


Chapter Assessment

Physics You Learned

The *Physics You Learned* provides a quick reference for students to review the physics concepts from the chapter. Students should be encouraged to use this section as a guide of important concepts that serves to summarize the essential information from each section in the chapter.

Based on the information provided in *Physics You Learned*, students could prepare questions for a quiz and have a classmate answer their questions. Once students solve the quiz, they should check to see if their answers are correct. Students can then be divided into groups to have a discussion. Cooperative learning strategies are useful in helping students refresh their knowledge of equations and science vocabulary as well as reinforcing the basic concepts developed in the chapter. Another strategy that helps students recall prior learning and apply the physics of waves is drawing ray diagrams for optics and other diagrams that depict wave motion. Point out to students that their review of the *Physics Concepts* and *Is There an Equation?* will also help them prepare for their *Physics Practice Test*.


Chapter 5 Let us Entertain You

Physics
You Learned

Physics Concepts	Is There an Equation?
The length, mass, and tension of a vibrating string determine the vibration rate. As the length of the string increases, the vibration rate decreases. As the mass of the string increases, the vibration rate decreases. As the tension in the string increases, the vibration rate increases.	
Frequency (f) is the number of vibrations that are produced per second. The frequency determines what the ear hears as pitch.	$f = \# \text{ of cycles/second}$
The period of a wave (T) is the time it takes for a wave to complete one cycle and is equal to one divided by the wave's frequency (f).	$T = \frac{1}{f}$
Active Physics Plus	The fundamental frequency of vibration (f) of a stringed instrument is equal to the square root of the string tension (T) divided by four times the mass multiplied by the length of the string.
	$f = \sqrt{\frac{T}{4mL}}$
Wave motion is the energy of vibration transferred through a material (the medium).	
A transverse wave occurs when the particles of the medium vibrate at right angles to the path in which the wave travels.	
A longitudinal wave occurs when the particles of a medium vibrate parallel to the direction of the path in which the wave travels.	
The amplitude of a wave is the maximum distance the vibrating particles move from their rest position. The crest is the highest point of displacement of the wave, and the trough is the lowest point. The speed of a wave in a medium is independent of the wave's amplitude.	
When two waves in a medium meet, their amplitudes add together.	
A periodic wave is a wave that repeats at definite intervals.	
Standing waves are produced when two waves of equal amplitudes and frequencies travel in opposite directions. Points on a standing wave that do not move are called nodes.	
The velocity (v) of a periodic wave traveling in a medium is equal to the wave frequency (f) multiplied by the wavelength (λ).	$v = f\lambda$
The wavelength (λ) of a periodic wave is equal to twice the distance (L) between successive nodes, or the distance between identical points on successive waves.	$\lambda = 2L$
Vibrating air columns produce standing longitudinal waves in musical instruments. Tubes closed at one end set up standing waves when the tube length is one-fourth the wavelength. Tubes open at both ends set up standing waves when the tube length is one-half the wavelength.	
Diffraction of waves occurs when the waves pass through an opening. The degree of diffraction is determined by the ratio of the wavelength to the size of the opening. Because the wavelength of light is very short, light travels in straight lines unless it passes through a very narrow opening.	
When light is blocked from an area because it travels in straight lines, a shadow is formed. If the source of light is larger than a point, the shadow will either be completely dark (the umbra), or partially dark, with lighter edges (the penumbra).	
Active Physics Plus	The shadows formed by light rays obey simple geometric rules that allow the size of shadows from an object's size and distance to be calculated.

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	When a beam of light strikes a mirror and reflects, the angle of incidence (i) is equal to the angle of reflection (r). This is known as the law of reflection.	$\angle i = \angle r$
	All angles in optics are measured to a perpendicular (the normal) to the surface.	
	Plane mirrors form virtual images located behind the mirror. The image has the same size as the object and is the same distance behind the mirror as the object is in front of it.	
Active Physics <i>Plus</i>	Multiple images are formed by two plane mirrors placed at an angle to each other.	
	Concave, circular mirrors focus parallel rays of light to a point called the focus. Concave mirrors can form images, called real images, that can be projected onto a screen. The size and location of the image depends upon the distance of the object from the mirror. If the object is closer to the mirror than the focal length , the images formed are virtual and enlarged.	
Active Physics <i>Plus</i>	For a concave mirror, one divided by the focal length ($1/f$) equals one divided by the image distance ($1/d_i$) plus one divided by the object distance ($1/d_o$). This formula can be used to locate the position of the image formed by a concave mirror.	$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$
	Convex mirrors are able to produce only virtual images that cannot be projected onto a screen.	
	Refraction occurs when light passes from one transparent medium to another.	
	The index of refraction of a medium (n) relative to air equals the sine of the angle of incidence ($\angle i$) in air divided by the sine of the angle of refraction ($\angle r$) in the medium.	$n = \frac{\sin \angle i}{\sin \angle r}$
Active Physics <i>Plus</i>	The index of refraction of light in the incident medium (n_i) times the sine of the angle of incidence in that medium equals the index of refraction in the refracted medium (n_r) times the sine of the angle of refraction. This is known as Snell's law .	$n_i \sin \theta_i = n_r \sin \theta_r$
	The speed of light in a transparent medium (v) equals the speed of light in a vacuum (c) divided by the index of refraction of the medium (n). The speed of light in any medium is always less than the speed of light in a vacuum.	$v = c/n$
	If light travels from a medium of higher index of refraction to one of lower index, at an angle greater than the critical angle , the light will undergo total internal reflection .	
	Lenses use the principle of refraction to form images.	
	A convex lens is thicker in the center than the edges, and focuses parallel rays of light to a point. Convex lenses can form images that can be projected onto a screen. The size and location of the image depends upon the distance of the object from the lens. If the object is closer to the lens than the focal length, the images formed are virtual and enlarged (like those formed by a magnifying glass).	
	The formula used to locate the image formed by a convex lens is the same formula used for image location by a concave mirror.	$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$
	A concave lens can produce only virtual images that are smaller than the object.	
	Colors that you see are due to reflected light. When illuminated with white light, some colors are absorbed, and the reflected colors are what you observe.	
	When light of different colors are added together, a new color is produced. This is called additive color mixing .	