

# *Physics L.O*

*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:** units measurement, measurement error, accuracy.

**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; holtbook \_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; holtbook 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
- ▶ 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
- ▶ F. Newton's Second Law in gravitational field
- ▶ G. Free Fall
- ▶ H. Apparent weight

**Evidence:** "RECALL: compare between mass and weight?????"

BA; holtbook \_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
- ▶ E. The equilibrium torque condition: rotational analogue of Newton's Laws
- ▶ F. Simple machines
- ▶ G. The mechanical advantage of simple machines
- ▶ H. 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; holtbook 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 formula 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  $0.200 \times 10^{-4} \text{ m}^2$ , 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. **Texts & References:** Holt Ch. 11 & Halliday 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 heart rate 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 Hooke'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.

**PH.1.08:** applying the concepts of constancy of mechanical energy for an object under the effect of the gravitational force in some physical and life applications.

**Skills:**

- 1 identify the physical meaning of energy, work, and power.
2. determine the K.E, P.E, and M.E for an object.
3. applying the concept of the constancy of mechanical energy for an object under the effect of gravitational force only in some application like pendulum and others.
- 4- determine the factors affect K.E, P.E, and work.
- 5-determine the work done graphically.
6. solve problems to determine the power developed.

**Concepts**

1. Energy.
2. work.
- 3-constancy of mechanical energy for an object that is affected by force of gravity.
- 4-power
- 5-escape velocity of satellite.
- 6-types of potential energy.