

### Warning:



- **Not a toy; use only in a laboratory or educational setting.**
- **California Proposition 65 Warning: This product may contain chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.**
- **Be careful when using any heat source to protect yourself from possible burns. Also, be sure the Ball & Ring are cooled to room temperature before putting the set away.**



## Ball & Ring Apparatus

Everyone knows that applying heat to an object increases its temperature. But what is going on when the temperature of an object increases?

Temperature is created through the movement of atoms and molecules. When they are exposed to the energy provided by heat, they become agitated and move around, taking up more space than if they were still. This can be tested by applying heat underneath a miniature hot air balloon or parachute. When the air's molecules spread out, the air becomes lighter and rises. This is how we can tell that the molecules become agitated when heated.

### Ball & Ring Apparatus



Air is not the only thing that expands when heated. Metals undergo thermal expansion as well. The Ball & Ring Apparatus will illustrate this principle. The kit includes two screwdriver-like handles. On the end of one is a metal ball. On the end of the other is a ring through which the ball just barely fits. Insert the ball through the ring. Move it back and forth to show that the ball easily moves in and out of the hole. Insert the ball once more and heat it up with a candle or lighter or low intensity heat source. Once it is heated, try to remove it from the ring. You will find that the ball has expanded and will not be able to pass through the ring until it has cooled.

What does this exercise prove? Applying heat to most solids will result in some sort of expansion. The amount of expansion is determined by the amount of heat applied, the time over which the heat is applied and the material that is used.

Different materials will expand at different rates. The rate is referred to as the coefficient of expansion of that particular type of material. For example, iron will expand .000012 cm per centigrade for every cm of length.