The Ocean: A Giant Heat Reservoir

Solar Energy Is Absorbed by Earth

A vast amount of energy makes its way from the Sun to Earth. Much of that energy gets absorbed by matter on Earth: air, water, and land. As these different kinds of matter absorb heat energy, their molecules begin to move faster, causing their temperature to rise. An increase in temperature is evidence that molecular particles are speeding up.

Temperature is a *measure* of 1) how hot or cold something is (the internal thermal energy of a material), and 2) the average kinetic (moving) energy of molecules or atoms in a sample of matter. **Heat** is the *transfer of energy* from one substance to another; it's a process, not an entity.

Water Absorbs Heat Energy More Slowly than Air Does

Water can absorb a lot of heat energy without much change in temperature. If air and water absorb the same amounts of energy, the air heats up much more quickly than the water. This can be demonstrated by adding heat energy to two balloons, one filled with air and one with water. As soon as heat energy makes contact with the latex, the air balloon will pop immediately, but the water balloon will not.

One reason for this is that water contains far more molecules than air does in the same amount of space (volume). In water, the heat energy is dispersed among many molecules; each water molecule absorbs some of the energy and moves a little faster. The water molecules in the balloon continue to absorb energy without getting much warmer. The latex stays cool and doesn't pop. In the same volume of air, which contains fewer molecules, each air molecule gets a bigger share of the energy to absorb and moves much faster. As the air molecules heat up, they move farther apart from one another, zip off in different directions, and collide with others, creating a rise in temperature. The faster the molecules move, the higher the temperature. When the air molecules in the balloon can't absorb any more energy—which happens almost immediately—the heat energy is absorbed by the latex matter of the balloon, which quickly bursts.

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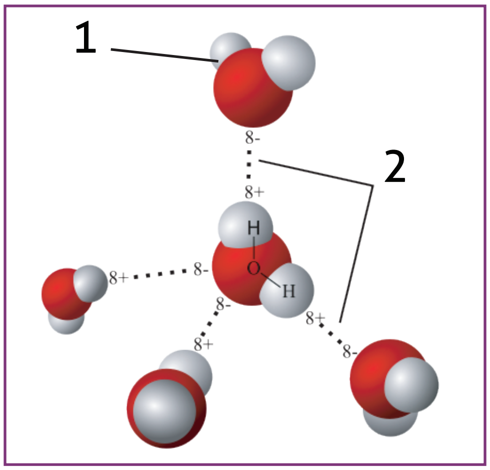
Water Molecules Absorb Heat Energy Differently from Other Molecules

In other kinds of matter, such as rock, molecules heat up quickly compared to water even if that matter has approximately the same number of molecules in the same amount of space as water.

A water molecule is made up of three atoms: two hydrogen and one oxygen. The bonds between the oxygen and hydrogen atoms in a water molecule (1), unlike the bonds between atoms in most other kinds of molecules, are very flexible and can absorb a lot of energy before increasing in temperature. This allows them to wobble in place as they absorb energy, rather than zipping off in different directions, colliding with other molecules and causing the temperature to increase.



Hydrogen bonds between adjacent water molecules (2), although not as strong as the bonds that hold the atoms within a molecule together, are still strong and flexible enough to keep water molecules from separating from one another easily. Water can bond to as many as four other water molecules, which helps strengthen and stabilize the bonds between them even more.

Because it takes more energy to break the bonds between adjacent liquid water molecules than between molecules of most other substances, water can absorb more energy before the bonds break and the water molecules start moving faster and bumping into one another, causing the temperature to increase.

The Ocean Acts as a Heat Reservoir

About 70% of the surface of Earth is covered by ocean, and the ocean can be up to seven miles deep. That's a lot of water on the planet, and all that water can absorb a lot of heat energy. This makes our ocean a vast heat reservoir.

Because water can absorb an enormous amount of energy before heating up, the ocean helps keep our planet from getting too hot. And when the ocean releases (transfers) heat energy back into the cooling air, such as at night or in winter, it also helps keep our planet from being too cold. The ocean keeps temperatures on our planet moderate enough to sustain life.

