Term 2 – Instructional Guide – Part 1

Grade 07 – Science

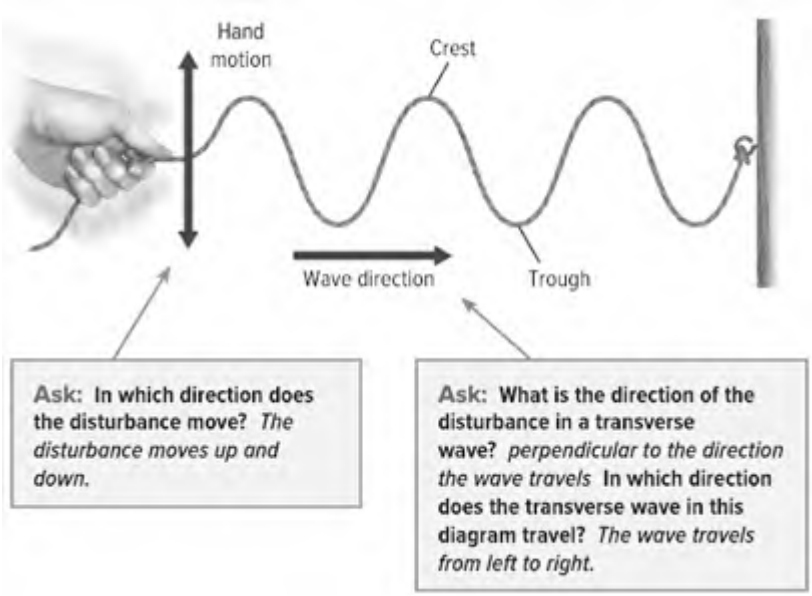
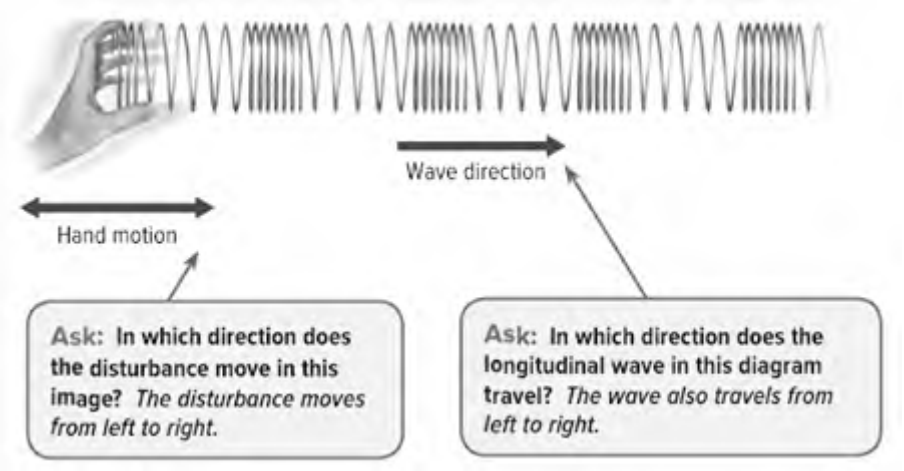
SCI20

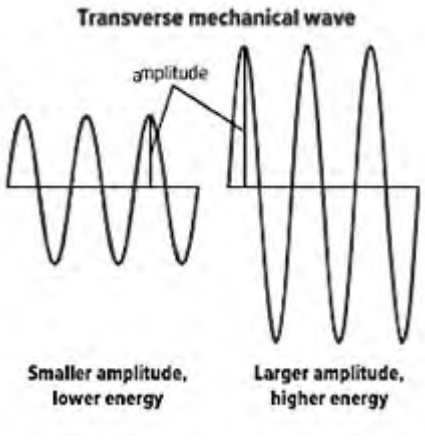
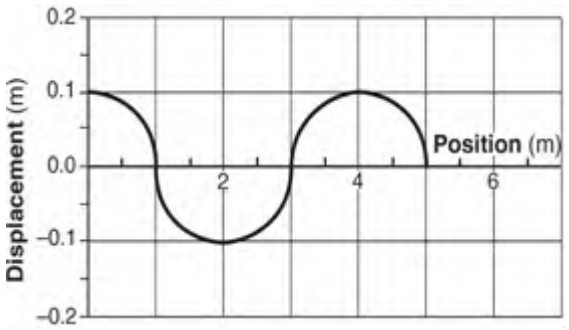
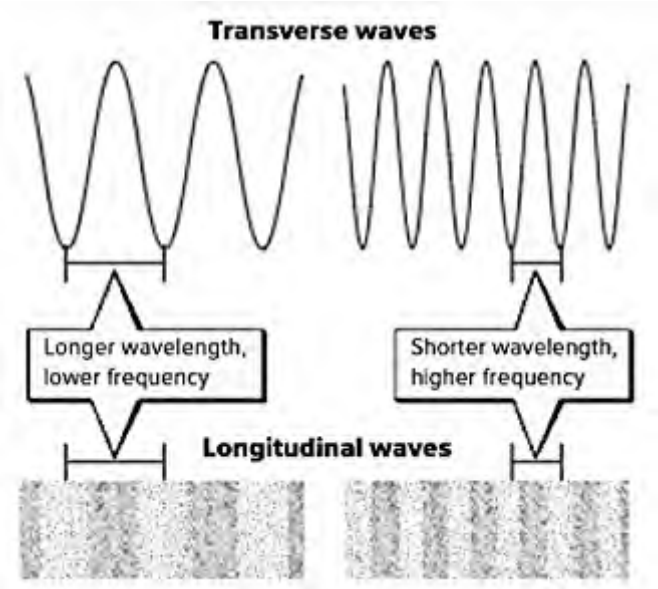
Learning Outcome	Number of Periods	Suggested Exercises /Assignments
LO 13 Describe the production and properties of waves and their interaction with matter (KPIs 13.1 – 13.16)	7	Refer to practice questions below

13.1	Define a wave as a disturbance that transfers energy from one place to another without transferring matter *Understand how a wave affects energy and matter: A wave moves energy from one place to another. A wave moves through matter but does not move it.*
13.2	List some sources of waves and describe how waves transfer energy from place to place and describe how vibrations produce mechanical waves *Mechanical waves are produced when a source of energy causes particles of matter to vibrate. The vibrating particles push against nearby particles, transferring energy. Electromagnetic waves are produced when a source of energy causes a charged particle to vibrate.*
13.3	Classify waves into two types- Mechanical and electromagnetic waves. Further classify mechanical waves into transverse and longitudinal waves
13.4	Use a graphical representation of waves, identifying and defining the crest and trough for a transverse wave as well as compression and rarefaction for a longitudinal wave

Table 1 Types of Wave Motion

Type of Wave Motion	Mechanical Waves	Electromagnetic Waves
Transverse—perpendicular to the direction the wave travels	✓ example: flag waving in a breeze	✓ example: light waves
Longitudinal—parallel to the direction the wave travels	✓ example: sound waves	
Combination—both transverse and longitudinal	✓ example: water waves	

	Transverse wave:  **Longitudinal Wave:** 
13.5	Distinguish between a transverse and longitudinal wave, giving examples of each
Lab 7	Experiment with slinky- transverse and longitudinal waves
13.6	List examples of mechanical waves like sound waves, water waves, seismic waves and discuss their sources *Water waves are causes by the wind pushing against the water. They are a combination of transverse and longitudinal waves, causing water particles to move in small circles.* *Seismic waves can be transverse, longitudinal or a combination of the two types. (P-waves are longitudinal, S-waves are transverse, and the surface waves are a combination of S and P waves)*
13.7	Define electromagnetic wave as a transverse wave that can travel through empty space (vacuum) and through matter
13.8	Define amplitude of a wave as the maximum distance that the wave moves from its rest position. Identify the amplitude of a transverse and longitudinal wave

13.9	Relate the amplitude of a wave to its energy and identify the source of energy for the waves	
13.10	Define wavelength of a wave as the distance from one point on a wave to the same point on the next wave, measured in meters *Example question: Identify the wavelength and amplitude on a graphical form.* *The wavelength for the wave below=distance/number of waves* *=5 m/1.25=4.0 m (or 4m-0m=4m)* *Amplitude=0.1 m*	
13.11	Relate the wavelength to the distance between two consecutive crests (or troughs) for a transverse wave and the distance between two consecutive compressions (or rarefactions) for a longitudinal wave	
13.12	Define frequency of a wave as the number of wavelengths that pass a point each second and measured in Hertz (Hz) or per second (s^{-1}) *According to the definition, frequency is the reciprocal of the time period.* *Therefore:* $f = 1/\mathrm{T}$ *Example: If 2 waves pass a point in 1 second, the frequency is 2 Hz and the time period is ½=0.5 s*	

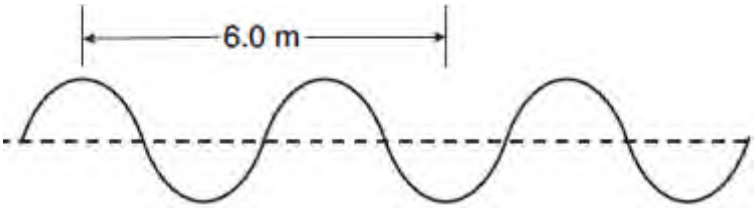
13.13	Show how frequency and wavelength are related and define wave speed. Calculate wave speed using the equation: $$Wave\ speed = frequency \times wavelength$$ $$s = f\lambda$$ *Example question: If the frequency of the wave below is* $2.0\ Hz$*, calculate its speed.* $s = f\lambda$ $s = 2.0\ Hz \times 4.0\ m = 8\ m/s$ 
13.14	Realize that mechanical waves like sound waves usually travel fastest in solid and slowest in gases *The speed of a wave depends on the type of the wave and the medium through which the wave travels*

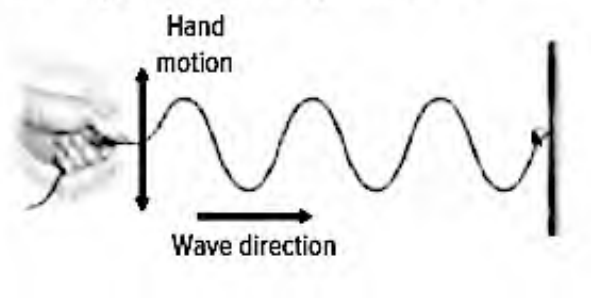
Table 2 Wave Speeds

Type of Wave	Typical wave speed (m/s)
Ocean wave	25
Sound wave in air	340
Transverse seismic wave (S wave)	1,000 to 8,000
Longitudinal seismic wave (P wave)	1,000 to 14,000
Electromagnetic wave through empty space	300,000,000

13.15	Realize that electromagnetic waves move fastest in empty space and slowest in solids *The speed of all electromagnetic waves is the same in vacuum*
13.16	Describe how waves interact with matter explaining the process of transmission, absorption, reflection, refraction and diffraction ***Transmission*** *is the transfer of energy through a medium.* ***Absorption*** *is the transfer of wave energy to the medium through which the wave travels.* ***Reflection*** *is the bouncing of a wave off a surface such that the angle of reflection is equal to the angle of reflection.* ***Refraction*** *is the change in direction of a wave as it changes speed while moving from one medium to another*
Lab 8	Experiment to verify the law of reflection & Experiment to observe refraction and diffraction using ripple tank

- **Practice Questions**

Use the figure to answer questions 1-3.



1. The figure above shows waves generated on a rope. Which type of waves are shown in the figure?
   - A. Combination
   - B. Electromagnetic
   - C. Longitudinal
   - D. Mechanical

2. Which statement best describes the correct relationship for the wave shown in the figure?
   - A. The disturbance is parallel to the direction the wave travels.
   - B. The disturbance is perpendicular to the direction the wave travels.
   - C. The disturbance carries matter and energy in the same direction along the wave
   - D. The disturbance has both back-and-forth and up-and-down motion

3. Which describes how the wave would change if the person's hand moved at a faster rate?
   - A. The amplitude would decrease
   - B. The amplitude would increase
   - C. The frequency would decrease
   - D. The frequency would increase

4. If two waves are traveling at the same speed, which description is most accurate?
   - A. The wave with the longer wavelength has the higher frequency
   - B. The wave with the shorter wavelength has the higher frequency
   - C. Both waves must have equal wavelengths
   - D. Both waves must have equal frequencies

5. As a water wave passes, the particles that make up the water move ___.
   - A. back and forth, parallel to the wave
   - B. in circles around the same point
   - C. up and down at right angles to the wave
   - D. whichever direction the wave moves

6. The refraction of a wave is caused by a change in ___.
   - A. amplitude
   - B. frequency
   - C. speed
   - D. wavelength

7. In a longitudinal wave, where are the particles most spread out?
   - A. Crest
   - B. Trough
   - C. Rarefaction
   - D. Compression

8. The distance between one point on a wave and the nearest point just like it is the ____.
   - A. amplitude
   - B. frequency
   - C. intensity
   - D. wavelength

9. In which type of wave does the medium travel in circular motion?
   - A. Transverse
   - B. Longitudinal
   - C. Electromagnetic
   - D. Water

10. What is the unit of wave frequency?
   - A. Decibels
   - B. Hertz
   - C. Meters
   - D. Seconds

11. Which of the following would produce mechanical waves?

A. Burning a candle
B. Hitting a wall with a hammer
C. Turning on a flashlight
D. Tying a rope to a doorknob

12. A vibration produces a complete wave in 0.25 *s*. What is the frequency of the wave?

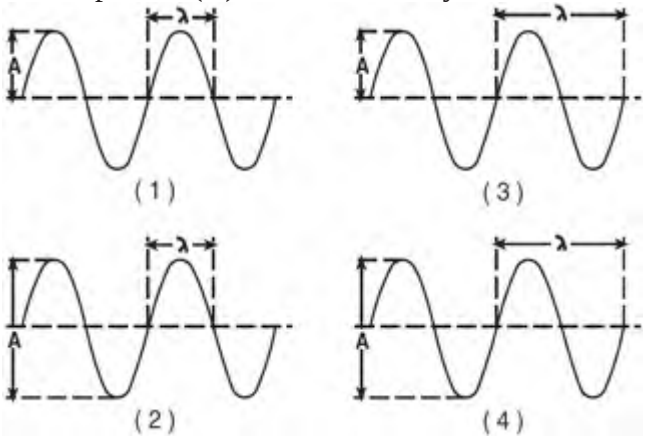
A. 0.25 Hz
B. 0.5 Hz
C. 2 Hz
D. 4 Hz

13. Which of the following is/are ways in which waves interact with matter?

I. Transmission
II. Absorption
III. Reflection
IV. Refraction

A. I and II only
B. II and IV only
C. II and III only
D. I, II, III and IV

14. Which wave diagram has *both* wavelength (λ) and amplitude (A) labeled correctly

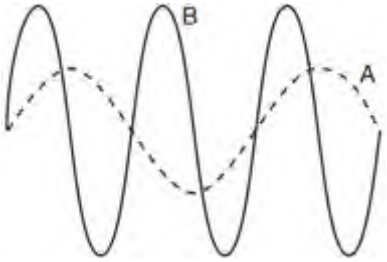


A. 1
B. 2
C. 3
D. 4

15. A periodic wave having a frequency of 5.0 hertz and a speed of 10 meters per second has a wavelength of ___.

A. 0.50 m
B. 2.0 m
C. 5.0 m
D. 50 m

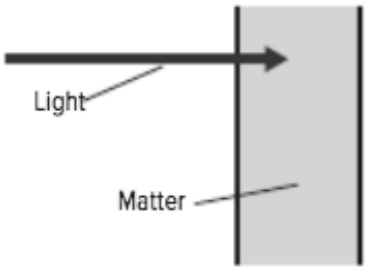
16. The diagram below shows waves A and B in the same medium.



Compared to wave A, wave B has ____.

A. twice the amplitude and twice the wavelength
B. twice the amplitude and half the wavelength
C. the same amplitude and half the wavelength
D. half the amplitude and the same wavelength

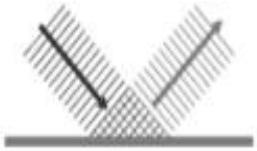
17. The arrow in the diagram below shows a point on a light wave that stops as it interacts with matter. Which type of interaction does the arrow represents?



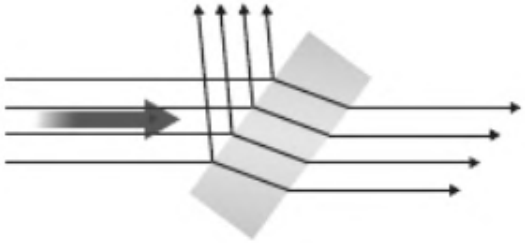
A. absorption
B. reflection
C. refraction
D. transmission

18. The picture below shows a light ray bouncing off a flat surface. What is the correct scientific term for this interaction?

A. Reflection
B. Refraction
C. Diffraction
D. Transmission



19. Which interactions of light with matter are taking place in the picture below?



A. diffraction, reflection, and absorption
B. reflection, refraction, and transmission
C. reflection, scattering, and diffraction
D. translucent, transparent, and opaque

20. What are waves? How does a wave affect energy and matter?

21. Differentiate between mechanical and electromagnetic waves in the table below. Give some examples of each.

Mechanical Waves	**Electromagnetic waves**

22. Differentiate between transverse and longitudinal waves, giving examples of each.

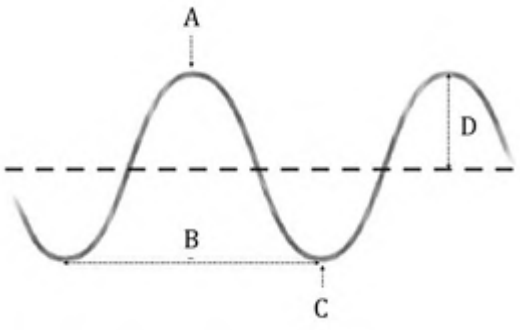
Transverse Waves	**Longitudinal waves**

23. Discuss the cause and the movement of particles in water waves.

24. Define frequency. If a wave's frequency is 0.5 Hz, how long does it take it to pass a point?

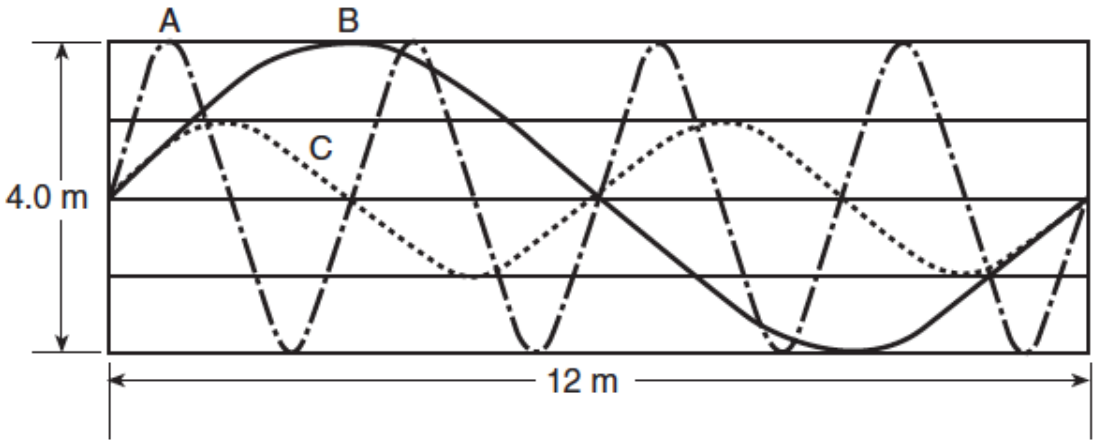
25. What is amplitude? How can you decrease the amplitude of a sound wave?

26. The diagram below represents a transverse wave. Match each of the quantity on the left in the table below with the corresponding letters A to D from the figure below.



Quantity	(A, B, C, D)
Crest	
Trough	
Amplitude	
Wavelength	

27. Three waves, A, B, and C, travel 12 meters in 2.0 seconds through the same medium as shown in the diagram below.

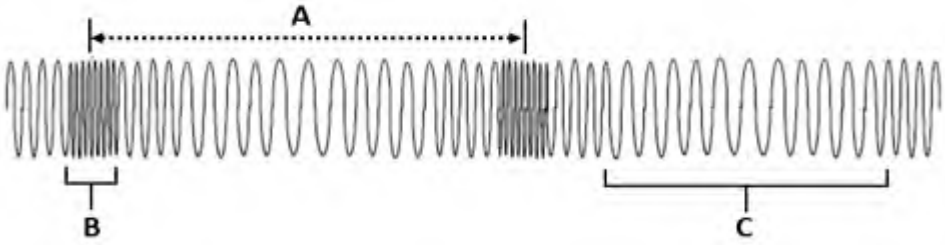


a. What is the amplitude of wave C?

b. What is the period of wave A?

c. What is the speed of wave B?

28. The figure below shows a wave on a slinky spring.



a. What type of mechanical wave is this? Describe the movement of the particles as the wave moves forward

b. Match each of the quantity on the left in the table below with the corresponding letters A to C from the figure above.

Quantity	A, B, C
Wavelength	
Rarefaction	
Compression	

29. What are transmission, absorption and reflection?

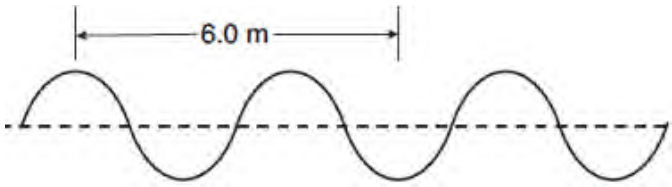
30. Compare and contrast reflection and refraction in the table below.

Reflection	Refraction

31. What is diffraction?

32. How does the motion of the medium in transverse mechanical waves, longitudinal waves, water waves, and seismic waves differ?

33. The diagram below represents a periodic wave traveling through a uniform medium.

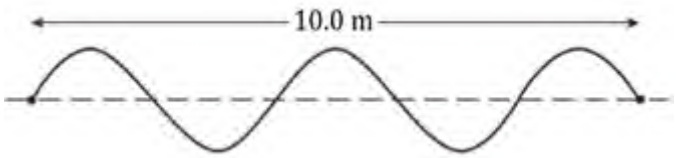


If the frequency of the wave is 2.0 Hz, calculate the quantities on the left in the table below. Show your **calculations** and the **final answer with correct unit**.

Quantities to calculate	Calculations	Final answer
Time period		
Wavelength		
Speed		

34. The diagram below shows a wave on a rope.

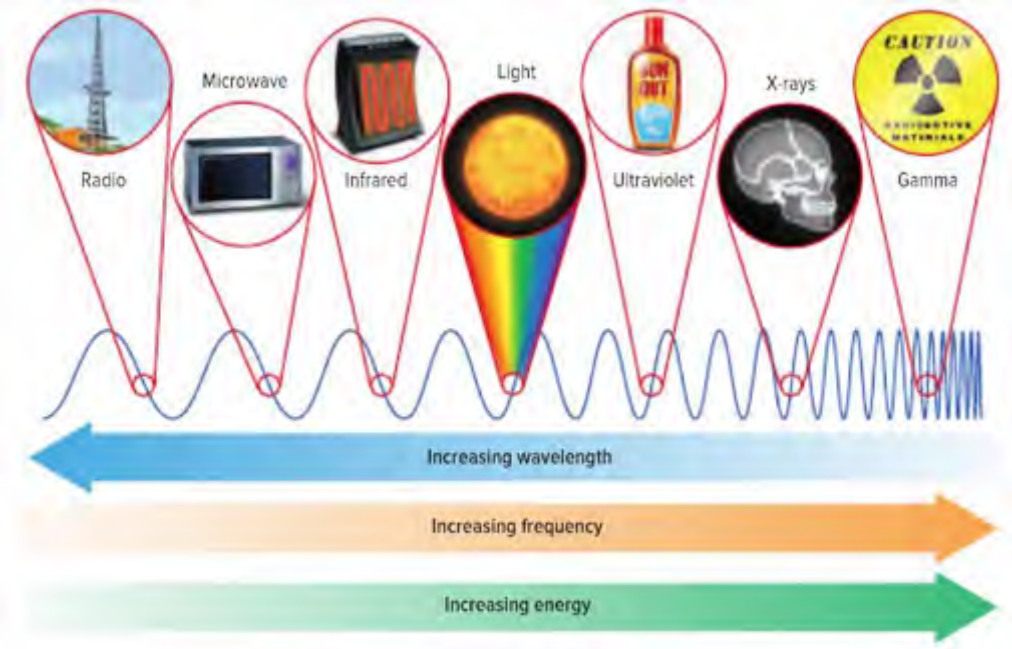
a. Determine the wavelength of the wave.

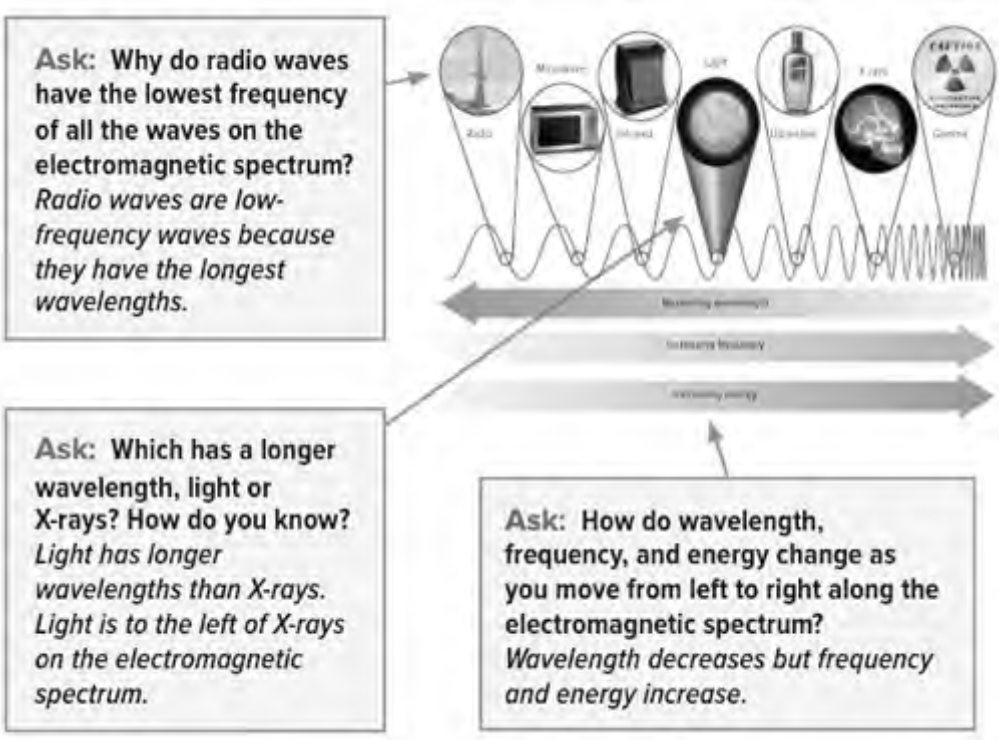
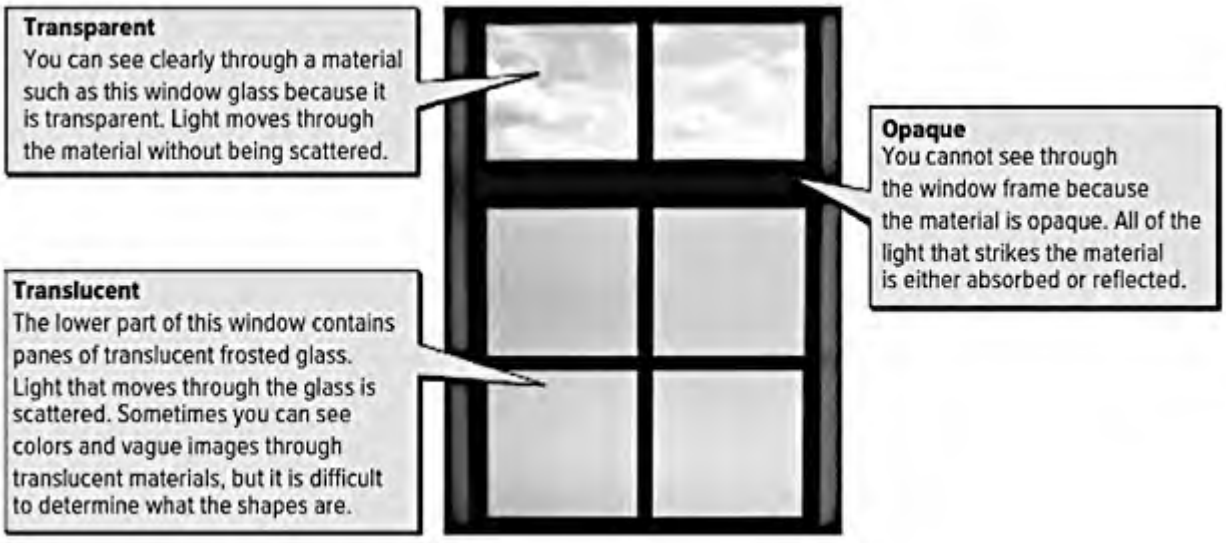


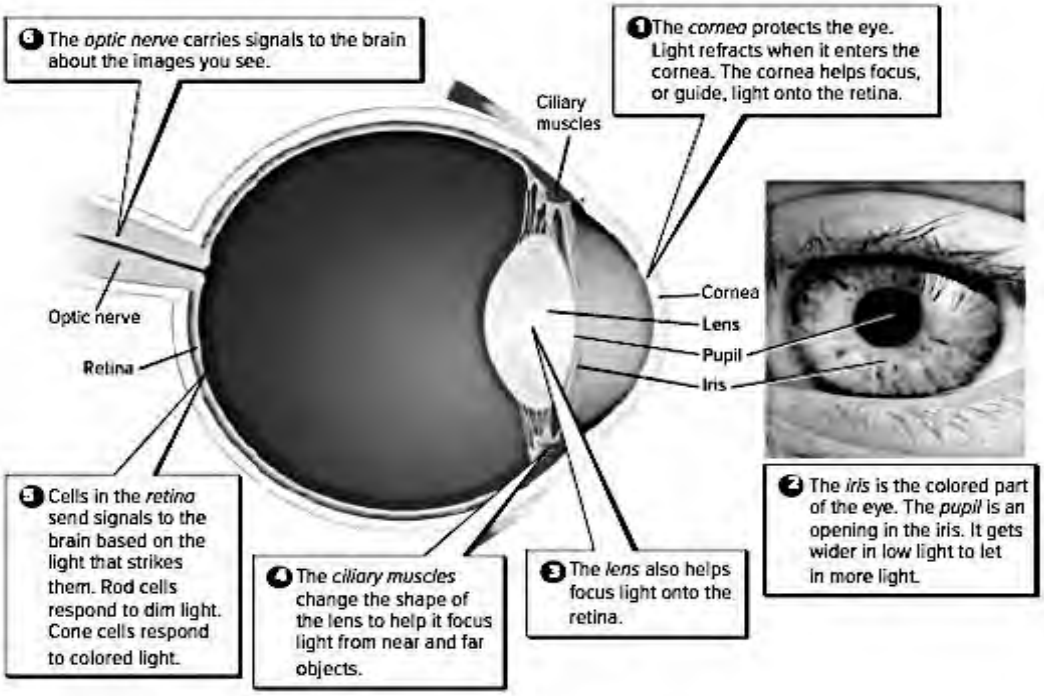
b. If the frequency of the wave is 2.0 hertz, find the the speed of the wave.

35. Compare and contrast how transmission, reflection and absorption affect a wave.

36. Copy and fill in the graphic organizer below. In each oval, list a way in which waves can interact with matter

Learning Outcome		Number of Periods	Suggested Exercises /Assignments
LO 14 Compare light waves with other electromagnetic waves and describes some ways in which light interacts with matter (KPIs 14.1 – 14.13)		4	Refer to practice questions below
14.1	Classify light waves as part of the electromagnetic spectrum and that light is the only visible part of the spectrum *Visible light has a spectrum of colors from red to violet*		
14.2	Compare luminous and non-luminous objects *Note the examples of luminous and non-luminous objects such as:* *Luminous: Sun, stars, lightbulb, campfire, candle….* *Non Luminous: Moon, planets, book, mirror,…*		
14.3	List the different electromagnetic waves like light, radio waves, microwaves, infrared waves, ultra violet, x-rays and gamma rays. Identify some of their sources *Sun is the major source of all waves along the electromagnetic spectrum, nevertheless, it is not the only natural source. Stars and other objects in space also are sources of EM waves. In addition, people, animals and objects emit infrared waves.*		
14.4	Describe the electromagnetic spectrum, listing all the radiations in the order of increasing or decreasing frequencies, wavelength and energy  		

14.5	List the properties of each of the electromagnetic waves in the spectrum. Compare and contrast between the waves  *Compare and contrast in terms of wavelength, frequencies and uses of the waves.*
14.6	State that all types of the electromagnetic waves have the same speed in vacuum and that the wavelength and frequency of light waves determines the color of light *Red color has the longest wavelength and the shortest frequency, while violet has the shortest wavelength and the longest wavelength*
14.7	define transparent, translucent and opaque *Identify some examples of each. For example:* *Transparent: Glass, water, Air,….* *Translucent: Tracing paper, frosted glass,….* *Opaque: Wood, wall, book, …..* 

14.8	Describe how matter can transmit, absorb, and reflect light and that these interactions differ in how much light the matter transmits and how it changes the direction *Relate transmission through transparent or translucent objects, while absorption by opaque objects.*
14.9	Explain the meaning of intensity of light *Defined as, the amount of energy passing through a square meter of space in one second, intensity describes the brightness of a light wave.*
14.10	Use the properties like scattering and refraction to describe the interaction of Sunlight with matter *The sunlight scatters as it interacts with matter, due to different wavelengths that the sun light contains.*
14.11	Explain why the sky is blue and the Sun is yellow
14.12	Describe how the eyes change light waves into the images you see 
14.13	Identify the part of the eye that responds to color

- **Practice Questions**

1. Steel is opaque. Which describes how light waves can interact with steel?

A. absorption and reflection
B. diffraction and transmission
C. reflection and refraction
D. transmission and refraction

2. Which property is unique to electromagnetic waves?

A. the ability to interact with matter
B. the ability to travel through matter
C. the ability to have different intensities
D. the ability to travel through empty space

3. Which must be true of the cornea for the eye to work properly in sending a message to the brain?

A. It must absorb light
B. It must block out light
C. It must reflect light
D. It must transmit light

4. Which of the following colors of light has the longest wavelength?

A. red
B. green
C. violet
D. yellow

5. Which of the following statements is/are true regarding electromagnetic waves?

I. They are longitudinal waves
II. They are transverse waves
III. They all travel with the same speed in vacuum

A. I only
B. II only
C. I and III only
D. II and III only

6. Which of the following materials is opaque?

A. Wood
B. Glass
C. Water
D. Air

7. The part of the eye that responds to colored light is the ___.

A. pupil
B. cornea
C. iris
D. cones

8. Which is always a transverse wave?

A. microwave
B. seismic wave
C. sound wave
D. water wave

9. How does light differ from other forms of electromagnetic waves?

10. List the uses of the electromagnetic waves in the table below.

Electromagnetic waves	**Uses**
Radio waves	
Microwaves	
Infrared	
X-rays	

11. Answer the questions below to compare infrared waves to other electromagnetic waves.

a. Do infrared waves have wavelengths that are longer or shorter than visible light waves?

b. Does an infrared wave have a frequency that is higher or lower than a microwave?

c. How do infrared waves and microwaves differ?

d. Contrast radio waves, infrared waves and ultraviolet waves

e. If the turn on an electric stove and stand to the side of it, what type of electromagnetic wave causes you to feel the heat from the burner?

12. Answer the following questions on ultraviolet waves.

a. Is the wavelength of ultraviolet light shorter or longer than that of visible light?

b. Why can ultraviolet waves be dangerous?

c. Describe how light waves and ultraviolet waves differ.

d. What kind of wave has slightly shorter wavelengths than ultraviolet waves?

13. Answer the following questions on gamma rays.

a. Why can't gamma rays be used for communication in the same way as radio waves?

b. Radio waves bounce off walls, but gamma rays can penetrate through them. Why do you think that is the case?

14. Fill in a graphic organizer below that shows the sequence of wave types in the electromagnetic spectrum in the order of increasing frequency.

15. The table below shows parts of the electromagnetic spectrum.

Radio waves	Microwaves	**A**	Visible light	**B**	**C**	Gamma rays

a. Identify the missing parts (A, B and C) of the electromagnetic spectrum.
A: _____
B: _____
C: _____

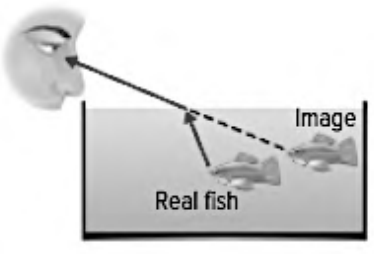
b. For each of the statements in the table below, write TRUE if it is correct and FALSE if it is incorrect.

Statement	**True or false**
Infrared waves transfer heat energy from a campfire	
All the electromagnetic waves travel with the same speed in vacuum	
Microwaves are used in cell phones for communication	
Radio waves have very high frequency and energy compared to the gamma rays	
Ultraviolet rays are used to take pictures of inside of the body	
The color of visible light depends on the wavelength and frequency of the waves	
Electromagnetic waves can either be reflected, refracted, absorbed or transmitted	
Radio waves are of low frequency, low energy that have a wavelength longer than about 30 cm	
Gamma rays are used to take pictures inside the body	

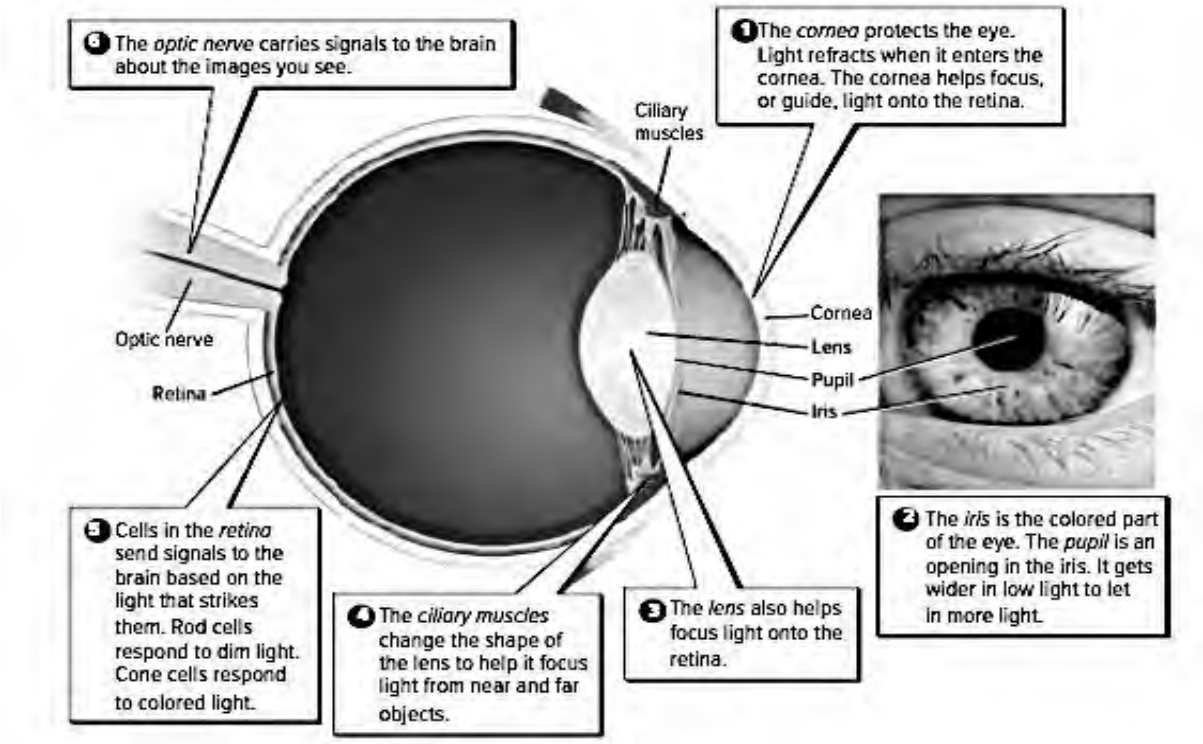
16. Differentiate between transparent, translucent and opaque materials with examples.

Transparent	**Translucent**	**Opaque**

17. Explain the diagram below in terms of the interaction of light waves with matter



18. Construct a drawing of the major parts of the eye and describe how each part helps turn light waves into visual information



19**.** Name one thing that could affect a person's perception of the intensity of light. How could you increase the intensity of a flashlight beam?

20. What is the process by which an object can be seen and recognized? Be sure to include the interactions of light waves and matter in your summary.

21. Answer the following questions on interaction of sunlight and matter.

a. How does blue wavelength of sunlight interact with particles of the air?

b. Why is the sky blue? Why is the Sun yellow?

c. Particles of air also scatter violet and indigo wavelengths but the sky does not appear dark blue or purple during the day. What might you infer about human eyes and indigo and violet wavelengths?

d. Does the sunlight speedup or slow down as it enters the Earth's atmosphere?

e. How does sunlight change as it enters the Earth's atmosphere?

f. Why does the sunlight refract as it enters the Earth's atmosphere?

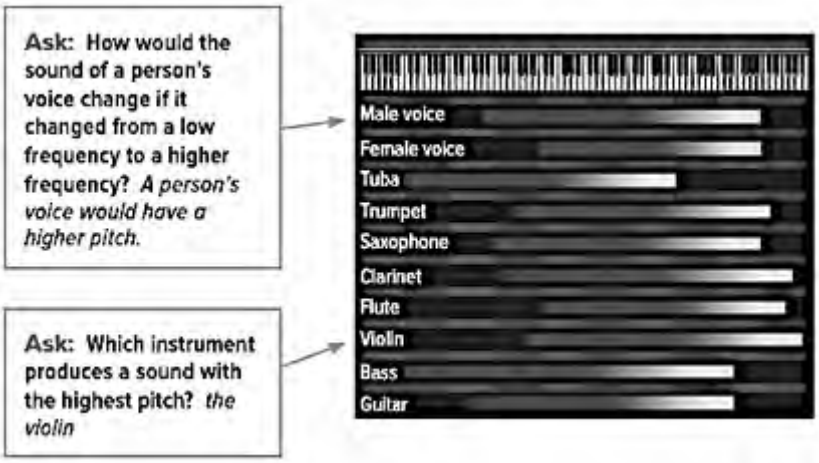
22. Answer the following questions on vision and eye.

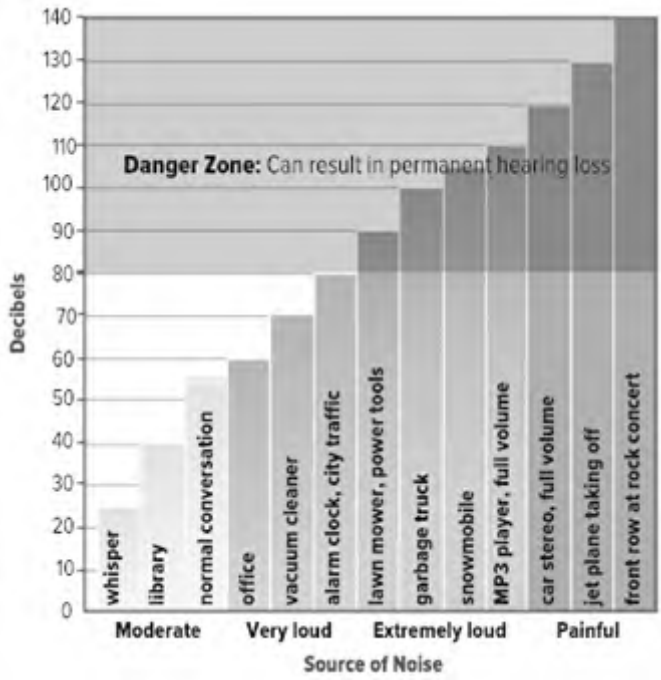
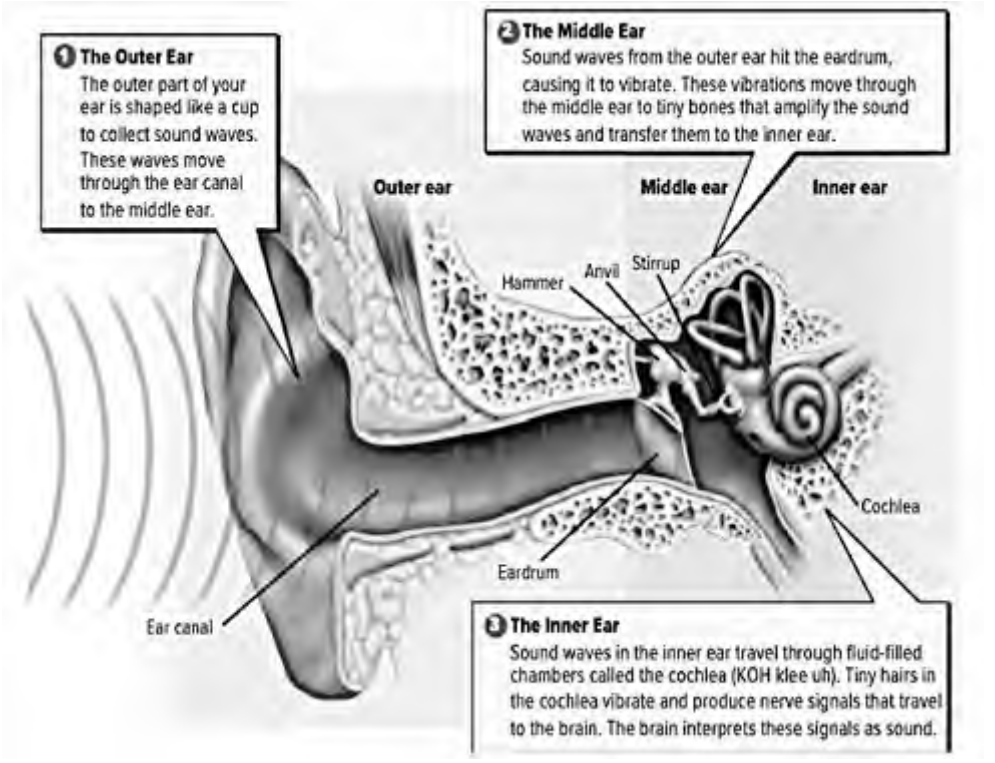
a. How does the retina help you see?

b. How do eyes change light waves into the images you see?

c. How can a cornea affect a person's vision?

23. Why does a 200-W lightbulb appear brighter than a 100-W lightbulb? Mention properties of light in your explanation.

Learning Outcome		Number of Periods	Suggested Exercises /Assignments
LO 15 Describe some of the properties of sound waves and how our ears enable people to hear sound (KPIs 15.1 – 15.9)		3	Refer to practice questions below
15.1	Describe sound waves as longitudinal waves that must travel through a medium		
15.2	State that the audible frequency for a normal human ear is between 20 Hz to 20000 Hz		
15.3	Describe how compressions and rarefactions differ in a sound wave *Compression is the part of a longitudinal wave where the particles are closest together. A rarefaction is the part of a longitudinal wave where the particles are farthest apart.* *Pressure is greater than normal in a compression but lower in a rarefaction.*		
15.4	Relate the properties of sound waves like wavelength, amplitude, frequency and speed to the compressions and rarefactions of the sound wave		
15.5	Define the pitch of a sound and discuss how it depends on the frequency of the sound wave		
15.6	Relate the speed of sound to the type of medium and the temperature of the medium. Compare the speed of sound to the speed of the electromagnetic waves		**Table 3 The Speed of Sound** Material / Speed (m/s) Air (0°C) 331 Air (20°C) 343 Water (20°C) 1,481 Water (0°C) 1,500 Seawater (25°C) 1,533 Ice (0°C) 3,500 Iron 5,130 Glass 5,640
15.7	Relate the loudness of sound as the ear's perception of intensity and calculate the fraction by which the sound intensity changes *Sound waves spread out in all directions and have less energy the farther you are from the source.* *The fraction by which the sound intensity changes* $=(r_1/r_2)^2$ *A sound with a large amplitude has a high intensity*		

15.8	Describe decibel (dB) as the unit to measure sound intensity or loudness and use the decibel scale to understand the safe limits of different types of sound *The word decibel tells you that the levels are in increments of 10. Each increase in 10 dB causes about twice as loud sound.* *Example: The decibel level of a city traffic is about 85 dB, and the level of a rock concert is about 105 dB. How much louder is a rock concert compared to a city traffic?* $105 - 85 = 20$ Since each increase 10 dB indicates twice as loud, therefore, the rock concert is 4 times louder than the city traffic. 
15.9	Explain how different parts of the ear (outer, middle and inner) contribute to enable hearing	

- **Practice Questions**

1. Which of the following statements is/are true regarding sound waves?

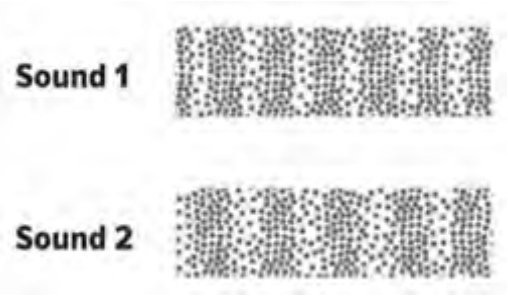
I. They can travel through vacuum
II. They are transverse waves
III. They are mechanical waves

A. I only
B. II only
C. III only
D. I and II only

2. What is the audible frequency for a normal human ear?

A. 2 Hz to 2000 Hz
B. 125 Hz to 2000 Hz
C. 20 Hz to 20000 Hz
D. 1000 Hz to 4000 Hz

3. The figure below shows two sound waves in the same region.



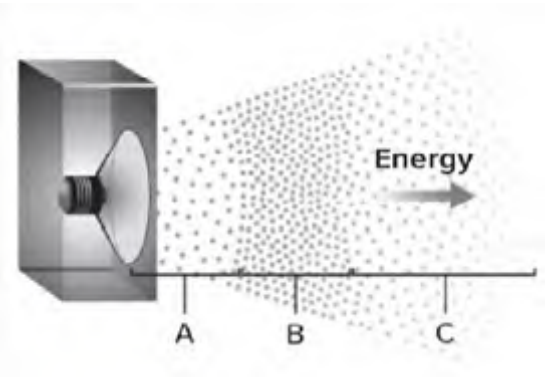
Which of the statements below is true?

A. Sound 1 has a higher pitch
B. Sound 1 has a lower frequency
C. Sound 1 has a smaller amplitude
D. Sound 1 has a greater wavelength

4. In which medium is the speed of a sound wave the greatest?

A. Air in your classroom
B. Iron railroad track
C. Pool of water
D. Vacuum in space

5. The figure below shows sound produced from a speaker.



The speaker _____ that causes the sound.

A. produces echoes
B. produces vibrations
C. releases light
D. releases heat

6. A ringing bell is located in a chamber. When the air is removed from the chamber, why can the bell be seen vibrating but not be heard?

A. Light waves can travel through a vacuum, but sound waves cannot
B. Sound waves have greater amplitude than light waves.
C. Light waves travel slower than sound waves.
D. Sound waves have higher frequencies than light waves

7. You turn up the volume on the car radio. Which of the following properties of the sound changes?

A. amplitude
B. frequency
C. speed
D. wavelength

8. If a sound is loud and low-pitched, the sound wave also has which of the following properties?

A. low frequency and high amplitude
B. low frequency and low amplitude
C. high frequency and high amplitude
D. high frequency and low amplitude

9. Based on the data in the table, which of the following statements is most likely true?

A. Sound travels fastest through gases because they are less dense
B. Sound travels fastest through liquids because they are more fluid
C. Sound travels fastest through solids because they are denser.
D. Sound travels fastest through materials that have higher temperatures.

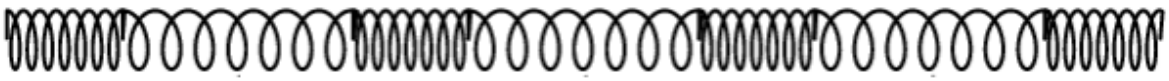
10. Which property of a sound wave describes the amount of energy that passes through a square meter of space each second?

A. Frequency
B. Amplitude
C. Intensity
D. Wavelength

11. Longitudinal waves have compressions and rarefactions.

a. Explain the difference between a compression and a rarefaction in a sound wave.

b. Mark the compressions and rarefactions on the slinky below.



c. How does the compressions and rarefactions in sound waves change as the energy increases?

12. Complete in the graphic organizer below to describe the path of the sound wave from when it is produced until its interpreted by the brain. Describe the function of each part of the path.

13. Construct two wave diagrams for each of the sound waves mentioned in the table below.

Description	Diagram
Two waves with the same amplitude but different frequencies	
Two waves with the same wavelength/frequency but different amplitudes	

14. An MP3 player at maximum volume produces sound at 110 dB. The table shows the time exposure before a risk of hearing damage. How many hours a day could you listen to your MP3 player at full volume before a hearing loss risk? Explain.

Recommended Noise Exposure Limits	
Sound Level (dB)	Time Permitted (h)
90	8
95	4
100	2
105	1

15. The passage of lightning through air produces thunder. Why is lightning seen before thunder is heard?

16. Answer the following questions on intensity change.

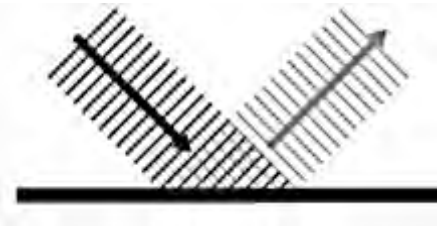
a. By what fraction does the sound intensity change if you move from 2 m away from a source to 10 m away from the source?

b. You are standing 3 m from someone who is using a lawn mower. How will the sound intensity change if the person moves the mower to a distance 12 m from you?

c. A car 5 m away from you beeps its horn. How would the intensity of the beep change if you moved to a distance 40 m from the car?

17. You are standing outside and hear a jet flying overhead. You look up toward the direction of the sound, but you notice that the jet is far ahead of where the sound seems to come from. Explain why you can hear a jet only after it passes overhead.

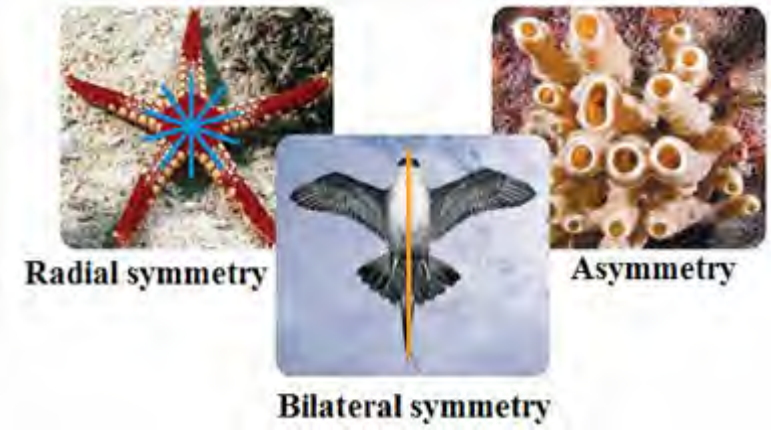
18. The figure below shows light rays striking a flat surface. Describe how the figure would change if the surface the light rays hit against were bumpy instead of flat.

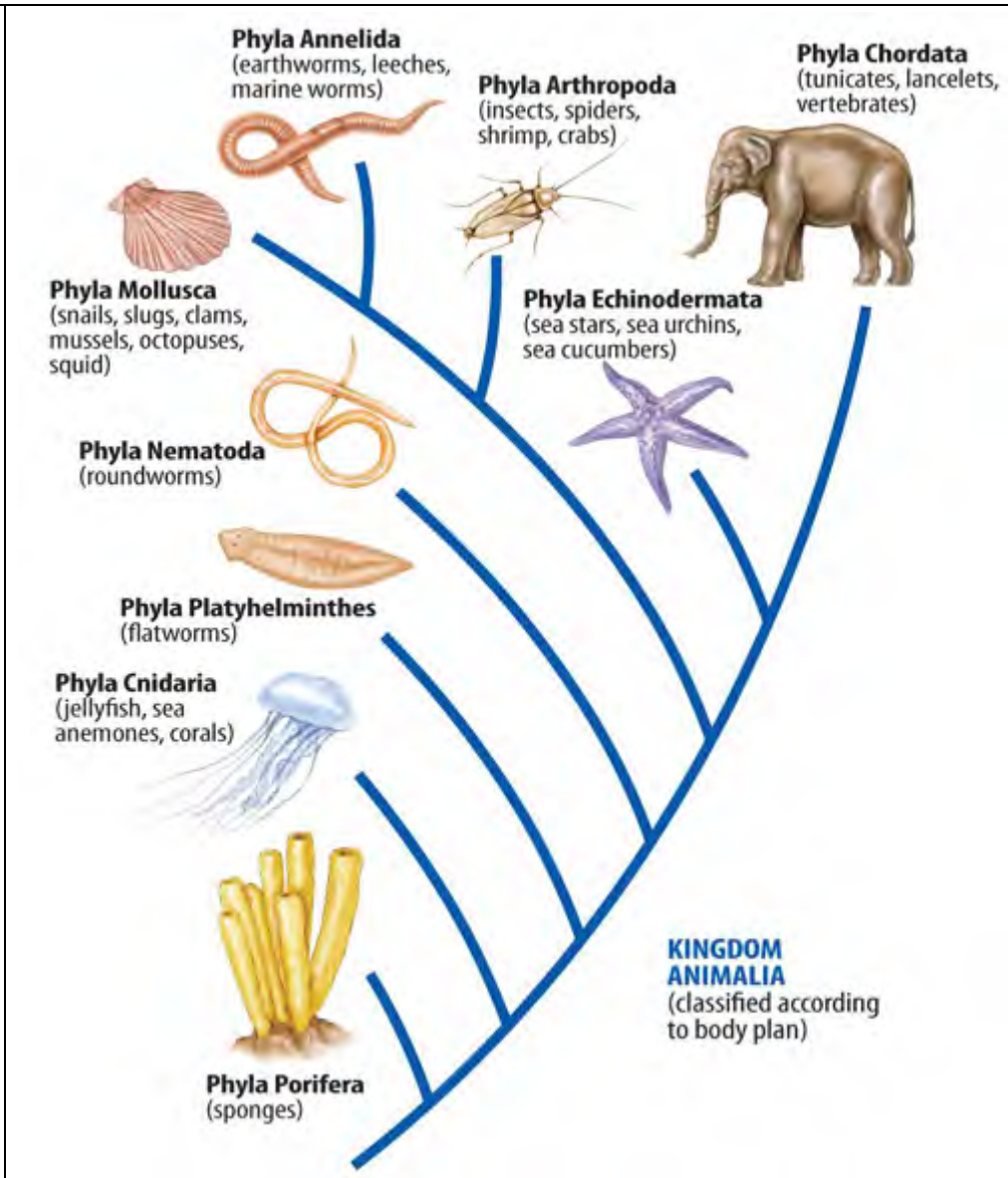


19. People sometimes confuse the pitch of a sound with the sound's intensity. How would you explain the difference between these two properties to a classmate?

20. What roles do the outer ear, the middle ear, and the inner ear play in hearing?

Learning Outcome	Number of Periods	Suggested Exercises /Assignments
LO 16 Describe how the main characteristics of animals are used to classify them (KPIs 16.1 – 16.9)	5	Lesson 7.1 What are Animals Lesson 7.1 Assessment: Q 1- 10 Chapter Review: Q. 1, 2, 3, 4, 15, 19 Standardized test practice: 1, 4, 6, 8, 9, 12, 14

16.1	Recognize six main characteristics of animals • *Composed of many cells (are multicellular)* • *Their cells have a nucleus* • *Are held together by a protein called collagen.* • *Animals have muscle cells and nerve cells.* • *They get the energy they need from the food they eat.* • *All animals begin their lives as fertilized cells called zygotes, which develop into embryos.*
16.2	Recognize how animals are grouped based on their shape or symmetry *Bilateral symmetry: It is a body plan in which an organism can be divided into two halves that are mirror images of each other.* *Radial symmetry: It is a body plan in which an organism can be divided into two parts that are mirror images of each other anywhere through its central axis.* *Asymmetry: It is a body plan which cannot be divided into any two parts that are mirror images.* 
16.3	Recognize how animals are classified based on shared characteristics in a family tree *Scientists classify the members of the animal kingdom into as many as 35 phyla. The nine major phyla contain 95–99 percent of all animal species. Animals belonging to the same phylum have similar body structures and other characteristics.* *A family tree shows the relationships among and within generations of a family. Animal phyla also are organized by how they are related through time.*

	
16.4	Define taxonomy *A system to categorize all living things into levels called taxons.*
16.5	Recognize how animals are classified into vertebrates and invertebrates *<u>Vertebrate</u> is an animal with a backbone. Fish, frogs, snakes, birds, and humans are vertebrates* *An <u>invertebrate</u> is an animal without a backbone. Sponges, jellyfish, worms, insects, and clams are all invertebrates.*
16.6	Identify the meaning of adaptation *An adaptation is an inherited trait that helps a species survive in its environment*
16.7	Identify three different types of adaptations *Structural, behavioral and functional.* *A structural adaptation is a change in the body's structure* such as open circulatory system or improved senses

	Behavioral adaptation is a change in the animals behavior due to a change in the environment such as matting behavior *Functional adaptations are related to changes in the body function to enable survival such as hibernation*
16.8	Describe, using examples, the structural adaptations which include a change in the body's structure. *Structural adaptations include physical features that have improved species' senses, skeletons, and blood circulation.*
16.9	Identify, using examples, the behavioral adaptations including instincts and learned behavior *Instinct behaviors such as migration, A male fly instinctively waves its wings at a female to attract its attention.* *Learned behavior such as imprinting, young songbirds learn how to sing their songs by listening to their parents.* *More examples of behavioral adaptations include animals behaviors that help them avoid predators or catch their prey. Some animals use chemicals produced by their bodies. A skunk sprays a bad-smelling liquid at predators. An octopus squirts ink when it is in danger. The ink darkens the water and confuses predators, giving the octopus time to escape.*
16.10	Identify, using examples, the functional adaptations in animals *Functional behaviors enable animals to survive such as hibernation and adaptations that enable animals to reproduce successfully either in water or on land including internal fertilization for animals living on land or external fertilization in water and the number of fertilized eggs.*
Lab 9	Explore activity: What are animals?

- **<u>Practice Questions</u>**

1. *On each line, write the term from the word bank that correctly completes each sentence. Some terms may be used more than once or not at all*

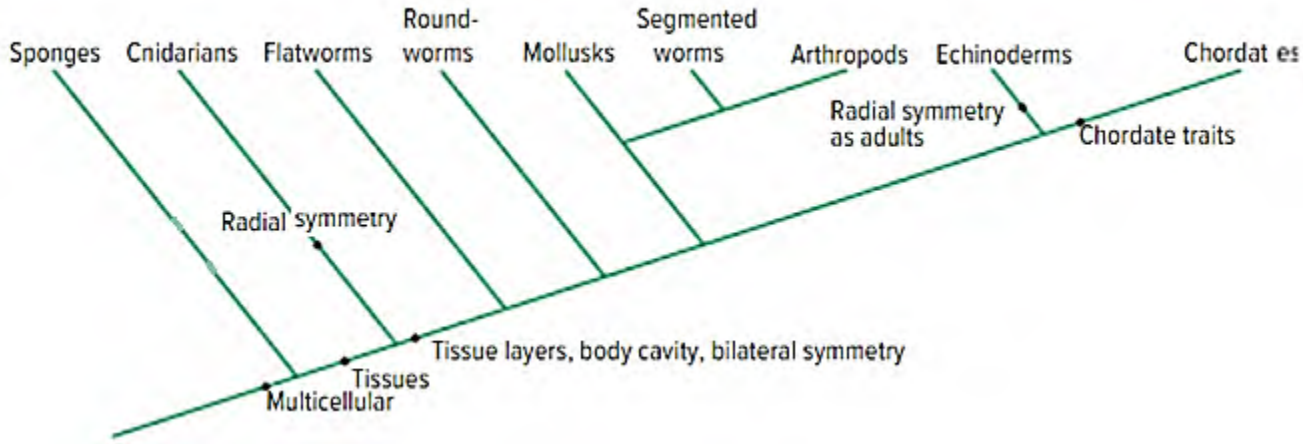
cells	**collagen**	**digest**	**energy**	**multicellular**
organisms	**protein**	**reproduction**	**taste**	

   a. Animals (1.) _____their food.
   b. Animals have specialized cells for different functions, such as digestion, (2.) _____, vision, or (3.) _____. Animals are (4.) _____and eukaryotic.
   c. Animals get (5.) _____for life processes by eating other (6.) _____Animals have a(n) (7.) _____called collagen that surrounds the (8.) _____and helps them keep their shape.

2. Which body plan describes body parts arranged the same way on both sides of an organism's body?
   A. Asymmetry
   B. Bilateral symmetry
   C. Radial symmetry
   D. Unilateral symmetry

3. Which term is used to describe an animal with a backbone?
   A. Chordate
   B. Mammal
   C. Invertebrate
   D. Vertebrate

Use the image below to answer questions 4-7.



4. Which animal phyla are most closely related?
   A. Arthropods and Echinoderms
   B. Chordata and Echinoderms
   C. Mollusks and segmented worms
   D. Flatworms and round worms

5. Which phyla include several kinds of organisms that have radial symmetry?
   A. Cnidarians and Echinoderms
   B. Mollusk flatworms
   C. Segmented worms and sponges
   D. Round worms and arthropods

6. Which two phyla have the least similar DNA?
   A. Arthropods and segmented worms
   B. Chordata and cnidarian
   C. Flatworms and round worms
   D. Sponges and flatworms

7. Which characteristic is true for a sponge?
   A. Body cavity
   B. Tissue layers
   C. Multicellular
   D. Bilateral symmetry

8. Which of the following is a structural adaptation?
   A. Hibernation
   B. Imprinting
   C. Migration
   D. Open circulatory system

9. Compare vertebrates and invertebrates, and identify one phylum to which these organisms belong.

10. Identify what type of symmetry is shown below

Butterfly

Sea anemone

11. When fertilization occurs internally, only a few eggs must be produced in order to reproduce successfully. Why do you think this is true?

12. Camouflage is an adaptation that helps some predators sneak up on their prey. A tiger has stripes that help it hide in tall grasses. A killer whale is black on top and white underneath. From above, the black looks like the dark ocean. From underneath, the white looks like the light of the sky above. Is camouflage a behavioral, structural, or functional adaptation? Explain your answer.

Learning Outcome	Number of Periods	Suggested Exercises /Assignments
LO 17 Describe the main characteristics of invertebrates and their classification (KPIs 17.1 – 15.6)	4	Lesson 7.2 Invertebrates Lesson 7.2 Assessment: Q 1- 10 Chapter Review: Q. 5, 6, Standardized test practice: 2, 7, 13

17.1 Define invertebrates

Invertebrates are animals without a backbone. Sponges, jellyfish, worms, insects, and clams are all invertebrates.

17.2 Recognize common characteristics in all invertebrates

- *Invertebrates lack a backbone*

They support their bodies with a hydrostatic skeleton (fluid-filled internal cavity) or an exoskeleton (hard outer covering)

17.3 Identify three adaptations of invertebrates that enable them to get the energy they need and avoid danger

- *Some are parasites.*
- *Some hunt for food.*
- *Some are able to change color to match their surroundings*

17.4 Compare and contrast sponges, cnidarians, flatworms, segmented worms, Mollusks and roundworms regarding their structural adaptations, environment they live in and their effect on human

Invertebrate	***Structure***	***Environment and feeding***	***Effect on human***
Sponges 	*Simple animals because they have only a few types of cells and no true tissues.* *Scientists group sponges by the kinds of materials that make up these fibers. The fibers in the most common group of sponges are made of the protein spongin or silica*	*Live in water and cannot move as adults. They attach to rocks and other underwater structures. Take in food when water passes through their bodies,*	*Sponges are sold as natural sponges. They are used to scrub surfaces, but the fibers can scratch shiny surfaces.*
Cnidarians  	*Most cnidarians have tentacles around their mouths called nematocysts that are used to catch the prey* *They have radial symmetry*	*Spend their adult lives attached to underwater surfaces, some of them can swim in salt water*	*Most of the cnidarian fossils are corals. Coral reefs protect beaches and shorelines from rough seas.*

	Flatworms 	*Have bilateral symmetry*	*Live in fresh and salt water such as planarian. Some are parasites such as liver fluke*	*Live inside humans, gets its food from humans and does not help humans survive.*
	Segmented worms 	*They are also called Annelida, means "little rings." Their body is made up from rings that are called segments. Each segment is a fluid-filled compartment. Therefore, a segmented worm has a hydrostatic skeleton. The sides of the earthworm's body felt prickly. The prickles are tiny, stiff hairs called setae. Setae help earthworms grip surfaces.*	*Earthworms tunnel through soil and take it into their bodies to absorb nutrients from the soil. Segmented worms also can be parasites. Leeches attach their mouths to other animals and suck blood.*	*Their tunnels help break up soil.* *They infect human and cause diseases*
	Mollusks 	*Most mollusks have a footlike muscle that generally is used for movement.* *A mollusk also has a mass of tissue called a mantle.* *A mantle is a thin layer of tissue that covers a mollusk's internal organs.* *Mantel is involved in making the shell of most mollusks.* *A mollusk's shell supports and protects its soft body. Some mollusks, such as slugs, do not have shells. Other mollusks, such as squids, have internal shells.*	*Live in water and on land* *The eating methods of mollusks vary:* - *by filtering food particles from the water in which they live* - *Other mollusks, such as octopuses, are predators and catch their prey in long, strong tentacles*	*They are food for fish, birds, and humans.* *Mollusk shells provide information about the conditions in an ecosystem.* *Scientists use the shells to find the source and distribution of water pollutants.*
	Round worms 	*They have a hydrostatic skeleton for movement have a hard outer covering, called a cuticle, for protection. It must be shed and replaced with a larger cuticle for the roundworm to grow. An outer covering is shed and replaced in a process called molting.*	*Most roundworms live in soil and are too small to see without a magnifying lens. They can be parasites or harmless*	*Roundworms eat dead organisms and return nutrients to the soil. some can be harmful to humans and plants*
17.5	Recognize main characteristics of arthropods including body structure, exoskeleton, molting process and ability to fly - *Bilateral symmetry* - *An arthropod has a hard-outer covering, so it must molt in order to grow.* - *An arthropod has an exoskeleton for both movement and protection.* 			

	• *Its muscles attach to the exoskeleton.* • *An arthropod uses its muscles when moving its jointed appendages.* • *An appendage is a structure, such as a leg or an arm that extends from the central part of the body.* *Insects are arthropods that undergoes metamorphosis, the body form of an animal changes as it grows from an egg to an adult.*
17.6	Recognize main characteristics of Echinoderms  • *A hard endoskeleton covered by a thin, bumpy, or spiny* • *Radial symmetry,* • *Can sense things in their environment from all directions.* • *A mouth, stomach, and intestines* • *They feed on plants and animals.* • *No head or brain. They do have a nerve ring that surrounds the mouth.* • *Cells that respond to light and touch.*
Lab 10	Explore activity: Who lives here?

- **<u>Practice Questions</u>**

1. To which phylum does the organism below belong?

A. Arthropods

B. Cnidarian

C. Echinodermata

D. Segmented worms

2. Anish finds an organism in damp soil with bilateral symmetry and a long, soft, segmented body. It has two openings to its digestive system and a circulatory system made up of blood vessels. The organism most likely is a member of phylum

A. Arthropods

B. Cnidarian

C. Echinodermata

D. Segmented worms

3. Which trait is true of the animal shown in the image below?

A. It has exoskeleton
B. It has radial symmetry
C. It is a vertebrate
D. It lacks symmetry

4. The simplest of all invertebrates are called _____.
A. arthropods
B. corals
C. flatworms
D. sponges

5. The specialized cells used by cnidarians to capture food are called_____.
A. appendages
B. mantel
C. molts
D. nematocyst

6. The tissue involved in making the shell of most mollusks is called the_____.
A. appendages
B. mantel
C. molts
D. nematocyst

7. Which phyla has members that are characterized by lack of symmetry?
A. Arthropods
B. Cnidarian
C. Echinodermata
D. Sponges

8. List the benefits of sponges?

9. What is a parasite? What are the invertebrates that can be parasites?

10. How can mollusks be useful for the environment?

11. Use the image to complete the table below and identify the characteristics of each invertebrate.

Image	Phylum	Symmetry	Unique characteristic
 Sea Anemone			
 Sea Urchin			
 Beetle			

12. Complete the table below to compare and contrast the round worms and segmented worms regarding their structure and source of food.

Invertebrate	***Structure***	***Environment and feeding***
Segmented worms		
Round worms		

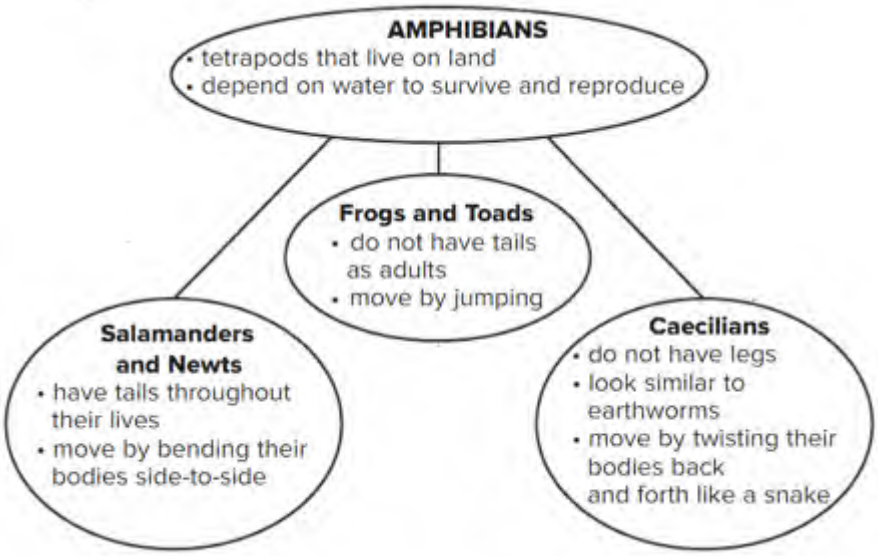
Learning Outcome		Number of Periods	Suggested Exercises /Assignments
LO 18 Describe the main characteristics of chordates and their classification (KPIs 17.1 – 15.6)		5	Lesson 7.3 Chordates Lesson 7.3 Assessment: Q 1- 9 Chapter Review: Q. 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 20 and 21 Standardized test practice: 3, 5, 10, 11
18.1	Identify four main characteristics of a chordate *A notochord, postanal tail, nerve cord, pharyngeal pouches. In vertebrates, these characteristics are present only during embryonic development.* *A notochord is a flexible rod-shaped structure that supports the body of a developing chordate.*		
18.2	Identify the characteristics of Lancelets and Tunicates as two invertebrate chordates *Most chordates are vertebrates, but the chordates also include two groups of invertebrates; tunicates and lancelets.* *Lancelets: small chordate animals which live in sand just off of ocean shores, they get food by catching floating food particles.* *Tunicates: live in the sea, attached to rocks or other stationary objects. They have true tissues and internal structures such as organs.*		
18.3	Identify fish, amphibians, reptiles, birds and mammals as vertebrate chordates • *All vertebrates have a backbone a series of structures that surround and protect the nerve cord, or spinal cord.* • *The spinal cord connects all the nerves in the body to the brain.* • *Bones that form a backbone are called vertebrae.* • *Vertebrates have well-developed organ systems.* • *All vertebrates have digestive systems with two openings, circulatory systems that move blood through the body, and nervous systems that include brains.* • *The five major groups of vertebrates are fish, amphibians, reptiles, birds, and mammals.*		
18.4	Explain the importance of gills for breathing *Gills are used for absorbing oxygen gas from water*		
18.5	Summarize the characteristics of fish, amphibians, reptiles, birds and mammals ***Fish*** *Fish spend their entire lives in water and have two important characteristics in common: gills for absorbing oxygen gas from water and paired fins for swimming.* • *Jawless Fish: Lampreys are jawless fish. The skeleton of jawless fish is made of cartilage. The tip of your nose and the flaps of your ears are made of cartilage. Some jawless fish get their nutrition from other fish. They have a circle of teeth that attach to the sides of other fish and make a wound. They then slowly suck out blood and other body fluid from the fish.* • *Sharks and Rays: Most of the skeleton of sharks and rays is made of cartilage. However, shark skulls are made of bone. Sharks have paired fins. They are fast swimmers and have powerful jaws. Their jaws make them dangerous predators of other animals, especially other fish.* • *Bony Fish: All other fish have a bony skeleton, as well as paired fins and jaws. Bony fish, such as goldfish, also have a special sac called a swim bladder that the fish can fill with gas. This*		

helps the fish move up and down in the water. Sea horses are unique bony fish because the males carry the young in their bodies as they develop

Amphibians

- *Amphibian mean "both ways of life" Most amphibians spend part of their lives in water and part on land.*
- *Amphibian skin is thin and moist. On land, amphibians must live in moist habitats to keep their bodies form drying out*
- *Amphibians' bodies change as they grow older. Often, the young have different body forms than the adults.*
- *Scientists are concerned about the survival of amphibians. Some types of amphibians have not been seen for years. Scientists think the amphibian population is decreasing because of disease, climate change, herbicides, and the destruction of amphibian habitat.*

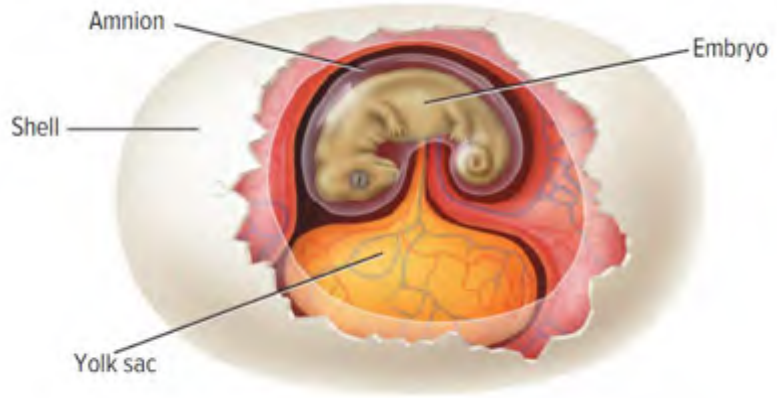
Frogs, toads, and salamanders belong to the class Amphibia. There are three types of Amphibians Frogs and toads, salamanders and newts and caecilians



Reptiles

- *Lizards, snakes, turtles, crocodiles, and alligators belong to the class Reptilia.*
- *All reptiles have waterproof skin that is covered in scales.*
- *Like amphibians, most reptiles have three-chambered hearts.*
- *Unlike amphibians, lizards and other reptiles have lungs throughout their lives.*

- *Most reptiles lay fluid-filled eggs with leathery shells that they lay on land. Called amniotic egg. Amnion, a protective membrane that surrounds the embryo.*



- *Alligators and crocodiles are found in warm parts of the world. They live in or near water but lay their eggs in nests on the shore.*
- *Warming, or basking, in sunlight is a behavioral adaptation of ectotherms. A reptile with a warm body can move faster and catch prey more easily. Reptiles move to cool, dark places to conserve energy when food is scarce*

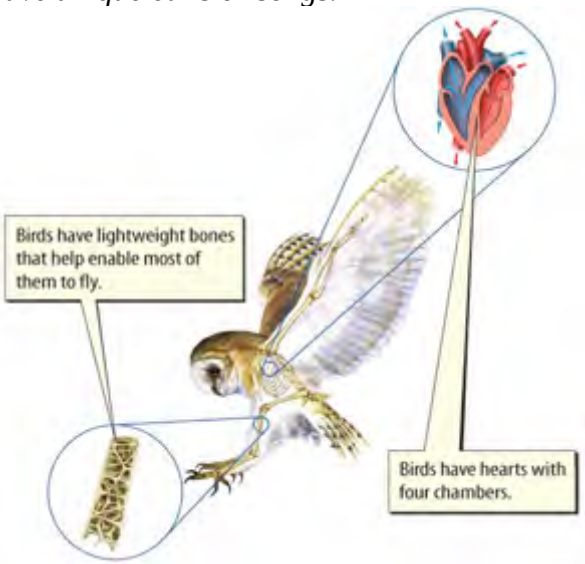
Birds

All birds are in the class Aves.

Many birds make nests to hold their eggs, and many have unique calls or songs.

Birds have

- *Lightweight bones*
- *Four-chambered hearts*
- *Skin covered with feathers and scales*
- *Two legs*
- *Two wings, different shapes of bird wings help the bird survive. Bird wings have two major shapes.*
    - *They can be long and narrow for soaring flight, so that birds can travel long distances.*
    - *Bird wings can also be short and broad, so that birds can change directions easily and catch prey or escape from an enemy*



- *A bird does not have a urinary bladder to weigh the bird down when the bladder is full. Instead, birds concentrate their urine into crystals. The crystals are the white part of bird droppings.*

Mammals

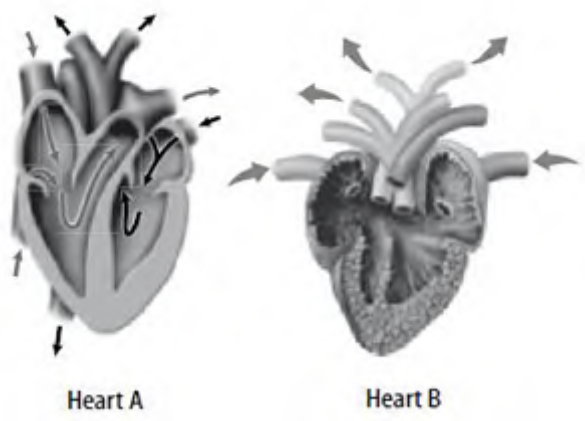
Dogs, cats, goats, rats, seals, whales, and humans are among the many vertebrates belonging to the class Mammalia.

- *All mammals have hair or fur covering their bodies.*
- *They are endotherms*
- *Mammals tear and chew their food using teeth.*
- *The most notable characteristic of mammals is the presence of mammary glands that produce milk which feeds young mammals.*
- *Most mammals give birth for young, afew species of mammals, including the duck-billed platypus, lay eggs.*

18.6	Distinguish between ectotherms and endotherms using examples *<u>Ectotherms</u>: animals that heat their bodies from heat in their environments such as reptiles* *<u>Endotherms</u>: animals that generate their body heat from the inside such as birds and mammals*
18.7	Describe the mammary glands *Mammary glands, special tissues that produce milk for young mammals.*
18.8	Identify three groups of mammals *Monotremes, marsupials, and placental mammals* *<u>Monotremes</u> A few types of mammals lay eggs. When their young hatch, they are nourished by their mother's milk. These mammals include the platypus and the echidna.* *<u>Marsupials</u> Mammals that raise their young in pouches are called marsupials. The young are not fully developed when born. After birth, they crawl through their mother's hair into a pouch. Here they can drink their mother's milk and continue to grow. Most marsupials are native to, or live in, Australia. Many marsupials resemble mammals that live in North America. There are marsupial squirrels, marsupial mice, and marsupial moles* *<u>Placental Mammals</u> The last group of mammals is called placental mammals. They have a structure called a placenta that the young are attached to as they grow inside the mother. You are probably most familiar with different kinds of placental mammals, such as cats, horses, cows, and humans.*
Lab 11	Explore activity: What animals are around you?
Lab 12	Observe bones from different animals

- **<u>Practice Questions</u>**

Use the images below to answer questions 1 and 2.



1. How do the hearts in the images above differ?
   A. Heart A has four chambers while heart B has three chambers
   B. Heart A has twice as many chambers as heart B has
   C. Heart A is found in fish, but heart B is found in amphibians
   D. Heart A is found in mammals while heart B is found in birds

2. Animals in which group of organisms have a heart similar in structure to heart A?
   A. Amphibians
   B. Birds
   C. Fish
   D. Reptiles

Use the table below to answer questions 3and 4.

Organism	Characteristics
Q	Smooth and moist skin, bony skeleton, adults have lungs
R	Feathers and scales, wings
S	Gills, fins, cartilaginous skeleton
T	Scales, lungs, fins
U	Hair or fur, glands that produce milk

3. Based on the table, which does NOT correctly identify the group to which the animal belongs?
   A. Q: amphibians
   B. R: birds
   C. T: reptiles
   D. U: mammals

4. An organism that has flippers and gives birth to live young belongs to which group?
   A. R
   B. S
   C. T
   D. U

5. Which of the following connects nerves in a vertebrate's body to the brain?
   A. Backbone
   B. Blood vessels
   C. Cartilage
   D. Spinal cord

6. Which vertebrate has mammary glands?
   A. Amphibians
   B. Birds
   C. Reptiles
   D. Mammals

7. How do skeletal and respiratory structures generally differ between chordates that live in the water and chordates that live on land?

8. What is the difference between endotherms and ectotherms?

9. What helps keep a bird's body temperature constant?

10. During a field trip, Mrs. Henson's class examined and identified several organisms. The graph below summarizes what they found. Based on the information in the graph, predict what type of environment Mrs. Henson's class studied. Explain your reasoning.