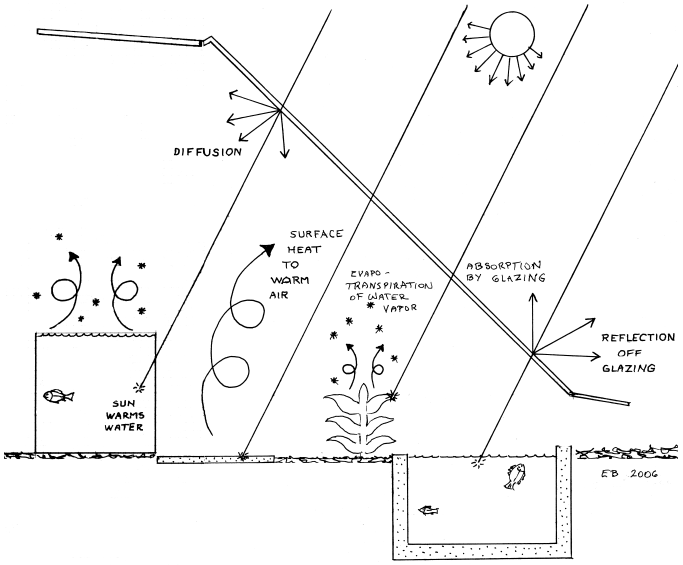
Solar Ponds For Heat Storage in Bioshelters

Heat

"Alchemical processes depend on the maintenance of steady temperatures, and much experience is needed in the design of furnaces to precisely regulate the heat and draft ...."

quote from old alchemy

When sunlight strikes a material, the material becomes warmer. In a bioshelter, materials like water, soil, stone, cement, and plants absorb incoming solar energy, warm up, and store heat. The heat stored in this thermal mass is later released by radiation and air convection. The process is simple, automatic, dependable, and requires no machinery. Thermal mass in a greenhouse include water, soil, stone walls and walks, cement pavers and foundation walls, and steel framework.



Solar Heat

In a conventional greenhouse, there is not enough mass in the building to absorb all the solar energy entering the greenhouse, so the air becomes very hot. Normally the heat is vented out of the building during the day. But then on subsequent cold nights the greenhouse must be heated with fuel. Solar energy stored daily in solar ponds can substitute for heating with gas, oil, wood or electricity. In mild temperate climates like Cape Cod, with sunny winters, solar ponds can largely eliminate the need to burn fossil fuel for heat.

Pond Water as Thermal Mass

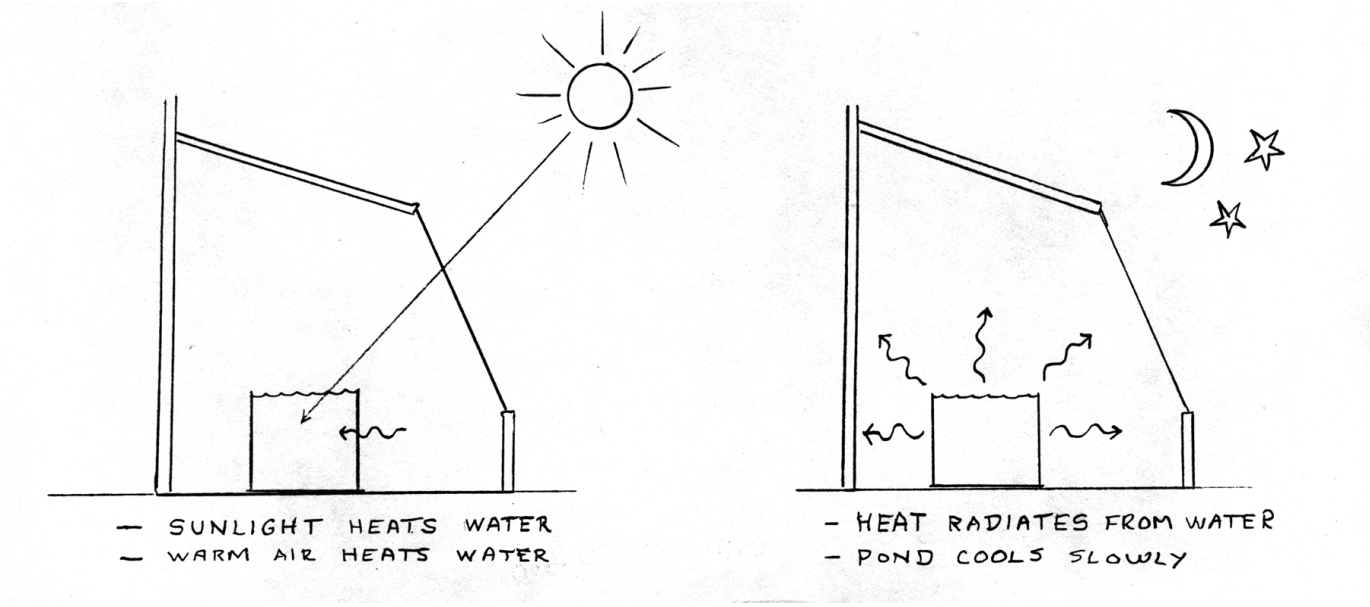
With enough thermal mass, heat can be stored from sunny days to keep the greenhouse warm at night without burning fuel. Solar heat storage and release in solar ponds is automatic. It occurs due to passive, natural movement of light, warm water and warm air. It does not require pumps or fans or controls.

Water is the cheapest, most effective thermal mass for storing heat. Ponds of water can store enormous amounts of solar heat. Dark water and dark containers of water absorb sunlight better than clear water. Ideally the sunlight

should strike the ponds directly. Solar ponds absorb sunlight on the sides, and as water along the side gets warm, it rises and circulates, efficiently storing heat in the entire water volume. Water has more surface area to absorb and release heat if it is in several distributed containers rather than being in a single large container.

When sunlight strikes a solar pond, most of it passes through the clear sides, enters the water and is absorbed by green algae in the water. The algae can capture about 5% of the solar energy by photosynthesis, and store it. The other 95% of the solar energy absorbed by the algae becomes heat, which warms the pond water.

During a sunny day, the water in a solar pond warms up and stores heat. Each night some of that heat escapes and warms the air or is radiated to nearby objects. During a sunny day a pond can warm up 5 degrees F, and release most of that heat in the night. When there are several days of no sun, pond will provide useful heat for several nights in row as it slowly cools. This storage-and-release also reduces the extreme daytime high temperature and raises the exteme nighttime low temperature in the greenhouse. In computer simulations of dome greenhouses, the presence of solar ponds as thermal mass reduced the average daily temperature swings by 10 degrees F, and raised the monthly minimum temperatures by 6-8 degrees F.



Sunny Day

Night after a Sunny Day

Other Water as Thermal Mass

Any water in a bioshelter acts automatically as passive thermal mass - water in the soil, water in plants, water in ponds, and even water vapor. Most plants are 95% water. Plants are excellent thermal mass, being distributed in space in thin layers with a large surface area, and are able to quickly absorb and release large amounts of heat. Much of the solar energy that strikes plant leaves evaporates water, producing water vapor that contains the heat energy.