force pairs between objects are equal and opposite, even if objects are of different mass.

SEC Topic & Code: Force and equilibrium

## assignment

trending\_updrive\_etalocal\_florist

- PH.1.03 - Predict an object's motion based on the forces that are acting on it.[expand\\_morelink](#)

### Week 04 - Week 06

Comment(s): 1. Suggestion: keep things mathematically simple on this first intro to Newton's Laws. e.g. only use graphical addition and subtraction of vectors 2. Recommend that prediction be kept to direction and a qualitative indication of strength. e.g. "block will move at an angle close to 60 degrees with an acceleration less than if the two forces had acted in the same direction" (given two different length forces acting at right angles) 3. 1-D kinematics will be covered in mechanics starting at beginning of semester 1, so not much time is needed to go over kinematic variables...except that acceleration as change in velocity in time is crucial. i.e. it should be stressed that this is how equilibrium will be defined ... i.e. when there is no change in motion 4. Using rulers and protractors, a simple activity can ask for the approximate length and direction of a force that will produce equilibrium. 5. When doing centripetal force introduce the idea of "fictitious forces". In this case the common use of "centrifugal force" is fictitious because the real force that causes circular motion is centripetal. ... We tend to make things about us, so if we move to the right as our car turns left, we think a centrifugal force pushes us to the right. Instead, we lack a centripetal force to the left that would cause us to move in a circle with the car. This idea of fictitious forces is an important one because it is essential in Newtonian physics to clearly identify the forces that are acting. We will spiral back to this several times. The next will be in the discussion of force and pressure changes in Y1 S2. 6. More on fictitious forces: When one is in a rotating frame of reference, or any accelerating frame, then the centripetal becomes a centrifugal force. However Newton's laws are meant to be followed in an inertial reference frame, i.e. one that is not accelerating. "How much force must be applied to a 750-kg automobile traveling at 30 km/hr to cause it to stop in 6 seconds?"

Learning Outcome: Predict an object's motion based on the forces that are acting on it.

Key Concepts:

- 1. Equilibrium vs. motion vs. change in motion
- 2. Force as a vector
- 3. Net force acting on a free body.
- 4. Newton's Laws of Motion
- 5. Centripetal acceleration
- 6. Centripetal force
- 7. Inertial reference frame

Skills:

- 1. Identify forces acting on an object and represent them pictorially in a free body diagram.
- 2. Use free-body diagram to determine net force acting on a body via graphical vector addition
- 3. Given all of the forces acting on a body, use Newton's 1st law to determine whether the object is in equilibrium (i.e. moving at constant velocity, including 0)
- 4. Given all of the forces acting on a body, apply Newton's 2nd law to determine the acceleration of an object not in equilibrium
- 5. Knowing the state of motion of an object but not all forces on a body, determine the resultant of the unknown force(s)

- 6. Describe why an object moving in a circle experiences a centripetal acceleration towards the center of rotation, even though it is moving at constant speed..
- 7. Identify the force or forces that cause a body to move in a circle about a fixed point in space

#### Essential Questions:

- How can you design a tall structure that does not blow over in heavy winds?
- How can you control the direction a large tree will fall when chopping it down?
- Why is it possible that a sheet of paper can be dragged quickly from beneath a heavy body, but the body does not move?

Textbook and Resource Materials: Active Physics p 132 – 143; p 157 – 173 \*\*\*\*\*

Evidence of Learning: RECALL: mention Newton's Laws of motion and their mathematical expressions ?????? BA; holbook t\_ch4\_-q1-pg 129 \*\*\*\*\* ST; holtbook \_ch4\_-q5-pg 129 \*\*\*\*\*

Capstone Connection: How to achieve the stability of the sustainable structure of your capstone project?

SEC Topic & Code: motion, equilibrium, acceleration, Newtons' Laws Net Force

#### assignment

trending\_uplocal\_florist

- PH.1.04 - Model the gravitational force on an object near the earth as proportional to...expand\_morelink

#### Week 07 - Week 08

Comment(s): Recommend the stress on "field strength" for a few reasons: 1) to compare with electric and magnetic fields later 2) Field is an essential concept used to describe "action at a distance" forces 3) forces have already been classified as Field or Contact 4) one can talk about field strength diminishing the farther from earth's surface, or getting stronger near jupiter, etc. i.e. field strength depends on the planet, and distance from the planet, and can be compared without referring to the weight of an object 5) mention that g due to earth is NEVER 0 for finite distances. And, in fact g will be = 0 only at one spot in universe ... where effects from all suns, planets, asteroids, meteors, etc... cancel out. In other words, the idea of "weightlessness" is something different from the absence of weight, which is an almost universal misunderstanding of the situation. i.e. weightless objects almost always have weight. WEightless only means that Apparent Weight = 0.

Learning Outcome: Model the gravitational force on an object near the earth as proportional to the object's mass, with constant of proportionality g, the gravitational field strength.

#### Key Concepts:

- 1. Mass
- 2. Gravity
- 3. Gravitational field
- 4. Weight
- 5. General Law of Gravitation
- 6. Newton's Second Law in gravitational field
- 7. Free Fall
- 8. Apparent weight

#### Skills:

- 1. Differentiate between mass and weight
- 2. Solve problems to determine the mass, weight and apparent weight in different physical situations
- 3. Apply the General Law of Gravitation to qualitatively rank the gravitational field of different planets (using only  $M/R^2$ )
- 4. Identify the action-reaction pairs that exist when an object close to earth experiences a force due to gravity (i.e. a weight)

#### Essential Questions:

- How strong must an elevator cable be to accelerate an elevator car upward with an acceleration of  $g/2$ ?
- Why do you weigh less compared to sea level if you are on the top of the highest mountain on earth?
- Why can astronauts jump much more easily on the Moon than on Earth?
- What does it mean to be "weightless"?

Textbook and Resource Materials: active physics p 157– 173 \*\*\*\*\*

Evidence of Learning: "RECALL:compare between mass and weight ????? BA; holbook \_ch7\_ - q2-pg 247 \*\*\*\*\* ST; holtbook \_ch7\_-q5-pg 247 \*\*\*\*\*

Capstone Connection: Determine the force between the earth and your Capstone dwelling  
SEC Topic & Code: gravity, weight, and mass

#### assignment

local\_florist

Center of mass, torque, and general equilibrium

#### folder

- PH.1.05 - determine the conditions for stability of extended rigid bodies by...[expand\\_morelink](#)

#### Week 09 - Week 10

Comment(s): 1. Here the idea of equilibrium is extended to include NO CHANGE in ROTATIONAL motion. rotational motion does not occur in mechanics until year 3, so this idea needs to be introduced here, but nothing overly mathematical should be done. Systems that increase spin rate up or slow down spinning are clearly cases where rotational equilibrium is not the case. Disks spinning at a constant rate are in equilibrium, etc. 2. Similarly for torques: using example of opening a large door, develop idea that amount of angular acceleration will be proportional to how much you push, and where you push wrt axis of rotation of door. Then talk about different directions (open/close the door) and develop a simplified way to do torque problems: only consider ones where forces are perpendicular to motion arms, producing either CCW or CW rotation (call these + or -) 3. Mention that torques are vectors b/c they are made up of forces...but they will be handled in greater depth later... 4. Keep simple machine discussion to a minimum because work has not yet been defined. It will come later, so this is the beginning of a work spiral. Instead, focus on the torque applied to a lever, the simplest of simple machines. The discussion of a lever is important obviously because this LO is about torque. Mechanical advantage can be mentioned, as well as the fact that the lever is a simple machine, but I wouldn't discuss other machines here 5. As for center of mass, keep it simple as well. It will be covered in more detail at beginning of module on momentum and impulse. Stick to discrete masses in 1-D.

A lab activity determining the center of mass of a 2-D object is recommended as well  
Learning Outcome: determine the conditions for stability of extended rigid bodies by considering translational and rotational equilibrium

Key Concepts:

- 1. Center of mass
- 2. Torque
- 3. Static equilibrium
- 4. Translational vs. Rotational Equilibrium
- 5. The equilibrium torque condition: rotational analogue of Newton's Laws
- 6. Simple machines
- 7. The mechanical advantage of simple machines
- 8. Stability of extended rigid bodies depends on the sum of the forces, the sum of the torques and on the location of the center of mass.

Skills:

- 1. Determine the center of mass for different objects and systems of objects
- 2. Calculate the magnitude of the total torque acting on an object
- 3. Identify forces and torques acting on a stationary extended object, and be able to apply the equilibrium torque condition.
- 4. Determine the torque of a simple machine: the lever.

Essential Questions:

- Are pyramids more stable than a building with a rectangular cross-section?
- How tall can a truck be to safely drive on a banked road in terms of the angle of the road?
- How did the ancient Egyptians raise the pyramid stones without using our modern machines?

Textbook and Resource Materials: active physics p 157– 173 \*\*\*\*\*

Evidence of Learning: RECALL: what is meant torque and the lever arm ????? BA; holbook t \_ch7\_-q1-pg 258 \*\*\*\*\* ST; holtbook \_ch7\_-q3-pg 258

Capstone Connection: How to save effort during the building process? ??????Not sure what this is getting at: seems like a question about simple machines?????

SEC Topic & Code: torque, rotational equilibrium, equilibrium, simple machines

[assignment](#)

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Restoring Forces

[folder](#)

- PH.1.06 - Understand that certain material objects (e.g. springs that follow Hooke's...[expand\\_morelink](#)

Week 11 - Week 12

Comment(s): stress that Hooke's LAW is not Universally valid. Instead the word "law" is more about materials that deform linearly with applied force. When they obey the "law" they are Hooke's

Law materials. This is similar to Ohm's Law, which will be discussed in Year 2. Spend some time explaining similarity/difference between spring constant and Young's modulus.

Learning Outcome: Understand that certain material objects (e.g. springs that follow Hooke's Law) generate restoring forces that act to maintain them in an equilibrium shape.

Key Concepts:

- 1. Elasticity & Hooke's Law
- 2. Range of validity for Hooke's Law
- 3. Stress and strain
- 4. Young's modulus

Skills:

- 1. Measure spring constant of a linear spring
- 2. Measure stress and strain of different materials
- 3. Calculate stress and strain of different materials
- 4. Measure Young's modulus for a material
- 5. Calculate Young's modulus for a material
- 6. Identify unknown materials using Young's modulus

Essential Questions:

- Do all solid objects generate restoring forces?
- Which is most preferred, to make the shock absorber in cars from a high-elasticity material or from a low-elasticity one, and why?

Textbook and Resource Materials: Holt ch 11 & Haliday ch 7 part 1

Evidence of Learning: RECALL: mention mathematical formulae of Hooke's law

BA:pg323\_q9\_surway book A 200-kg load is hung on a wire of length 4.00 m, cross-sectional area  $0.200 \times 10^{-4} \text{ m}^2$ , and Young's modulus  $8.00 \times 10^{10} \text{ N/m}^2$ . What is its increase in length?

10. ST:pg323\_q12\_surway book Assume that if the shear stress in steel exceeds about  $4.00 \times 10^8 \text{ N/m}^2$ , the steel ruptures. Determine the shearing force necessary to (a) shear a steel bolt 1.00 cm in diameter and (b) punch a 1.00-cm-diameter hole in a steel plate 0.500 cm thick.

Capstone Connection: Role of elasticity in building materials and design

SEC Topic & Code: stress, strain, Hooke's Law

[assignment](#)

[trending\\_uplocal\\_floristbusiness](#)

- PH.1.07 - Predict an object's motion when it is subject to a restoring force [expand\\_morelink](#)

Week 11 - Week 12

Comment(s): Springs can be used in equilibrium situations and non-equilibrium. Good to mention this to students. Equilibrium: measure weight of a hanging mass Non-equilibrium: Qualitatively determine the motion of a friction mass/spring system (horizontal) not in equilibrium ... arguing that it will look like a sine curve... with simple demo, show that frequency will depend on spring constant and inversely on mass...with little or no effect due to amplitude...this will be done in detail later in Mechanics year 2...

Learning Outcome: Predict an object's motion when it is subject to a restoring force

Key Concepts:

- 1. Hooke's Law & Linear Springs



- 2. The spring constant
- 3. Yield point
- 4. Tension and compression

#### Skills:

- 1. Determine the limit of elasticity of different springs
- 2. Use Hooke's law to design spring suspensions
- 3. Apply Hooke's Law to measure weight of an object

#### Essential Questions:

- If your heart has a restoring force when it stretches or contracts, how will your heart rate change if your heart becomes thicker?
- Which one is more elastic, an iron string or a spider string, and why?

Textbook and Resource Materials: active physics ch4\_sec 5\_pg 392

Evidence of Learning: RECALL: mention Hook's law BA: active ph\_pg 402\_q\_4 ST: active ph\_pg 402\_q\_5

Capstone Connection: Role of elasticity in building materials and design

SEC Topic & Code: linear springs and Hooke's Law

[assignment](#)

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#### Fluid Mechanics

### folder

- PH.1.08 - Use pressure difference between two points of a fluid and Newton's laws to...[expand\\_morelink](#)

#### Week 01 - Week 03

Comment(s): Important here to stress that liquids and gases are considered "fluids" Also, the simplifying assumption of homogeneous substances, i.e. density is constant. This is a good module to talk once again about fictitious forces. Similar to the centrifugal force idea discussed in Semester 1, here we have the vacuum force. Many think that there is such a thing as suction, as if something in your vacuum cleaner reaches out, grabs some dust, and pulls it up the vacuum hose. Vacuum cleaners, and drinking from straws, etc., is only possible when there is a pressure difference (and the force this causes can overcome gravity to pull it up and/or in. Archimedes should be used in a variety of situations - from holding heavy objects underwater to how to design hot-air balloons

Learning Outcome: Use pressure difference between two points of a fluid and Newton's laws to analyze behavior of that fluid.

#### Key Concepts:

- 1. Fluids

- 2. Pressure
- 3. Manometer
- 4. Pressure gauge
- 5. Units of pressure
- 6. Effect of atmospheric pressure on boiling point of water
- 7. Change in atmospheric pressure with altitude
- 8. Pressure difference and force
- 9. Archimedes Principle

#### Skills:

- 1. Determine pressure change as function of height in columns of fluid
- 2. Explain how a mercury barometer measures atmospheric pressure
- 3. Determine atmospheric pressure as a function of altitude
- 4. Convert between different pressure units (such as: kPa, atm, mm Hg)
- 5. Explain how a straw works
- 6. Explain how a manometer works
- 7. Measure the gauge pressure of a trapped gas
- 8. Use manometers & barometers
- 9. Explain different boiling points of water at different altitudes
- 10. Measure the apparent weight of an immersed object.
- 11. Determine the Buoyant force on a submerged, or floating object
- 12. Use Archimedes principle to explain why large ships do not sink

#### Essential Questions:

- How does a vacuum cleaner work?
- If you are in a car that is submerged in a flood, how hard will it be to open your door? What is the best way to open the door?
- Why does a physician typically measure blood pressure in your upper arm?
- Is it easier or harder to boil water when on top of a very high mountain?

Textbook and Resource Materials: Holt ch 8 & Haliday CH 14

Evidence of Learning: quizzes, check points, assignments & discussions

Capstone Connection: Using gas and steam pressure to generate energy in traditional and alternative energy applications

SEC Topic & Code: pressure, buoyant force, apparent weight

[assignment](#)

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#### Fluid Dynamics

### folder

- PH.1.09 - Apply principles of fluid dynamics to determine pressure and velocity in a...[expand\\_morelink](#)

Week 04 - Week 06

Comment(s): After covering continuity and pascal principle, this section will be the first in which energy stuff is described in more than a passing way. This is the beginning of a spiral approach to work and energy... Suggestion: begin by defining work by constant pressure as  $pdV$ . (Is this

done in CHM somewhere?) Then define kinetic energy of fluid in terms of density and  $dV$ . Then argue for a Work-energy theorem for fluids which are moving in laminar flow in a HORIZONTAL pipe. i.e. begin with a simple derivation of a restricted BERNoulli equation (one at same vertical position wrt earth) do some horizontal problems...then go vertical, arguing for a term that involves height as well because as fluid goes up there's no way it doewn's lose velocity. In other words, you can get to a full statement of Bernoulli .... and do a bunch of problems using it...remarking that the students will see much more about conservation of energy in YEAr 2...

Learning Outcome: Apply principles of fluid dynamics to determine pressure and velocity in a variety of typical fluid systems

Key Concepts:

- 1. General properties of Fluids
- 2. Continuity equation
- 3. Laminar vs Turbulent Flow
- 4. Pascal's Principle
- 5.  $pdV = \text{Work}$
- 6. Work-Energy Theorem
- 7. Conservation of Energy in fluids
- 8. Bernoulli Equation

Skills:

- 1. Apply Bernoulli's Principle in daily life
- 2. Explore alternative energy applications of fluid dynamics such as windmills, hydrological dams, tidal generation.
- 3. Determination of flow rate.
- 4. Determination of volume rate.
- 5. Solve problems on flow rate.
- 6. Explain some phenomena on equation of continuity.
- 7. Explain some applications on Bernoulli's equation.

Essential Questions:

- How do planes stay in the air?
- If an artery starts narrowing due to thickening of the arterial walls, what happens to the blood pressure inside the artery?
- How much pressure is needed at the base of an apartment building to provide adequate shower pressure on the 10th floor?
- How does the perfume sprayer work?

Textbook and Resource Materials: Holt ch 8 & Haliday CH 14

Evidence of Learning: quizzes, check points, assignments& discussions

Capstone Connection: Using gas or liquid flowing to generate energy for alternative energy applicaitons.

SEC Topic & Code: pressure, velocity, kinetic energy

[assignment](#)

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Thermodynamics

[folder](#)

- PH.1.10 - Design a system for efficient energy production using concepts of...[expand\\_more](#)[link](#)

#### Week 07 - Week 10

Comment(s): with 1st law of Thermo coming in the next LO, this LO should focus on heating/cooling properties of different materials as a function of wavelength of incoming radiation. Convection, Conduction, Radiation should be compared...where possible by experiment. This should be more of an empirical LO, with simple mathematics involved in design. e.g. a question about how large a solar collector must be given energy needs, efficiency, and incident radiation would be good

Learning Outcome: Design a system for efficient energy production using concepts of temperature, heat and thermal energy.

Key Concepts:

- 1. Temperature
- 2. Thermal energy
- 3. Heat
- 4. Conduction, Convection, Radiation
- 5. Measuring Temperature
- 6. Temperature scale
- 7. Heat capacity
- 8. Specific heat capacity
- 9. Blackbody radiation
- 10. Solar heat collector.
- 11. Natural sources of heat: sun, geothermal
- 12. Latent heat

Skills:

- 1. Differentiate between temperature, thermal energy and heat
- 2. Measure temperature
- 3. Solve problem of general law of thermometer
- 4. Describe how temperature changes as a result energy transfer to a system  
Convert between different temperature scales (k – f - c)
- 5. Describe the natural sources of heat
- 6. Explain the idea of solar heat collectors.
- 7. Identify the uses of solar heat collector in daily life
- 8. Calculate temperature change for a given amount of a substance for a given energy transfer, or determine the amount of energy required for a given substance to change temperature by a specific amount.

Essential Questions:

- How efficient can a solar collector be?
- Can you make a thermometer without mercury?

Textbook and Resource Materials: Holt ch 9 & Haliday CH 18

Evidence of Learning: quizzes, check points, assignments& discussions

Capstone Connection: Using light and heat sources to generate other forms of energy

SEC Topic & Code: temperature, heat, thermal energy

[assignment](#)

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- PH.1.11 - Analyze energy flow in typical heating and cooling applications by applying...[expand\\_morelink](#)

Week 10 - Week 12

Comment(s): Be sure to perform experiment to demonstrate conservation of thermal energy .... demonstrate that area under p-v graph is energy transfer - connection to calculus

Learning Outcome: Analyze energy flow in typical heating and cooling applications by applying the 1st Law of Thermodynamics.

Key Concepts:

- 1. Conservation of thermal energy
- 2. Energy graphs
- 3. Low temperature physics
- 4. Thermodynamic processes (isothermal – isovolumetric- isobaric- adiabatic)
- 5. Phase changes

Skills:

- 1. Explain p-v graphs
- 2. Calculate the work done as gases are compressed/expanded both mathematically and graphically
- 3. Determine equilibrium temperatures in heating/cooling situation
- 4. Describe how 1st Law of thermodynamics is applicable for each type of thermodynamic process.
- 5. Explain methods to produce low temperature near absolute zero.
- 6. Describe applications for low temperature physics.

Essential Questions:

- What is more efficient at cooling a building in a desert climate: an air conditioner or a heat pump?
- If average temperatures of earth surface increase by 2 degree Celsius, how much ice in Greenland will melt?

Textbook and Resource Materials: Haliday ch 18

Evidence of Learning: quizzes, check points, assignments& discussions

Capstone Connection: Applying Laws of thermodynamics to types of alternative energy.

SEC Topic & Code: energy flow, heating, cooling, thermodynamics

[assignment](#)

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## Physics Grade 2

### General Law Of Gravitation (2019)

- PH.2.01 - Use Newton's Universal Law of Gravitation when considering the effects of...[expand\\_morelink](#)

Week 01 - Week 02

Comment(s):

A good idea to stress the idea of inverse-square law here. So many things in physics follow this mathematical form: electric fields, intensity, .... The field idea is really important - especially because of what is to come with electricity and magnetism, where field is stressed much more than actual forces. There is a chance to follow up on energy here - especially with determination of escape velocities. Students have seen energy in Year 1 already - with fluids and thermo

Learning Outcome: Use Newton's Universal Law of Gravitation when considering the effects of gravity far from the Earth's surface, or near other planets

Key Concepts: •1. Newton's Law of Universal Gravitation •2. Gravitation constant. •3. Gravitational field •4. Field Force •5. Inverse square law •6. Launching velocity of satellites. •7. Orbital velocity of satellites. 8. escape velocity of a satellite

Skills: •1. Determine the gravitational force between any two bodies - both celestial or earthly •2. Deduce the factors affect the gravitational field intensity at a point. •3. Use universal gravitation to explain why  $g$  near earth is  $98\text{m/s}^2$  •4. Calculate the ratio between the gravitational field strength on two different planets •5. Calculate the escape velocity for different planets •6. Calculate the orbital velocity of satellite at a certain height. •7. Compare the free fall acceleration on Earth and on the Moon

Essential Questions: •On what planet in the solar system would you weigh the most and what ramifications does this have for human colonies on that planet? •What velocity must a satellite have to be in a geosynchronous orbit 100 km above the Earth's surface?

Textbook and Resource Materials: •On what planet in the solar system would you weigh the most and what ramifications does this have for human colonies on that planet? •What velocity must a satellite have to be in a geosynchronous orbit 100 km above the Earth's surface?

Evidence of Learning: BA1: Holt Physics page: 242 BA1: 1-3 ST1: Holt Physics page: 246 ST1: 1, 2

Capstone Connection: apply gravity to water treatment processes

Relations: 0

SEC Topic & Code: 0

[assignment](#)

- PH.2.02 - Use concept of a field to analyze the similarities and differences between...[expand\\_morelink](#)

### Week 03 - Week 04

#### Comment(s):

The Field idea very important in understanding non-contact forces! stress that all non-contact forces are "carried" by a specific field that acts on a specific property of an object (mass, charge...and later, charge and velocity) Stress graphical as opposed to analytic methods for determining direction of electric forces and fields. Tie-in to vector work in mechanics, of course Field lines near dipoles and other simple charge distributions are very important - Also important to discuss the situation where field-free regions are to be determined. There is a connection to equilibrium here.

Learning Outcome: Use concept of a field to analyze the similarities and differences between electrostatic and gravitational forces via Coulomb's Law and Newtons' Gravitational Law.

Key Concepts: 1. Static electricity 2. Coulomb's Law 3. Electric Field, Electric Field intensity 4. Conservation of electric charge. 5. Repulsion and attraction of electric charges. 6. Methods of electrification 7. Electroscope 8. Electric Field Lines 9. electric potential

Skills: 1. Explain the repulsive and attractive force between two charges 2. Explain methods of electrification 3. Identify the type of accumulated electric charge on an object by using electroscope. 4. Compare electrostatic force between two objects to the gravitational force between them 5. Determine direction of total electrostatic force on a charge in the presence of other charges, using vector addition 6. Determine direction of the total electric field at a point in space in presence of nearby electric charges, using vector addition 7. Qualitatively describe the electric field near a dipole 8. Draw electric field lines near a charge distribution 9. determine where (if any) field-free regions exist near a charge distribution

Essential Questions: How does gravitational force between electron and proton in a hydrogen atom compare to the electrostatic force between them? How do lightning rods protect structures? Was the great pyramid a giant lightning rod?

Textbook and Resource Materials: How does gravitational force between electron and proton in a hydrogen atom compare to the electrostatic force between them? How do lightning rods protect structures? Was the great pyramid a giant lightning rod?

Evidence of Learning: R: Q2 BA1: Q: 1-6 BA2: Q 1-4 BA3: Q: 1,2 BA4: Practice D ST1: Q 5 ST2: Q 7

Capstone Connection: Draw connections between circuit diagrams and water flow in plumbing models

Relations: 0

SEC Topic & Code: HSST-PH 2.01 (HSST-PH 2.01)

[assignment](#)

## Direct Current Circuits (2019)

- PH.2.03 - Use the concepts of electric potential energy and voltage to analyze the flow...[expand\\_morelink](#)

### Week 05 - Week 06

#### Comment(s):

Students will be able to distinguish between ohmic and non-ohmic materials and learn what factors affect resistance. Very important to stress that many devices DO NOT follow Ohm's Law, and hence "Law" does not mean never to be violated, A discussion that includes conduction electrons, average drift velocity, is a good one....it ties in with energy states to be discussed in quantum physics, and links back to early kinematics b/c charges are accelerated by electric field, speeding up until they collide Spend some time developing the important relationship that R is proportional to length/area, with proportionality constant the resistivity of the material.this will be very helpful when considering series and parallel resistors in the next LO

Learning Outcome: Use the concepts of electric potential energy and voltage to analyze the flow of current through conductors and resistors

Key Concepts: 1. Dynamic electricity 2. Electric current 3. Current density 4. Potential difference & voltage 5. Electrical resistors 6. Resistivity & conductivity 7. Electromotive force (emf) 8. internal resistance 9. terminal voltage 10. Ohm's law 11. Ohmic vs. non-Ohmic materials.

Skills: 1. Explain the required conditions for continuous flow of electric charge. 2. Measure some physical quantities as voltage, current intensity and ohmic resistance of a conductor. 3. Verify Ohm's law practically and measure V-I diagrams 4. Use the graph between terminal voltage of the battery and the current intensity to find the EMF of the cell and its internal resistance 5. Solve DC circuit problems that require use of Ohm's law 6. Differentiate between Ohmic and non-Ohmic materials 8. Understand how the length and cross-sectional area of a conducting wire affects its electrical resistance

Essential Questions: How dangerous is it to touch a live wire at 220 volts? And how does this compare to 5000 Volts?

Textbook and Resource Materials: How dangerous is it to touch a live wire at 220 volts? And how does this compare to 5000 Volts?

Evidence of Learning: R: Q 2-4 BA: Q 1-3 ST: Q 11, 12

Capstone Connection: Apply ohmic properties to water purity measurement

Relations: 0

SEC Topic & Code: HSST-PH 2.02 (HSST-PH 2.02)

[assignment](#)



- PH.2.04 - Analyze DC circuits with simple resistive elements (i.e. ohmic devices)[expand\\_morelink](#)

Week 07 - Week 08

Comment(s):

simple stuff only: no bridges stress that parallel and series are NOT the only way be careful to explain that parallel does not mean the resistors are physically parallel IN SPACE compare to fluids stress practical combinations: voltage and current dividers Use Resistance proportional to Length/Area from previous LO to come up with rules for combining resistors in series or parallel

Learning Outcome: Analyze DC circuits with simple resistive elements (i.e. ohmic devices)

Key Concepts: 1. Connections of resistors (series & parallel) 2. Kirchoff's current law 3. Kirchoff's voltage law

Skills: 1. Determine the net resistance of series and parallel combinations of resistors in a DC circuit 2. Analyze a DC circuit containing only series and/or parallel resistors to predict current, and voltage through all devices 3. Given a set of resistors and a power supply, design electric circuits to obtain the largest total current leaving the power supply and the smallest total current leaving the power supply 4. Use Kirchoff's Laws to solve for current and voltage, in a multi-loop DC circuit containing resistors

Essential Questions: How would you design a string of 100 streetlights so that if one bulb burns out the others stay lit? Is this the most efficient way to do this in terms of electrical energy usage? How are electrical devices connected in a home & why?

Textbook and Resource Materials: How would you design a string of 100 streetlights so that if one bulb burns out the others stay lit? Is this the most efficient way to do this in terms of electrical energy usage? How are electrical devices connected in a home & why?

Evidence of Learning: R: Q 1-6 BA1: Q 1-3 BA2: Q 1-3 ST: Q 2, 5 & 6

Capstone Connection: Apply electric fields and forces to water treatment

Relations: 0

[assignment](#)

Capacitors & Inductors (2019)

- PH.2.05 - Analyze the effects on time dependence and energy storage due to simple...[expand\\_morelink](#)

Week 08 - Week 9

Comment(s):

In addition to energy storage, capacitors help one add time-variation to DC circuits. This can be described non-mathematically by discussing charge buildup on a parallel plate capacitor. i.e. you should be able to convince students that charging will follow a curve that shows an exponential slowing down important applications: flash batteries, defibrillators exponential functions: this has already been argued. Stating that voltage and current are definitely exponentials, with time

constant = RC should then be experimentally verified. Energy storage in Electric FIELD is a strange concept: how can there be energy where there may not be any matter? Important to stress, or show via video, that energy is still stored even if capacitor is in a vacuum. With good data analysis software, you should be able to experimentally demonstrate that the current through capacitor is proportional to the time rate of change of voltage across it, which makes for a great calculus connection.

Learning Outcome: Analyze the effects on time dependence and energy storage due to simple capacitive elements in DC circuits.

Key Concepts: 1. Capacitor charging and discharging 2. Energy storage 3. dielectric material 4. Time constant 5. Exponential charge/discharge 6. Capacitance in series and parallel group of connected capacitors

Skills: 1. Use the fact that capacitance increases with size of surface but decreases with increasing separation to explain why capacitors in parallel. 2. Use the fact that capacitance increases with size of surface, but decreases with increasing separation to explain why capacitors in series add reciprocally. 3. Calculate charge and voltage across capacitors in DC circuits once equilibrium is reached. 4. Describe  $i$  and  $v$  characteristics of capacitor in DC circuit with respect to time mathematically and graphically. 5. Measure and predict time constants in simple RC circuits. 6. Calculate the energy stored in the electric field inside a fully charged capacitor.

Essential Questions: How much charge needs to be present in a storm cloud in order for lightning to strike earth? How large a capacitor is needed for a family to store enough electrical energy for one day?

Textbook and Resource Materials: How much charge needs to be present in a storm cloud in order for lightning to strike earth? How large a capacitor is needed for a family to store enough electrical energy for one day?

Evidence of Learning: R1: Q1 R2: Q 1, 2, 5, 6 R3: Q 1, 3, 5 BA1: Q 2,3 BA2: Q 3, 4, 7, 8 BA3: Q 9, 10 ST1: Q 4, 5 ST2: Q 4 ST3: Q 9 – 13

Capstone Connection: Compare and contrast traditional generator operation to other forms of alternative energy conversion.

Relations: 0

SEC Topic & Code: HSST-PH 2.02 (HSST-PH 2.02)

[assignment](#)

Magnetic Fields & Forces (2019)

- PH.2.06 - Predict the direction of magnetic field produced by current-carrying wires in...[expand\\_more](#)

Week 10 - Week 11

Comment(s):

Use only basic right-hand rule...stick to strictly orthogonal situations seek good simulations show that circular motion of charged particles should be possible...ultimate connection to centripetal force, to be developed in mechanics mention that, like an electric field that can store energy, it will turn out that magnetic fields will also have an energy function is there a connection to the material in CH 3.10?

Learning Outcome: Predict the direction of magnetic field produced by current-carrying wires in different configurations.

Key Concepts: 1. Magnetic field: strength and direction 2. Magnetic field lines 3. Magnetic flux and magnetic flux density .4. Magnetic domain 5. Magnetic field due to a straight wire 6. Magnetic field due to a loop. 7. Magnetic field due to a solenoid. 8 Rules to determine the direction of magnetic field (Ampere's rule) 9. Polarity of a solenoid.

Skills: 1. Draw the pattern of magnetic field (i.e. magnetic field lines) of two magnetic poles close to each other (similar and different, i.e north- north and north-south). 2. Draw the pattern of magnetic field (i.e. magnetic field lines) near current-carrying wires in various configurations (eg. straight wires, circular and square loops). 3. Calculate the magnetic field strength and direction at a normal distance from a straight current-carrying wire 4. Calculate the magnetic field strength and direction at the center of a current-carrying loop. 5. Calculate the magnetic field intensity at a point on the axis of a solenoid. 6. Determine the position of the neutral point near two long parallel wires carrying currents in the same or in opposite direction (i.e. the position where the magnetic field = 0)

Essential Questions: Can power lines cause navigational devices in planes or automobiles to behave incorrectly due to interfering magnetic fields?Is this a threat to transportation safety? Why it is advisable to live far away from a high power line?

Textbook and Resource Materials: Can power lines cause navigational devices in planes or automobiles to behave incorrectly due to interfering magnetic fields?Is this a threat to transportation safety? Why it is advisable to live far away from a high power line?

Evidence of Learning: \* Student can draw the graphs that represent forward and reverse connection of a P-N junction correctly.

Capstone Connection: Applying modern physics in our daily life to produce energy that is essential in industrial processes.

Relations: 0

SEC Topic & Code: HSST-PH 2.04 (HSST-PH 2.04)

[assignment](#)

- PH.2.07 - Determine the magnetic force on a charged particle moving in a magnetic field...[expand\\_morelink](#)

Week 12 - Week 13

Comment(s):

At first, extensive use of righthand rule to determine field directions. Then argue that field strength should be proportional to current (not hard to convince. This can be done with a simple demo) Then argue that strength must diminish as you move farther from the current. The question is whether it is invers-square like gravity and electric fields. Turns out that field is only inversely dependent on distance. This should be demonstrated as opposed to deriving formulas such as  $B = \frac{\mu_0 I}{2\pi R}$ , etc. Is there a link to CH 3.10? Note that cross-product will be mathematical developed in mechanics...grade 3

Learning Outcome: Determine the magnetic force on a charged particle moving in a magnetic field and the effects of the force on the particle's motion.

Key Concepts: 1. Force on moving charge in magnetic field 2. Force on current-carrying wire in magnetic field 3. Magnetic torque and motors. 4. Measuring devices: (sensitive galvanometer, ammeter, voltmeter, ohmmeter)

Skills: 1. Determine the direction of magnetic force on charges moving in constant magnetic fields 2. Determine the direction of magnetic force on a current-carrying wire in a constant magnetic field 3. Explain the torque that exists on current-carrying loop in a magnetic field (if loop positioned correctly) 4. Explain how an electrical motor works 5. Explain how a galvanometer works 6. Explain how to convert a galvanometer into an ammeter. 7. Explain how to convert a galvanometer into a voltmeter.

Essential Questions: How much force is generated by an electromagnet used to move automobiles in a junkyard? Is it possible to make a charged particle move in circles using magnetic force?

Textbook and Resource Materials: How much force is generated by an electromagnet used to move automobiles in a junkyard? Is it possible to make a charged particle move in circles using magnetic force?

Evidence of Learning: \* Student can determine the factors affect induced EMF and able to draw the graph that represents these relations correctly.

Capstone Connection: Production of energy needed to be provided for different industrial processes.

Relations: 0

SEC Topic & Code: HSST-PH 2.04 (HSST-PH 2.04)

[assignment](#)

Electromagnetic Induction (2019)

- PH.2.08 - Use Faraday's law of induction to determine induced voltage in conducting...[expand\\_morelink](#)

Week 01 - 0

Comment(s):

This LO follows up on experimental evidence from 2.07 that voltage is somehow being produced as current is increasing in coil. There the time rate of change of current was proportional to voltage across inductor. Here the description is in terms of magnetic field: i.e. as field grows in coil, there is an induced voltage somewhere. Here I suggest simple situations where loops are perpendicular to magnetic field /flux should then be introduced...important to show that it is not necessarily magnetic field change that produces induced voltage, but rather magnetic flux change. So situations where field changes, and where area changes should be discussed. Because of its importance, the basic solenoid should be discussed. Its inductance in terms of number of loops, area, etc. can be surmised based on units and an understanding of flux change.

Learning Outcome: Use Faraday's law of induction to determine induced voltage in conducting loop due to changes in magnetic flux.

Key Concepts: 1. Electromagnetic induction 2. Faraday's law. 3. Lenz's Law 4. Loops and solenoids

Skills: 1. Explain electromagnetic induction. 2. Identify the factors that affect the induced EMF in a conductor. 3. Determine the polarity of induced current in a coil. 4. Give examples of electromagnetic induction applications. 5. Calculate induced EMF in a variety of basic situations, including changing B-field, or changing loop area

Essential Questions: How can mechanical energy be converted to electrical energy?

Textbook and Resource Materials: How can mechanical energy be converted to electrical energy?

Evidence of Learning: \* Student can solve the truth tables that represent a combination of some logic gates connected to each other in different ways. \* Students can predict the combination of hidden logic gates according to their truth table. \* Students can construct a circuit of logic gates depending on some provided conditions.

Capstone Connection: Using sensors in some industrial processes.

Relations: 0

SEC Topic & Code: HSST-PH 2.05 (HSST-PH 2.05)

[assignment](#)

- PH.2.09 - Analyze the effects on time dependence and energy storage due to simple...[expand\\_morelink](#)

Week 02 - 0

Comment(s):

Note that much more will be done with induction in the coming LO's! It is important here to demonstrate the behavior of an inductor in a DC circuit, using language that involves changes in magnetic field and especially flux...but avoid a mathematical analysis. This is the beginning of a

spiral approach to magnetic field, which will be revisited quite a bit as year 2 progresses. Also, the intent is to compare to a capacitor, another circuit element that serves as a temporary energy storage device. Similar to capacitors, inductors help one add time-variation to DC circuits. In a manner complementary to a capacitor where current is proportional to time rate of voltage, for an inductor the voltage is proportional to the time rate of change of the current. This is a nice calculus connection, and can be shown with a straightforward time measurement of voltage and current. Covering basic inductors provides a nice spiral bookended to capacitors. They are both similar circuit elements in that they "fight" change to the way charge is flowing or distributed. The capacitor "fights" change in voltage (because of opposite direction E-field growing inside capacitor), while the inductor "fights" change in current because of the induced voltage that arises due to changing magnetic flux in the inductor. Students should learn that an intriguing balance can be achieved with both in a circuit. band-pass filter, which In fact it may be valuable to ask students for their predictions... The RLC circuit is a band-pass filter, which will be covered later this semester as an example of a very important AC circuit. Finally, this topic provides another opportunity to talk about energy...only this time the energy is stored in the magnetic field. But the comparison with capacitors and stored energy is one of opposites: maximum energy is stored in the inductor field when the current has reached equilibrium amperage. The capacitor will have maximum energy stored in its field when no current is flowing. LR circuits provide another example of exponential behavior. examples of LR circuits should be emphasized, e.g. solenoid valves

Learning Outcome: Analyze the effects on time dependence and energy storage due to simple inductive elements in DC circuits.

Key Concepts: 1. Inductor 3. Back emf 4. Inductor charging and discharging 5. Energy storage 6. RL circuit 7. time constant 8. Exponential charge/discharge

Skills: 1. Use the fact that inductors act like resistors once current begins flowing to why inductors in series add and inductors in parallel add reciprocally 2. Calculate current through and voltage across inductors in DC circuits once equilibrium is reached 3. describe i and v characteristics of inductor in DC circuit with respect to time mathematically and graphically 4. Measure and predict time constants in simple RL circuits 5. Calculate the energy stored in the magnetic field of an inductor when fully charged

Essential Questions: Are coils of wire with many loops more dangerous than those with fewer loops when provided electrical power?

Textbook and Resource Materials: Are coils of wire with many loops more dangerous than those with fewer loops when provided electrical power?

Evidence of Learning: \* the student can calculate induced EMF in a generator. \* the student can determine the polarity of the coil. \* Student explains the difference between motor and AC generator

Capstone Connection: 0

Relations: 0

SEC Topic & Code: HSST-PH 2.05 (HSST-PH 2.05)

[assignment](#)

- PH.2.10 - Analyze production and transmission of electrical energy via electromagnetic...[expand\\_morelink](#)

Week 03 - Week 04

Comment(s):

The students will be able to explain the effect of variation of the current in a coil on another coil in a closed circuit. / mention self- inductance...which goes to explaining the circuit behavior seen in basic inductors in Y2S1 Calculation of coupling coefficients and mutual induction coefficient should be done for very simple situations. The goal is to get students to consider the design principles needed to produce and change voltage for power generation and use.

Learning Outcome: Analyze production and transmission of electrical energy via electromagnetic induction.

Key Concepts: 1. AC generator 2. Effective value of EMF (rms) 3. D.C. Generator 4.D.CMotor

Skills: 1. Deduce the factors affecting the produced EMF in an A.C. generator. 2. Draw graphs illustrate the relation between (EMF & THETA) and between (EMF & t) 3. Draw graphs illustrate the relation between maximum voltage and the parameters affecting it. 4. Design your own workable model of an A.C. generator. 5. Explain how to Convert A.C. to D.C. 6. Explain what happens on replacing the resistance load in the D.C. dynamo by a battery.

Essential Questions: Why is it better to transmit electrical power at high voltages?How to transfer electric energy from power plants to consumption places?

Textbook and Resource Materials: Why is it better to transmit electrical power at high voltages?How to transfer electric energy from power plants to consumption places?

Evidence of Learning: 0

Capstone Connection: 0

Relations: 0

SEC Topic & Code: HSST-PH 2.05 (HSST-PH 2.05)

[assignment](#)

- PH.2.11 - Analyze the behavior of transformers using mutual Induction [expand\\_morelink](#)

Week 05 - Week 06

Comment(s):

There are many skills listed here that are probably at a level higher than is typical in HS; they are more typically associated with EE majors at a university level. I recommend focusing on the conversion of mechanical energy to electrical energy, covering the principles of motors vs. generators and discussing the advantages of high-voltage transmission of electrical energy based on minimizing resistive losses...which lead to step-up and step-down transformer design

Learning Outcome: Analyze the behavior of transformers using mutual Induction

Key Concepts: 1. Mutual induction between two coils. 2. Factors affecting the mutual induction between two coils. 3. Coefficient of mutual induction. 4. Transformer. 5. Step-up/step-down transformers 6. Eddy currents

Skills: 1. Compare between forward and reverse current in mutual induction. 2. Give examples on mutual induction applications 3. Explain the behavior of a transformer using mutual induction concepts 4. Calculate primary or secondary voltages given appropriate information about transformer coil. 5. Explain step-up and step-down transformers 6. Solve problems on transformer efficiency. 7. Calculate the efficiency of a transformer practically. 8. Design a system to reduce the loss of energy during transmission of energy from power stations to distribution areas using transformers. 9. Explain the eddy current. 10. Give examples of eddy current applications. 11. Compare between A.C. and D.C. transmission of electrical power

Essential Questions: How can voltages be increased or decreased with minimum loss of energy?

Textbook and Resource Materials: How can voltages be increased or decreased with minimum loss of energy?

Evidence of Learning: 0

Capstone Connection: 0

Relations: 0

SEC Topic & Code: HSST-PH 2.05 (HSST-PH 2.05)

[assignment](#)

AC Circuits (2019)

- PH.2.12 - Analyze simple AC circuits containing resistive elements.  
[expand\\_morelink](#)

Week 7 - Week 08

Comment(s):

This LO also includes a deep connection to harmonic motion..., i.e. oscillating magnet in loop will create AC voltage. (Or moving loop/fixed coil) . I would only mention this here. Basically, it is surprisingly "easy" to generate voltages that oscillate like a sine wave. So this LO is about how does an alternating power source change what has already been observed for DC circuits. Harmonic motion to be described in full mathematical detail in mechanics year 3 Note: depending on whether students will already have complex numbers, students could investigate multiple sources with different phase because rms voltage/current/power are time averages of sinusoids, there is a connection to integral calculus

Learning Outcome: Analyze simple AC circuits containing resistive elements.



Key Concepts: 1. AC circuits 2. Hot wire ammeter 3. Reactance of capacitor 4. Reactance of inductor 5. Impedance 6. rms voltage, current, power

Skills: 1. Determine total impedance of an AC circuit made up of series and parallel combinations of resistors 2. Understand difference between peak-peak voltage and current measurements and RMS measurements

Essential Questions: Do resistors and inductors behave the same or differently when power sources alternate their polarity?

Textbook and Resource Materials: Do resistors and inductors behave the same or differently when power sources alternate their polarity?

Evidence of Learning: \* the student can calculate induced EMF in a secondary coil of a transformer. \* Student can differentiate between the structure of the two types of transformer.

Capstone Connection: Production of energy needed to be provided for different industrial processes.

Relations: 0

SEC Topic & Code: HSST-PH 2.05- HSST-PH 2.02 (HSST-PH 2.05- HSST-PH 2.02)

### [assignment](#)

- PH.2.13 - Analyze the filtering characteristics of circuits containing capacitors...[expand\\_more](#)[link](#)

Week 9 - 0

Comment(s):

Describe impedance = resistance + reactance . Whether this should include full mathematical treatment including magnitudes of complex impedances will depend on whether it has been covered already, or will be done in the future. Even without math analysis, the frequency dependence of reactance should be demonstrated in laboratory or via simulation. Students should not be very surprised by filtering behavior b/c they have already seen the complementary behavior of capacitors and inductors in DC circuits Now though we are looking at complementary behavior of capacitors and inductors in AC circuits It is good to stress the oscillation of energy between electric and magnetic fields in LCR circuits For an application, filters are essential for communication systems

Learning Outcome: Analyze the filtering characteristics of circuits containing capacitors and/or inductors

Key Concepts: 1. LCR circuit 2. Resonance and resonance circuits 3. Band-pass filter 4. Low-pass filter 5. High Pass filter

Skills: 1. Measure the resonance behavior of a band pass filter 2. Calculate the resonant frequency of a band-pass filter 3. Explain how a low pass filter works based on the reactance of an inductor 4. Explain how a high pass filter works based on the reactance of a capacitor

Essential Questions: What happens when electrical power that oscillates in time is provided to circuit elements that display time behavior?

Textbook and Resource Materials: What happens when electrical power that oscillates in time is provided to circuit elements that display time behavior?

Evidence of Learning: \* Student can determine self induction of a coil and compare between the forward and backward induced emf by self- induction of a coil. \* Student can draw the graph between emf induced in a coil by self induction and the time.

Capstone Connection: Production of energy needed to be provided for different industrial processes.

Relations: 0

SEC Topic & Code: HSST-PH 2.05 (HSST-PH 2.05)

[assignment](#)

Semiconductors (2019)

- PH.2.14 - Analyze the properties of conductors, insulators, and semiconductors in terms...[expand\\_morelink](#)

Week 10 - 0

Comment(s):

This LO is the first of several LO's concerning quantum behavior and as such it should not be too mathematically intense. The basic quantum idea of discrete energy levels must be discussed, plus the development of energy bands when many atoms are near each other in a solid. The quantum stuff is effectively used here to help explain the ability of a designer to manufacture materials of almost any conductivity between insulators and conductors. Identifying the properties of intrinsic semiconductors such as Si and Ge, and then the effect of adding dopants that are either donors or acceptors should be a focus. Calculation of the effective number of charge carriers should be covered.

Learning Outcome: Analyze the properties of conductors, insulators, and semiconductors in terms of energy bands and donor or acceptor atoms

Key Concepts: 1. Classification of elements according to electric conductivity. 2. Doping with donors and acceptors 3. Energy band gap

Skills: 1. Explain the difference between the two kinds of semiconductors (pure - impure, or intrinsic/extrinsic). 2. Explain the presence of the energy band gap at a P-N junction 3. Calculate effective numbers of charge carriers

Essential Questions: What is a possible benefit of having a material that conducts electricity, but not nearly as efficiently as a metal conductor?

Textbook and Resource Materials: What is a possible benefit of having a material that conducts electricity, but not nearly as efficiently as a metal conductor?

Evidence of Learning: 0

Capstone Connection: 0

Relations: 0

SEC Topic & Code: HSST-PH 2.06 (HSST-PH 2.06)

### [assignment](#)

- PH.2.15 - Analyze simple DC and AC circuits containing diodes.  
[expand\\_morelink](#)

Week 11 - 0

Comment(s):

This follows and amplifies the P/N junctions and band gaps discussed in previous LO-- The goal is to justify the threshold voltage, and the one-directionality of a basic diode. Discuss what should happen in forward bias, especially that there will be a threshold voltage. Do a lab demo/web simulation showing this. Follow up with a discussion of reverse bias, and breakdown voltage. Applications of both forward and reverse bias should be covered. Analysis of a DC circuit with one diode should be featured. This is done in two steps: (1) assuming diode is not conducting, and (2) diode is conducting. If diode is conducting, the threshold voltage appears across the diode (note connection with this past year's practical exam) For AC circuit, use a basic half-wave rectifier circuit to analyze/measure. A good assignment is to ask students how to design a full-wave rectifier. applications of circuits with diodes: LED's...rectifiers and AC/DC converters...

Learning Outcome: Analyze simple DC and AC circuits containing diodes.

Key Concepts: 1. The P-N junction 2. forward vs. reverse bias connection 1. Diodes as one-way devices 2. Threshold voltage 3. non-ohmic device 4. Voltage Rectification 5. Breakdown voltage  
Skills: 1.. Compare with drawing between forward and backward connections of P-N junction. 2. Give examples of P-N junction applications. 3. Measure practically the current in each of the P-N junction connections. 5. Describe i-v properties of diodes in forward-bias 6. Describe i-v properties of diodes in reverse-bias 7. Analyze current through and voltage across resistive elements when a diode is present in a DC circuit 8. Analyze current through and voltage across resistive elements when a diode is present in an AC circuit 9. Explain how a rectifier circuit can be used for AC-DC conversion

Essential Questions: How can AC power be converted to DC power?

Textbook and Resource Materials: How can AC power be converted to DC power?

Evidence of Learning: 0

Capstone Connection: 0

Relations: 0

SEC Topic & Code: HSST-PH 2.06 (HSST-PH 2.06)

## Transistors (2019)

- PH.2.16 - Analyze basic circuits containing a bipolar transistor used as a digital...[expand\\_more](#)[link](#)

### Week 12 - Week 14

#### Comment(s):

This is an intro to basic n-p-n transistor --- just a description of how each interface works, and how the base current controls collector-emitter current. Students should get a basic qualitative understanding of transistors being off and on --- and that when on the transistors are "saturated"...i.e. at some fixed level...which leads to the possibility of physically representing 1's and 0's. The idea of using 1's and 0's for everything leads to the binary system which will be covered in the next LO. For the purposes here, students should understand that transistors are turned off/on by controlling a small base current, i.e. allowing for switches activated by any small source of current. see <http://www.allaboutcircuits.com/textbook/semiconductors/chpt-4/transistor-switch-bjt/>

Learning Outcome: Analyze basic circuits containing a bipolar transistor used as a digital switch or amplifier.

Key Concepts: 1. Bipolar Transistor (P-N-P) and (N-P-N) 2. Use of the transistor as a digital switch 3. Use of transistor as an amplifier. 4. base-emitter current 5. collector-emitter current 6. DC current gain 1. Binary numbers 2. Logic gates 3. truth table

Skills: 1. Draw a circuit to show the usage of the transistor as: a) switch. b) an amplifier. 2..

Describe how a NOT gate can be designed with a single transistor 3.. Implement logical expressions using standard logic gates 4. express by symbols PNP and NPN transistors 5- calculate the current gain (amplification factor) and current division factor of a transistor

Essential Questions: Can an electrical switch be manufactured that is activated by a very small current? Can an electronic device be manufactured that amplifies input signals?

Textbook and Resource Materials: Can an electrical switch be manufactured that is activated by a very small current? Can an electronic device be manufactured that amplifies input signals?

Evidence of Learning: 0

Capstone Connection: 0

Relations: 0

SEC Topic & Code: HSST-PH 2.06 (HSST-PH 2.06)

# Physics Grade 3

Optics (2019)

## folder

- PH.3.01 - Analyze the motion of travelling transverse and longitudinal waves.  
expand\_morelink

Week 1 - 0

Comment(s):

Stress that electromagnetic waves are non-mechanical waves, i.e. no medium required --- but fields are moving through empty space (this is a spiral back to fields) The power of physics: the mathematics here is same as travelling waves covered in mechanics year 2 S2, with the complication that there are E-fields and B-fields dancing around each other, with an energy flux density (Poynting vector) in direction of  $\mathbf{E} \times \mathbf{B}$  ( a spiral to cross-product, which is covered in mechanics Y3S1) Sometime should be devoted to talking about how EM waves are created.. and the parallels with mechanical waves Speed of light in different media, and a wave description of index of refraction would be very good if time permits Also, wondering if possible to talk about wave equation...at least show that  $\sin(kx - \omega t)$  satisfies a certain type of differential equation (which may mean the first time partial differentiation is seen ... not sure if students will see this in calculus) finally, here's an excellent resource: <http://en.tekstenuitleg.net/articles/networking/how-wireless-communication-works> in which EM waves are done in context of wireless networks

Learning Outcome: Analyze the motion of travelling transverse and longitudinal waves.

Key Concepts: 1. Mechanical waves 2. Transverse waves 3. Longitudinal waves 4. Wave speed in a medium 5. Wavelength

Skills: 1. Describe travelling waves using  $\sin(kx - \omega t)$  2. Determine speed of waves on a string 3. Understand pressure and displacement views of a travelling longitudinal wave

Essential Questions: What are the main types of the waves?

Textbook and Resource Materials: What are the main types of the waves?

Evidence of Learning: Questions and problems from Haliday Holt: Practice (B) page 427. Holt: Review page 431. Holt: page 434 - 435 Review. quizzes on google drive and some others are hard copies

Capstone Connection: Introduction for communication and communication systems. Integration with STEM Subject areas Math., G. 2, S.1, L.O. 2.04

Relations: 0

SEC Topic & Code: HSS-PH 3.02 (HSS-PH 3.02)

assignment

- PH.3.02 - Analyze oscillatory motion.  
expand\_morelink

Week 02 - Week 03

Comment(s):  
0

Learning Outcome: Analyze oscillatory motion.

Key Concepts: 1. Oscillation as a periodic motion 2. Parameters of oscillatory motion (amplitude - frequency - periodic time - energy) 3. Applications of oscillation (resonance - earthquakes - bridges)

Skills: 1. Identify the amplitude of oscillation 2. Recognize the relationship between frequency and period 3. Measure oscillation parameters practically 4. Determine the free fall acceleration practically through the Oscillation of a pendulum 5. Apply the concept of energy conservation to simple harmonic motion

Essential Questions: What is the relation between the frequency and the wavelength of a wave? Explain how the energy is conserved in the simple pendulum?

Textbook and Resource Materials: What is the relation between the frequency and the wavelength of a wave? Explain how the energy is conserved in the simple pendulum?

Evidence of Learning: Questions and problems from Haliday Holt: Practice (B) page 427. Holt: Review page 431. Holt: page 434 - 435 Review. quizzes on google drive and some others are hard copies

Capstone Connection: Modern communications use waves. Integration with STEM subject areas: Math., G. 2, S.1, L.O. 2.04

Relations: 0

SEC Topic & Code: HSS-PH 3.02 (HSS-PH 3.02)

[assignment](#)

Reflection of light (2019)

[folder](#)

- PH.3.03 - Use geometrical optics and laws of reflection to analyze the path of light...expand\_morelink

Week 03 - Week 04

Comment(s):  
0

Learning Outcome: Use geometrical optics and laws of reflection to analyze the path of light rays in optical systems consisting of planar mirrors.

Key Concepts: 1. Light rays 2. Law of Reflection. 3. Real & Virtual image. 4. Image formation in plane mirror. 5. Focus & Optical axis. 6. Convex & Concave mirrors. 7. Magnification.

Skills: 1. Use law of reflection to determine the position and size of image(s) formed when an object placed in front of a set of plane mirrors. 2. Predict image formed by concave/convex mirrors using ray-tracing and mirror equation. 3. Use optical bench to confirm mirror equations.

Essential Questions: What is the size of the smallest plane mirror that you need to view an image of your entire body?

Textbook and Resource Materials: What is the size of the smallest plane mirror that you need to view an image of your entire body?

Evidence of Learning: Holt: practice (B) page 379 Haliday: page 386 Haliday: page 403 Haliday page 404. Quizzes on google drive. Experiment.

Capstone Connection: Introduction for communication and communication systems.

Relations: 0

SEC Topic & Code: HSS-PH 3.01 (HSS-PH 3.01)

[assignment](#)

Communications (2019)

[folder](#)

- PH.3.04 - Design a system of communication through applying previous knowledge...[expand\\_more](#)[link](#)

Week 05 - Week 06

Comment(s):

This LO allows for a dramatic tie-in with the previous LO, in which Planck's energy quanta are now identified with photons. This LO allows you to spiral back to energy levels and bands that appeared at the end of physics Y2s2. In photoemission problems, be sure to cover situations where incident intensity remains the same, or where it changes applications: solar cells --- lasers. This LO is probably the right place to talk about the connections with wave view and particle view ... & the geometric optics approach. i.e. things like amplitude of wave is proportional to photon flux.

Learning Outcome: Design a system of communication through applying previous knowledge (electronics, LASER, mechanical...

Key Concepts: 1. Basic elements of communication. 2. Ground, Sky, Space wave propagation. 3.

Antennas. 4. Covering range of T.V transmitting tower. 5. Maximum usable frequency. 6. Satellite communication. 7. Mobile phones. 8. Optical fibers.

Skills: 1. Design a flowchart to express a communication system 2. Explain how information can be transmitted as variation in amplitude and frequency of waves 3. Use diagrams to design a system of communication 4. Analyze different communication systems to identify sorts of variation included 5. Apply previous knowledge (electronics, LASER, mechanical waves and em waves) to design 6. A system of communication and transmitting data

Essential Questions: Local TV Channels can not transfer matches of soccer world Cup, why?

Textbook and Resource Materials: Local TV Channels can not transfer matches of soccer world Cup, why?

Evidence of Learning: Quizzes on the internet

Capstone Connection: an introduction for communications

Relations: 0

SEC Topic & Code: HSS-PH 3.04 (HSS-PH 3.04)

## assignment

- PH.3.05 - Describe how information can be transmitted via electromagnetic radiation  
[expand\\_morelink](#)

Week 07 - Week 08

Comment(s):

First real detailed to quantum stuff (recall that energy levels and energy bands, band gaps, etc. have been described in semiconductor LO's) Blackbody radiation is important. Wien's and Stefan-Boltzman Laws are topics for classroom, or reading, but are not essential to the quantum view. What is essential is Planck's explanation of black-body curve assuming quantized energy ... which ultimately became recognized as photon energy in photoelectric effect. If time permits, quantum explanation of Wien is a good idea. It's also a good idea to start introducing phenomena that are explained by energy quantization, and observations that are analyzed using conservation of energy principles. Hence Compton scattering and x-ray production are good examples. Check out this pdf of slideshow from UCSD: <http://www-physics.ucsd.edu/students/courses/winter2009/physics1C/documents/8.1ParticleNatureofLight.pdf>

Learning Outcome: Describe how information can be transmitted via electromagnetic radiation

Key Concepts: 1. Encoding information 2. Amplitude modulation 3. Frequency modulation 4. Digital vs analog data 5. Digital vs. analog transmission 6. Wifi 7. Sampling.

Skills: 1. Convert base 10 values to binary and vice-versa 2. Explain how AM can be used to encode digital data. 3. Explain how FM can be used to encode digital data. 4. Analyze effect of sampling rate on data transmission

Essential Questions: How can TV, radio, cellular, and data signals be transmitted through open air, and even outer space?



Textbook and Resource Materials: How can TV, radio, cellular, and data signals be transmitted through open air, and even outer space?

Evidence of Learning: quizzes on google drive and some others are hard copies

Capstone Connection: using LASER in communications

Relations: 0

SEC Topic & Code: HSS-PH 3.04 (HSS-PH 3.04)

assignment

Refraction of light. (2019)

## folder

- PH.3.06 - Use geometrical optics to analyze image formation from concave/convex...expand\_morelink

Week 09 - 0

Comment(s):

Demos and laboratory are very effective here, especially for index of refraction and total internal reflection. It is encouraged to do a number of problems totally geometrically qualitatively, without resorting to formulas. In this way students should be encouraged to think more about which way light rays bend when passing through dense to less-dense optical material (or vice-versa) in addition to flat lenses, total internal reflection and fiber optics should also be discussed here is an excellent slide show on refraction from U Colorado:

[http://www.colorado.edu/physics/phys1230/phys1230\\_sp09/classnotes/6\\_Refraction.pdf](http://www.colorado.edu/physics/phys1230/phys1230_sp09/classnotes/6_Refraction.pdf)

Learning Outcome: Use geometrical optics to analyze image formation from concave/convex lenses.

Key Concepts: 1. Index of refraction. 2. Snell's law. 3. Total internal reflection. 4. Focus & Optical axis. 5. Real & Virtual image. 6. Convex & Concave lenses. 7. Magnification.

Skills: 1. Predict image formed by concave/convex lenses using ray-tracing and lens equation. 2. Determine critical angle for total internal reflection when light passes from more dense to less dense optical material. 3. Explain the optics of a reflecting telescope. 4. Explain the optics of a refracting telescope. 5. Explain the optics of a compound microscope. 6. Use an optical bench to measure the focal point of lenses. 7. Use optical bench to confirm lens equations.

Essential Questions: Explain why travelers may think that they see water in a "phantom oasis"

Textbook and Resource Materials: Explain why travelers may think that they see water in a "phantom oasis"

Evidence of Learning: 0

Capstone Connection: using waves in communications

Relations: 0

SEC Topic & Code: HSS-PH 3.01 (HSS-PH 3.01)

[assignment](#)

- PH.3.07 - Use wave description of light to analyze interference and diffraction.  
[expand\\_morelink](#)

Week 10 - Week 11

Comment(s):

Note that some of the skills here are also listed in the LO before it...The two together are basically one long LO

Learning Outcome: Use wave description of light to analyze interference and diffraction.

Key Concepts: 1. Superposition 2. Constructive/Destructive Interference 3. Slits and interference patterns 4. Diffraction gratings 5. Resolution of optical instruments.

Skills: 1. Explain/analyze young double-slit experiment 2. Explain/analyze use of diffraction gratings to produce monochromatic radiation 3. Calculate the resolving power of an objective lens

Essential Questions: •What is the resolving power of your eye? •How large can a photo taken on your smart phone be enlarged before the image degrades?

Textbook and Resource Materials: •What is the resolving power of your eye? •How large can a photo taken on your smart phone be enlarged before the image degrades?

Evidence of Learning: Questions and problems from Haliday-quizzes on google drive and some others are hard copies - Experiments

Capstone Connection: 0

Relations: 0

SEC Topic & Code: HSS-PH 3.03 (HSS-PH 3.03)

[assignment](#)

- PH.3.08 - Analyze light as electromagnetic waves consisting of travelling electric and...  
[expand\\_morelink](#)

## Week 12 - 0

### Comment(s):

This LO should focus more on encoding digital data into either analog or digital transmission.  
here's a website with the basic idea;

<http://www.qrg.northwestern.edu/projects/vss/docs/communications/1-how-is-data-put-on-radio-waves.html>

Learning Outcome: Analyze light as electromagnetic waves consisting of travelling electric and magnetic field waves

Key Concepts: 1. Electromagnetic waves 2. Wave properties: frequency, wavelength, speed 3. Polarized vs unpolarized light 4. Electromagnetic spectrum 5. Energy in electromagnetic waves

Skills: .1. Describe experimental observations that suggest light is a wave 2. Understand different regions of EM spectrum (IR, UV, visible, x-ray. etc..) and their uses 3. Explain how speed of light is determined 4. Explain evidence that speed of light constant in all reference frames

Essential Questions: How can light be characterized as both a wave and a particle?

Textbook and Resource Materials: How can light be characterized as both a wave and a particle?

Evidence of Learning: Questions and problems from Haliday- quizzes on google drive and some others are hard copies - Experiments

Capstone Connection: None Integration with STEM subject areas: Chem. , G.1 S.1, L.O. 3.03

Relations: 0

SEC Topic & Code: HSS-PH 3.03 (HSS-PH 3.03)

### assignment

- PH.3.09 - Analyze the production of complex waves using the principle of...[expand\\_morelink](#)

## Week 13 - Week 14

### Comment(s):

0

Learning Outcome: Analyze the production of complex waves using the principle of superposition.

Key Concepts: 1. Superposition of waves. 2. Interference. 3. Diffraction.

Skills: 1. Draw diagrams to express the resultant wave due to superposition between two waves.

2. Analyze the outcome of constructive and destructive interference of transverse wave pulses and use this to make predictions with other wave pulses. 3. Students will also recognize the standing wave on a resonant spring as being the superposition of two sinusoidal travelling waves.

Essential Questions: 0

Textbook and Resource Materials: 0

Evidence of Learning: Questions and problems from Haliday - quizzes (hard copies)

Capstone Connection: None

Relations: 0

SEC Topic & Code: HSS-PH 3.02 (HSS-PH 3.02)

[assignment](#)

Quantum Nature of Light (2019)

- PH.3.10 - Discuss evidence for the particle model of light and analyze specific...[expand\\_morelink](#)

Week 01 - Week 03

Comment(s):

This LO brings back Newtonian ideas, namely the nature of force allowing electrons to spin in the Bohr model (which must be emphasized as definitely what is not actually happening in the atom, but nevertheless provides a model with very accurate predictive power. This is a nice opportunity to discuss the nature of physical models) The Bohr model can be used to go into incredible detail on the line spectra of hydrogen, including Balmer, Rydberg, etc. Push Bohr to higher Z atoms ionized so that only one electron remains is a worthwhile exercise. See <http://courses.washington.edu/bhrchem/c152/Lec17.pdf> for possibilities

Learning Outcome: Discuss evidence for the particle model of light and analyze specific situations in terms of energy, wavelength, and temperature

Key Concepts: 1. Blackbody radiation 2. Energy quantization 3. Planck's Constant 4. Photon 5. x-rays 6. Inelastic scattering (Compton effect). Wave nature of the particle.

Skills: 1. Explain blackbody radiation, including laws associated with energy distribution (Wien, Stefan-Boltzman) 2. Solve Wien and Stefan-Boltzman type problems 3. Explain impossibility of wave explanation (ultraviolet catastrophe) 4. Explain Planck's success in matching blackbody distribution using assumption of quantized energy changes 5. Determine relationship between kinetic energy of electrons and emitted photons in x-ray emission 6. Apply the law of conservation of energy in analysis of Compton scattering and x-ray production. 7. Determine relationship between kinetic energy of electrons and emitted photons in x-ray emission 8. Properties of photon (Energy, mass, momentum, rate of photons, force) 9. Solve problems on De-Broglie equation.

Essential Questions: •How can we tell the temperature of the sun and other stars? •How are x-rays produced?

Textbook and Resource Materials: •How can we tell the temperature of the sun and other stars? •How are x-rays produced?

Evidence of Learning: Questions and problems from Haliday - quizzes (hard copies)

Capstone Connection: None.

Relations: 0

SEC Topic & Code: HSS-PH 3.05 (HSS-PH 3.05)

[assignment](#)

- PH.3.11 - Analyze the interaction of light and matter using the Photoelectric Effect...[expand\\_morelink](#)

Week 04 - Week 05

Comment(s):

Depeding on what is done in CHM, there may be a lot of overlap here, including analysis of x-ray data for crystal structure determination. Plenty of simulations available for crystal structure, and erngy band formation

Learning Outcome: Analyze the interaction of light and matter using the Photoelectric Effect where appropriate.

Key Concepts: 1. Photoelectric effect 2. Work function 3. Intensity 4. Cut-off frequency 5. LED's 6. Laser 7. Photocell

Skills: 1. Calculate cut-off frequency that will generate photoelectricity for a given material 2. Predict how photocurrent varies with changes in frequency and intensity 3. Compare wave and photon views of light 4. Describe principles behind photoabsorption and photoemission 5. Explain basic physics of Lasers 6. Explain basic physics of LED's 7. Explain basic conversion of light to electrical energy using photocell 8. Solar cell calculations: fill factor, efficiency; explanation of deviation from ideal behavior.

Essential Questions: •How can the sun's energy be used to generate electricity? •What is the explanation for the Greenhouse effect?

Textbook and Resource Materials: •How can the sun's energy be used to generate electricity? •What is the explanation for the Greenhouse effect?

Evidence of Learning: Questions and problems from Haliday - quizzes (hard copies)

Capstone Connection: None.

Relations: 0

SEC Topic & Code: HSS-PH 3.05 (HSS-PH 3.05)

[assignment](#)

## Materials Physics 1: Thermal & Electrical Properties (2019)

- PH.3.12 - Explain the thermal and electrical properties of materials using quantum...[expand\\_morelink](#)

### Week 06 - Week 07

#### Comment(s):

Depending on the level to be covered, the material here can be quite mathematical, including, say, BCS theory of superconductivity. But this would involve coverage of phonons, coupled oscillators, etc. Same with superfluids: one would have to get into phonon distributions as functions of  $T$ . (Note: b/c of this, there are mathematical similarities between superfluids and superconductors) Probably best to be simply descriptive here, with focus on general rules of thumb, applications, and current research, e.g. high- $T$  superconductors. Stress the energy benefits of superconductivity...

Learning Outcome: Explain the thermal and electrical properties of materials using quantum concepts from solid-state physics

Key Concepts: 1. Solid-state physics 2. Crystal structure 3. Coulomb forces 4. Phonons 5. Energy bands.

Skills: 1. Explain typical metal crystal structures (Simple cube, fcc, bcc, hcp) 2. Analyze vibration modes in a 1-D crystal structure 3. Miller indices. 4. Explain how photoelectron spectroscopy can be used to probe electron energy bands in solids

Essential Questions: •Why is iron a conductor while silicon is a semi-conductor? •Why is the speed of sound in titanium so much higher than in air?

Textbook and Resource Materials: •Why is iron a conductor while silicon is a semi-conductor? •Why is the speed of sound in titanium so much higher than in air?

Evidence of Learning: Haliday textbook

Capstone Connection: None. Integration with STEM subject areas: Math. G. 3, S.2, L.O. 3.10, 3.11 Chem. G.3 S.2, L.O. 3.12, 3.14

Relations: 0

SEC Topic & Code: HSS-PH 3.06 (HSS-PH 3.06)

[assignment](#)

## Materials Physics 2: Low Temperature Physics (2019)

- PH.3.13 - Explain the superconductivity and/or superfluidity for certain materials at...[expand\\_morelink](#)

## Week 08 - Week 09

### Comment(s):

See Nanotechnology Classroom Activities and Curriculum Materials: an incredible resource for all disciplines, organized by school level and discipline... <http://www.nnin.org/education-training/k-12-teachers/nanotechnology-curriculum-materials>

Learning Outcome: Explain the superconductivity and/or superfluidity for certain materials at very low temperatures using quantum mechanics concepts.

Key Concepts: 1. Cooling processes 2. Van Der Waals effect and chemical reaction 3. Super fluidity 4. Viscosity 5. Bose-Einstein condensates 6. Superconductivity 7. Cooper pairs

Skills: 1. Explain several cooling mechanisms that can bring materials close to 0K 2. Explain the properties of superfluids 3. Explain some applications of superfluidity. 4. Explain the properties of some metals at very low temperature. 5. Explain some applications of superconductors.

Essential Questions: Does life as we know it come to a stop when the temperature is Absolute Zero?

Textbook and Resource Materials: Does life as we know it come to a stop when the temperature is Absolute Zero?

Evidence of Learning: 0

Capstone Connection: 0

Relations: 0

SEC Topic & Code: HSS-PH 3.06 (HSS-PH 3.06)

[assignment](#)

## Materials Physics 3: Nanoparticles (2019)

- PH.3.14 - Describe new mechanical and electrical properties for objects in the nanoscale...[expand\\_morelink](#)

## Week 10 - Week 11

### Comment(s):

Relativistic kinematics has already been covered in mechanics (Y3S1). Now is the time to develop relativistic mass, energy-mass equivalent, etc....

Learning Outcome: Describe new mechanical and electrical properties for objects in the nanoscale range.

Key Concepts: 1. Nanoparticles 2. Nanofabrication 3. Atomic force microscope 4. Scanning tunneling microscope 5. Nanotubes

Skills: Skills will depend on focus areas. For ideas see: <http://www.nnin.org/education-training/k-12-teachers/nanotechnology-curriculum-materials>

Essential Questions: How can the science and engineering of nanomaterials be used to design/create more energy efficient materials for construction in Egypt?

Textbook and Resource Materials: How can the science and engineering of nanomaterials be used to design/create more energy efficient materials for construction in Egypt?

Evidence of Learning: 0

Capstone Connection: 0

Relations: 0

SEC Topic & Code: HSS-PH 3.06 (HSS-PH 3.06)

[assignment](#)