A Wave Transports Energy and Not Matter

When a wave is present in a medium (that is, when there is a disturbance moving through a medium), the individual particles of the medium are only temporarily displaced from their rest position. There is always a force acting upon the particles that restores them to their original position. In a slinky wave, each coil of the slinky ultimately returns to its original position. In a water wave, each molecule of the water ultimately returns to its original position. And in a stadium wave, each fan in the bleacher ultimately returns to its original, seated position. It is for this reason, that a wave is said to involve the movement of a disturbance without the movement of matter. The particles of the medium (water molecules, slinky coils, stadium fans) simply vibrate about a fixed position as the pattern of the disturbance moves from one location to another location.

1. This paragraph is saying:

Waves are said to be an energy transport phenomenon. As a disturbance moves through a medium from one particle to its adjacent particle, energy is being transported from one end of the medium to the other. In a slinky wave, a person passes on energy to the first coil by doing work on it. The first coil receives a large amount of energy that it next transfers to the second coil. When the first coil returns to its original position, it has the same amount of energy as it had before it was moved. The first coil transferred its energy to the second coil. The second coil then has a large amount of energy that it transfers to the third coil. When the second coil returns to its original position, it possesses the same amount of energy as it had before it was moved. The third coil has received the energy of the second coil. This process of energy transfer continues as each coil interacts with its neighbor. In this manner, energy is transported from one end of the slinky to the other.

2. This paragraph is saying:

This characteristic of a wave as an energy transport phenomenon distinguishes waves from other types of phenomenon. Consider a common phenomenon observed at a softball game - the collision of a bat with a ball. A batter is able to transport energy from her to the softball by means of a bat. The batter applies a force to the bat, thus imparting energy to the bat in the form of kinetic energy. The bat then carries this energy to the softball and transports the energy to the softball upon collision. In this example, a bat is used to transport energy from the player to the softball.

However, unlike waves, this event involves the transport of matter. The bat must move from its starting location to the contact location in order to transport energy. In a wave, energy can move from one location to another, yet the particles of matter in the medium return to their fixed position. A wave transports its energy without transporting matter.

3. How is kinetic energy different than energy moved by waves?
Waves are seen to move through an ocean or lake; yet the water always returns to its rest position. Energy is transported through the medium, yet the water molecules are not transported. Proof of this is the fact that there is still water in the middle of the ocean. The water has not moved from the middle of the ocean to the shore. If we were to observe a 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 duck always returns to its original position. The 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. 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 position.

4. Minute after minute, hour after hour, day after day, ocean waves continue to splash onto the shore. Explain why the beach is not completely submerged and why the middle of the ocean has not yet been depleted of its water supply.

5. A medium is able to transport a wave from one location to another because the particles of the medium are _____.
   a. frictionless
   b. isolated from one another
   c. able to interact
   d. very light