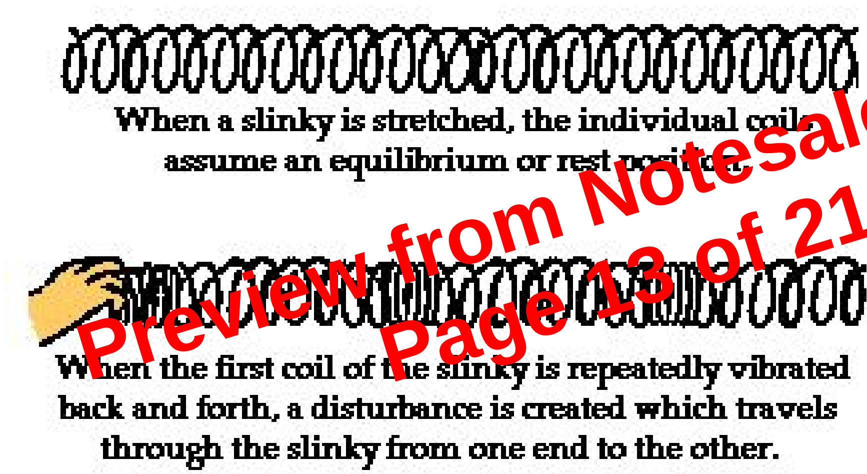
Unit 2: Cosmic Evolution

- Be able to determine the number of protons, electrons and neutrons in an atom using the periodic table
    - Protons
        - Atomic number
    - Electrons
        - Atomic number (if neutral)
    - Neutrons
        - mass # - # of protons

Understand how isotopes differ from each other and determine how many protons and neutrons are in specific isotopes

-
    - proton and electron # remain the same
    -
- Be able to read atomic symbols and name isotopes if given the atomic mass
- Explain how light/energy is emitted or absorbed by atoms
    - Explain the properties of light as a wave
    - distinguish between emit, absorb, reflect, refract
- Explain waves
    - calculate frequency, speed, wavelength & energy using Plank's constant
    - a disturbance that travels through a medium from one location to another location.
- Draw the Electromagnetic spectrum
    - describe the frequency and wavelength relationship
    - What is the speed of all of visible light? X-rays? Radio waves?
- Understand the distances between objects in the solar system
    - calculate speed, distance and time
    - describe and use a light year in equations
    - Use the speed of light in an equation
    - Identify the closest star to us
- Determine speed, velocity and acceleration.
- Determine velocity, acceleration and distance for free falling bodies.
    - Gravitational Constant -9.81 ms^2
    - d=at^2
- Explain Newton's three laws of motion (inertia, force, action, reaction).

from end to end and is held at rest, it assumes a natural position known as the **equilibrium or rest position**. The coils of the slinky naturally assume this position, spaced equally far apart. To introduce a wave into the slinky, the first particle is displaced or moved from its equilibrium or rest position. The particle might be moved upwards or downwards, forwards or backwards; but once moved, it is returned to its original equilibrium or rest position. The act of moving the first coil of the slinky in a given direction and then returning it to its equilibrium position creates a **disturbance** in the slinky. We can then observe this disturbance moving through the slinky from one end to the other. If the first coil of the slinky is given a single back-and-forth vibration, then we call the observed motion of the disturbance through the slinky a *slinky pulse*. A **pulse** is a single disturbance moving through a medium from one location to another location. However, if the first coil of the slinky is continuously and periodically vibrated in a back-and-forth manner, we would observe a repeating disturbance moving within the slinky that endures over some prolonged period of time. The repeating and periodic disturbance that moves through a medium from one location to another is referred to as a **wave**.



What is a Medium?

But what is meant by the word *medium*? A **medium** is a substance or material that carries the wave. You have perhaps heard of the phrase *news media*. The news media refers to the various institutions (newspaper offices, television stations, radio stations, etc.) within our society that carry the news from one location to another. The news *moves through* the media. The media doesn't make the news and the media isn't the same as the news. The news media is merely the *thing* that carries the news from its source to various locations. In a similar manner, a wave medium is the substance that carries a wave (or disturbance) from one location to another. The wave medium is not the wave and it doesn't make the wave; it merely carries or transports the wave from its source to other locations. In the case of our slinky wave, the medium through that the wave travels is the slinky coils. In the case of a water wave in the ocean, the medium through has not moved from the middle of the ocean to the shore. If we were to observe a gull or duck at rest on the water, it would merely bob up-and-down in a somewhat circular fashion as the disturbance moves through the water. The gull or duck always returns to its original position. The gull or duck is not transported to the shore because the water on which it rests is not transported to the shore. In a water wave, energy is transported without the transport of water.

The same thing can be said about a stadium wave. In a stadium wave, the fans do not get out of their seats and walk around the stadium. We all recognize that it would be silly (and embarrassing) for any fan to even contemplate such a thought. In a stadium wave, each fan rises up and returns to the original seat. The disturbance moves through the stadium, yet the fans are not transported. Waves involve the transport of energy without the transport of matter.

In conclusion, a wave can be described as a disturbance that travels through a medium, transporting energy from one location (its source) to another location without transporting matter. Each individual particle of the medium is temporarily displaced and then returns to its original equilibrium positioned.

What are waves?

[IMAGE OF ECHO w/Echolocation]

Sound is also a type of wave that we cannot see. Like ocean waves, sound waves something to travel through like waves through the ocean or through a flag. Sound can travel through air because air is made of molecules. These molecules carry the sound waves by bumping into each other, like dominoes knocking each other over. Sound can travel through anything made of molecules - even water! There is no sound in space because there are no molecules there to transmit the sound waves. Electromagnetic waves are different from sound waves because they do not need molecules to travel. This means that electromagnetic waves can travel through air and solid materials - but they can also travel through empty space. This is why astronauts on spacewalks use radios to communicate. Radio waves are one kind of electromagnetic wave.