Physics: Grade 1, Semester 1

Matter, Form and Function

Big Idea: For a structure to be sustainable, it must withstand different forces.

PH.1.01 - Students will be able to make measurements precisely and accurately using a variety of measurement tools. (Week 01 - Week 02)

Essential Questions:
- What are common sources of measurement error?
- What are the consequences of imprecise and/or inaccurate measurements?

Skills:
- A. Identify and describe systems of measurement
- B. Convert units between different systems of measurement
- C. Determine sources of measurement errors
- D. Use basic measurement tools to measure/compute length, area, volume and time
- E. Use dimensional analysis to verify or predict a physical law

Concepts:
- A. Physics as experimental science
- B. Systems of measurements and standards
- C. International system of units
- D. Prefixes of metric units
- E. From Macro to Nanoscale
- F. Measurement errors
- G. Measurement accuracy vs. precision
- H. Dimensional analysis

Evidence:
RECALL; ?????

compare the units of SI system and GCS system

BA; holt_ch1 book -q2-pg 20 *****

ST; holt_ch1 book -q4-pg 20

Texts & References: Active Physics p 22-26 *****

Capstone Connection: Using measurements in all capstone project topics.

Grand Challenge Connections: Address the exponential population growth and prepare for the impact,Reduce urban congestion and its impact,Increase industrial base for Egypt

Applications: CH.3.02,

Topic: unitsmeasurementmeasurement erroraccuracy

PH.1.02 - Students will be able to use Newton's 3rd Law to identify the forces of interaction that exist between pairs of objects (Newtonian pairs) (Week 03 - Week 04)

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?

Skills:
- 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.

Concepts:
- A. Forces
- B. Static equilibrium
- C. Dynamic equilibrium
- D. System of forces
- E. Newton's third law
- F. Free body diagram
- G. Action-Reaction Pairs
- H. Point particle

Evidence:
RECALL: mention Newton's third law ?????
BA; holbook t _ch4_sec1 -q3-pg 134 ******

ST; holt_ch4_sec1 book -q5-pg 134 *****
Texts & References: Active Physics p 199-209 *******
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.
Grand Challenge Connections: Address the exponential population growth and prepare for the impact,Reduce urban congestion and its impact,Increase efficient use of our land through improved use of arid areas
Topic: Force and equilibrium

PH.1.03 - Students will be able to predict an object's motion based on the forces that are acting on it. (Week 04 - Week 06)

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?

Skills:

- A. Identify forces acting on an object and represent them pictorially in a free body diagram.
- B. Use free-body diagram to determine net force acting on a body via graphical vector addition
- C. 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)
- D. Given all of the forces acting on a body, apply Newton's 2nd law to determine the acceleration of an object not in equilibrium
- C. Knowing the state of motion of an object but not all forces on a body, determine the resultant of the unknown force(s)
- D. 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..
- E. Identify the force or forces that cause a body to move in a circle about a fixed point in space

Concepts:

- A. Equilibrium vs. motion vs. change in motion
- B. Force as a vector
- C. Net force acting on a free body.
- D. Newton's Laws of Motion
- E. Centripetal acceleration
- F. Centripetal force
- G. Inertial reference frame

Evidence:

RECALL: mention Newton's Laws of motion and their mathematical expressions ???????
BA; holbook t _ch4_ -q1-pg 129 ******

ST; holtbook _ch4_-q5-pg 129 *****
Texts & References: Active Physics p 132 – 143; p 157 – 173 *******
Capstone Connection: How to achieve the stability of the sustainable structure of your capstone project?
Grand Challenge Connections: Address the exponential population growth and prepare for the impact,Increase efficient use of our land through improved use of arid areas
Topic: motion, equilibrium, acceleration, Newtons' Laws
Net Force

PH.1.04 - Students will be able to 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. (Week 07 - Week 08)

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"?

Skills:

- A. Differentiate between mass and weight
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- B. Solve problems to determine the mass, weight and apparent weight in different physical

situations

- C. Apply the General Law of Gravitation to qualitatively rank the gravitational field of different planets (using only M/R^2)
- D. Identify the action-reaction pairs that exist when an object close to earth experiences a force due to gravity (i.e. a weight)

Concepts:

- A. Mass
- B. Gravity
- C. Gravitational field
- D. Weight
- E. General Law of Gravitation
- E. Newton's Second Law in gravitational field
- F. Free Fall
- G. Apparent weight

Evidence:
"RECALL:compare between mass and weight ?????
BA; holbook _ch7_ -q2-pg 247 *****

ST; holtbook _ch7_-q5-pg 247 *****
Texts & References: active physics p 157– 173 *****
Capstone Connection: Determine the force between the earth and your Capstone dwelling
Grand Challenge Connections: Increase efficient use of our land through improved use of arid areas
Topic: gravity, weight, and mass

PH.1.05 - Students will be able to determine the conditions for stability of extended rigid bodies by considering translational and rotational equilibrium (Week 09 - Week 10)

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?

Skills:

- A. Determine the center of mass for different objects and systems of objects
- B. Calculate the magnitude of the total torque acting on an object
- C. Identify forces and torques acting on a stationary extended object, and be able to apply the equilibrium torque condition.
- D. Determine the torque of a simple machine: the lever.

Concepts:

- A. Center of mass
- B. Torque
- C. Static equilibrium
- D. Translational vs. Rotational Equilibrium
- D. The equilibrium torque condition: rotational analogue of Newton's Laws

- E. Simple machines
- F. The mechanical advantage of simple machines
- G. 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.

Evidence:
RECALL: what is meant torque and the lever arm ?????
BA; holbook t _ch7_ -q1-pg 258 *****

ST; holtbook _ch7_-q3-pg 258
Texts & References: active physics p 157– 173 *****
Capstone Connection: How to save effort during the building process? ?????Not sure what this is getting at: seems like a question about simple machines?????
Grand Challenge Connections: Address the exponential population growth and prepare for the impact,Increase efficient use of our land through improved use of arid areas
Topic: torque, rotational equilibrium, equilibrium, simple machines

PH.1.06 - Students will 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. (Week 11 - Week 12)

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?

Skills:
- A. Measure spring constant of a linear spring
- B Measure stress and strain of different materials
- C. Calculate stress and strain of different materials
- D. Measure Young's modulus for a material
- E. Calculate Young's modulus for a material
- F. Identify unknown materials using Young's modulus

Concepts:
- A. Elasticity & Hooke's Law
- B. Range of validity for Hooke's Law
- C. Stress and strain
- D. Young's modulus

Evidence:
RECALL:mention mathematical formale of Hook,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 3 10–4 m2, and Young’s modulus
8.00 3 1010 N/m2. What is its increase in length?
10.
ST:pg323_q12_surway book
Assume that if the shear stress in steel exceeds
about 4.00 3 108 N/m2, 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.
Texts & References: Holt ch 11 & Haliday ch 7 part 1
Capstone Connection: Role of elasticity in building materials and design
Grand Challenge Connections: Address the exponential population growth and prepare for the impact,Increase efficient use of our land through improved use of arid areas,Increase industrial base for Egypt
Topic: stress, strain, Hooke's Law

PH.1.07 - Students will be able to predict an object's motion when it is subject to a restoring force (Week 11 - Week 12)

Essential Questions:
- If your heart has a restoring force when it stretches or contracts, how will your heartrate change if your heart becomes thicker?
- Which one is more elastic, an iron string or a spider string, and why?

Skills:
- A. Determine the limit of elasticity of different springs
- B. Use Hooke's law to design spring suspensions
- C. Apply Hooke's Law to measure weight of an object

Concepts:
- A. Hooke's Law & Linear Springs
- B. The spring constant
- C. Yield point
- D. Tension and compression

Evidence:
RECALL:mention Hook's law
BA:active ph_pg 402_q_4
ST:active ph_pg 402_q_5
Texts & References: active physics
ch4_sec 5_pg 392
Capstone Connection: Role of elasticity in building materials and design
Grand Challenge Connections: Address the exponential population growth and prepare for the impact,Increase efficient use of our land through improved use of arid areas
Topic: linear springs and Hooke's Law

Physics: Grade 1, Semester 2

Energy Force and Power

Big Idea: Power of nature can be transformed into energy that benefits man.

PH.1.08 - Students will be able to use pressure difference between two points of a fluid and Newton's laws to analyze behavior of that fluid. (Week 01 - Week 03)

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?

Skills:
- A. Determine pressure change as function of height in columns of fluid
- B. Explain how a mercury barometer measures atmospheric pressure
- C. Determine atmospheric pressure as a function of altitude
- D. Convert between different pressure units (such as: kPa, atm,mm Hg)
- E. Explain how a straw works
- F. Explain how a manometer works
- G. Measure the gauge pressure of a trapped gas
- H. Use manometers & barometers
- I. Explain different boiling points of water at different altitudes
- J. Measure the apparent weight of an immersed object.
- K. Determine the Buoyant force on a submerged, or floating object
- L.Use Archimedes principle to explain why large ships do not sink

Concepts:
- A. Fluids
- B. Pressure
- C. Manometer
- D. Pressure gauge
- E. Units of pressure
- F. Effect of atmospheric pressure on boiling point of water
- G. Change in atmospheric pressure with altitude
- H. Pressure difference and force
- I. Archimedes Principle

Evidence:

quizs, check points, assighnments& disccussions

Texts & References: Holt ch 8 & Haliday CH 14

Capstone Connection: Using gas and steam pressure to generate energy in traditional and alternative energy applications

Grand Challenge Connections: Improve the use of alternative energies to reduce our reliance on extracted fuel sources

Topic: pressure, buoyant force, apparent weight

PH.1.09 - Students will be able to apply principles of fluid dynamics to determine pressure and velocity in a variety of typical fluid systems (Week 04 - Week 06)

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?

Skills:
- A. Apply Bernoulli's Principle in daily life
- B. Explore alternative energy applications of fluid dynamics such as windmills, hydrological dams, tidal generation.
- C. Determination of flow rate.
- D. Determination of volume rate.
- E. Solve problems on flow rate.
- F. Explain some phenomena on equation of continuity.
- G. Explain some applications on Bernoulli's equation.

Concepts:
- A. General properties of Fluids
- B. Continuity equation
- C. Laminar vs Turbulent Flow
- D. Pascal's Principle
- E. pdV = Work
- F. Work-Energy Theorem
- G. Conservation of Energy in fluids
- H. Bernoulli Equation

Evidence:
quizs, check points, assighnments& disccussions
Texts & References: Holt ch 8 & Haliday CH 14
Capstone Connection: Using gas or liquid flowing to generate energy for alternative energy applicaitons.
Grand Challenge Connections: Improve the use of alternative energies to reduce our reliance on extracted fuel sources, Increase industrial base for Egypt
Topic: pressure, velocity, kinetic energy

PH.1.10 - Students will be able to design a system for efficient energy production using concepts of temperature, heat, and thermal energy. (Week 07 - Week 10)

Essential Questions:
- How efficient can a solar collector be?
- Can you make a thermometer without mercury?

Skills:
- A. Differentiate between temperature, thermal energy and heat
- B. Measure temperature

- C. Solve problem of general law of thermometer
- D. Describe how temperature changes as a result energy transfer to a system Convert between different temperature scales (k – f - c)
- E. Describe the natural sources of heat
- F. Explain the idea of solar heat collectors.
- G. Identify the uses of solar heat collector in daily life
- H. Calculate temperature change fora 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.

Concepts:

- A. Temperature
- B. Thermal energy
- C. Heat
- D. Conduction, Convection, Radiation
- D. Measuring Temperature
- E. Temperature scale
- F. Heat capacity
- G. Specific heat capacity
- H. Blackbody radiation
- I. Solar heat collector.
- J. Natural sources of heat: sun, geothermal
- K. Latent heat

Evidence:
quizs, check points, assighnments& disccussions
Texts & References: Holt ch 9 & Haliday CH 18
Capstone Connection: Using light and heat sources to generate other forms of energy
Grand Challenge Connections: Improve the use of alternative energies to reduce our reliance on extracted fuel sources,Increase industrial base for Egypt
Topic: temperature, heat, thermal energy

PH.1.11 - Students will be able to analyze energy flow in typical heating and cooling applications by applying the 1st Law of Thermodynamics. (Week 10 - Week 12)

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?

Skills:

- A. Explain p-v graphs
- B. Calculate the work done as gases are compressed/expanded both mathematically and graphically
- C. Determine equilibrium temperatures in heating/cooling situation
- D. Describe how 1st Law of thermodynamics is applicable for each type of thermodynamic process.
- E. Explain methods to produce low temperature near absolute zero.
- F. Describe applications for low temperature physics.

Concepts:

- A. Conservation of thermal energy
- B. Energy graphs
- C. Low temperature physics
- D. Thermodynamic processes(isothermal – isovolumetric- isobaric- adiabatic)
- E. Phase changes

Evidence:

quizs, check points, assighnments& disccussions

Texts & References: Haliday ch 18

Capstone Connection: Applying Laws of thermodynamics to types of alternative energy.

Grand Challenge Connections: Improve the use of alternative energies to reduce our reliance on extracted fuel sources, Increase industrial base for Egypt

Topic: energy flow, heating, cooling, thermodynamics