

CAN the METTLE of METAL be IMPROVED?

PRE-LAB DISCUSSION:

Metals are used for many different purposes. Two hundred years ago, the town blacksmith produced nails, hammers, wheel rims, knives, and horseshoes from the same basic metal. In some applications, a metal must be able to bend easily without breaking, whereas in other cases the metal must resist bending. Today metallurgists can produce these results by using different metals, alloying metals, and by heat treating metals. The substitution of a different metal or using a special alloy is often costly. Therefore heat treatment of a common metal is often the most cost efficient method of producing a metal that has the properties required in a specific application. Most metals respond to heat treatment, but the treatment temperatures are unique for different metals.

Students may be assigned only one or two of the metals if the lab is being done in only one day.

OBJECTIVE: To determine the effects of annealing, quenching, and tempering on metals.

CHEMICALS/EQUIPMENT: Bunsen burner, tongs, beaker, bobby pins, hair clip, single strand steel wire

PROCEDURE:

CONTROL

1. Straighten a bobby pin and determine the number of bends to break it in two. Record this on the data chart. Repeat this two more times.

ANNEALING

1. Heat a bobby pin to red hot by holding it over the flame with the tongs. It must remain red hot for thirty seconds. Then gradually lift it straight up until it is about a foot out of the flame. Let the sample cool

gradually in the air for about three minutes. This process of strong heating and slow cooling is called annealing.

2. After it has cooled, bend it back and forth until it breaks and record the number of bends that it takes to break the metal.

3. Repeat this for two more times.

QUENCHING

1. Take a piece of bobby pin and heat it to redness. When it is red hot, immediately place it in a beaker of water. This process of strong heating and quick cooling is called quenching.

2. Bend the pin and record the number of bends needed to break the pin.

3. Repeat this two more times.

TEMPERING

1. Heat a pin to red hot and keep it in the flame for another thirty seconds. Then place it in a beaker of water. Reheat the pin until it glows with a **dull redness** and remove it gradually from the flame as you did in the annealing process. This process of strong heating, quick cooling, strong heating and then slow cooling is called tempering.

2. Bend the pin and determine the number of bends needed to break the pin.

3. Repeat the process two more times.

Repeat this procedure for the other metals available.

DATA
NUMBER OF BENDS TO BREAK

SAMPLE	UNTREATED	ANNEALED	QUENCHING	TEMPERING
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average				
average				
average				

THINKING SCIENTIFICALLY

1. What are the effects of annealing?

2. What are the effects of quenching?

3. What are the effects of tempering?

4. What type of treatment would be used in making a scalpel blade?

5. What type of treatment would be used in metal used for making wire?

6. What type of treatment was used in making spring clips?

7. What type of treatment produces the hardest metal ? [Hint: To answer this question correctly, you must first define the word "hard" in operational terms.]

8. What type of treatment produces the strongest metal? [Hint. To answer this question correctly, you must first define the word "strong" in operational terms.]

EXTRA

9. Using the library or Internet, find the heat treatment temperatures for other common metals such as aluminum.

10. Explain the meaning of the following statement:

*" A MAN IS LIKE STEEL,
WHEN HE LOSES HIS TEMPER,
HE IS WORTHLESS."*