## Investigation 3: Properties of Austenite and Martensite

Supplies

2 samples of NiTi , one in the austenite phase at room temperature and the other in the martensite phase at room temperature (#######)
string
400 mL beaker
method of bringing water to boiling (hot plate, Bunsen burner)
thermometer
tongs
gloves
Safety goggles
Liquid nitrogen (local sources include dermatologists, welders, universities, hospitals, research institutions). An alternative would be to use dry ice and acetone bath.



Teacher Notes

In the first part of this investigation, students will be given opportunities to observe different samples of NiTi, one in the martensite phase at room temperature and the other in the austenite phase at room temperature. They will determine which sample is martensite and which is austenite. Next, if the materials are available, students will cool the austenite sample using liquid nitrogen or a dry ice/ acetone bath (using extreme CAUTION) to transform it to the martensite phase so it can be bent (using gloves). After that, students will have an opportunity to determine the **transition temperature** of the martensite sample by slowly heating the sample until it becomes rigid (austenite phase). This transition temperature is determined by the relative amounts of nickel and titanium in the sample. Small changes in the composition of the metal can greatly affect the transition temperature of the wire. Temperatures at which Nitinol samples change from one phase to another vary widely as a direct result of very small changes in nickel/titanium ratio. By changing the relative amounts of nickel and titanium in the wire, wire can be made to respond to a wide range of temperatures and can be used for a variety of purposes.

A diagram of the set up for this part of the lab is shown in Figure 3. It is very important that the neither the thermometer nor the memory metal sample touch the bottom of the beaker or hot pot since the temperature of the heat element or the beaker will not be the same as the temperature of the water.

In this investigation, the transition temperature is defined as the temperature at which the wire has become completely rigid. Students should the average their transition temperature data with the rest of the class data. Students can then use this average transition temperature data and the graph provided to determine the percentage of nickel contained in their samples.