Metal, Alloys, & The USS KIDD

Numerous metals and alloys were used in the construction of the USS KIDD. In its simplest definition, an alloy is a mixture of a metal and another element. Different metals and alloys have different strengths, weaknesses, and properties. The most common alloy found in the makeup of the KIDD is steel. Steel is an alloy made up of iron and carbon and, at times, other trace elements. The skin or sides of the ship consist of steel that is 3/8 inch thick. Steel is very strong and durable, but when exposed to water or oxygen in the air, a chemical reaction will occur, causing it to corrode, or rust. To prevent this, the steel surfaces aboard ship are painted with a protective layer to prevent corrosion.

Brass is another common alloy found aboard ship. Brass is a bright, shiny metal alloy mostly made of copper and zinc, with other elements sometimes added in such as aluminum, arsenic, tin, or lead. Brass is very malleable (soft), non-magnetic, and corrosion resistant. It has low-friction properties and favorable resonance qualities. For these reasons, brass is used for plumbing fixtures, ammunition powder casings, ship's bells, and more.

Bronze is an alloy similar to brass except that it is made up of copper and tin mostly in varying amounts for different uses. Compared to brass, it is a darker, reddish-brown in color. Like brass, it is resistant to corrosion and is non-magnetic. Unlike brass, it is stronger and has greater resistance to metal fatigue. The KIDD's propellers are made from bronze, as are the cables and turnbuckles on the railings, the dogs on the hatches, and the anchor windlass.

Zinc bricks called "sacrificial anodes" are attached to the KIDD's steel hull near the bronze propellers. The flow of water around the hull, particularly around the propellers, produces a static electrical charge. This occurrence in an area of dissimilar metals—the steel hull and the bronze propellers—can cause accelerated corrosion. The zinc anodes dissolve into the seawater faster than the nearby steel or bronze and thus slow the deterioration of the nearby metals to a more normal rate of decay.

Copper can be found throughout the ship in wiring, plumbing, and the ship's boilers because of its resistance to corrosion and superior electrical conductivity. Platinum was used in some of the radar and sonar equipment due to it being very malleable and ductile, as well as its resistance to corrosion under high temperatures. Aluminum was used to replace some of the KIDD's superstructure and decks due to its corrosion resistance, light weight, and durability. However, the Navy stopped using aluminum in destroyer hull construction because of its lower melting point during fires as compared to steel.

1. Using the Periodic Table on Page 3, find each of the following elements and list their chemical symbol and atomic number:

    a. Iron _____
    b. Carbon _____
    c. Copper _____
    d. Zinc _____
    e. Aluminum _____
    f. Tin _____
    g. Arsenic _____
    h. Lead _____
    i. Platinum _____

2. What is an "alloy"? _____

    _____

3. Name three (3) alloys found aboard the USS KIDD: _____

    _____

    _____

4. Based on the previous paragraphs, what chemical reaction is of greater concern among all of the metal alloys aboard a ship like the USS KIDD? Give its scientific and common name.

    _____

5. "Friction" is the force resisting the motion of surfaces sliding against one another. Friction can produce a static electrical charge, as well as heat. In which use aboard the KIDD would the low-friction property of brass be most important?

    _____

    _____

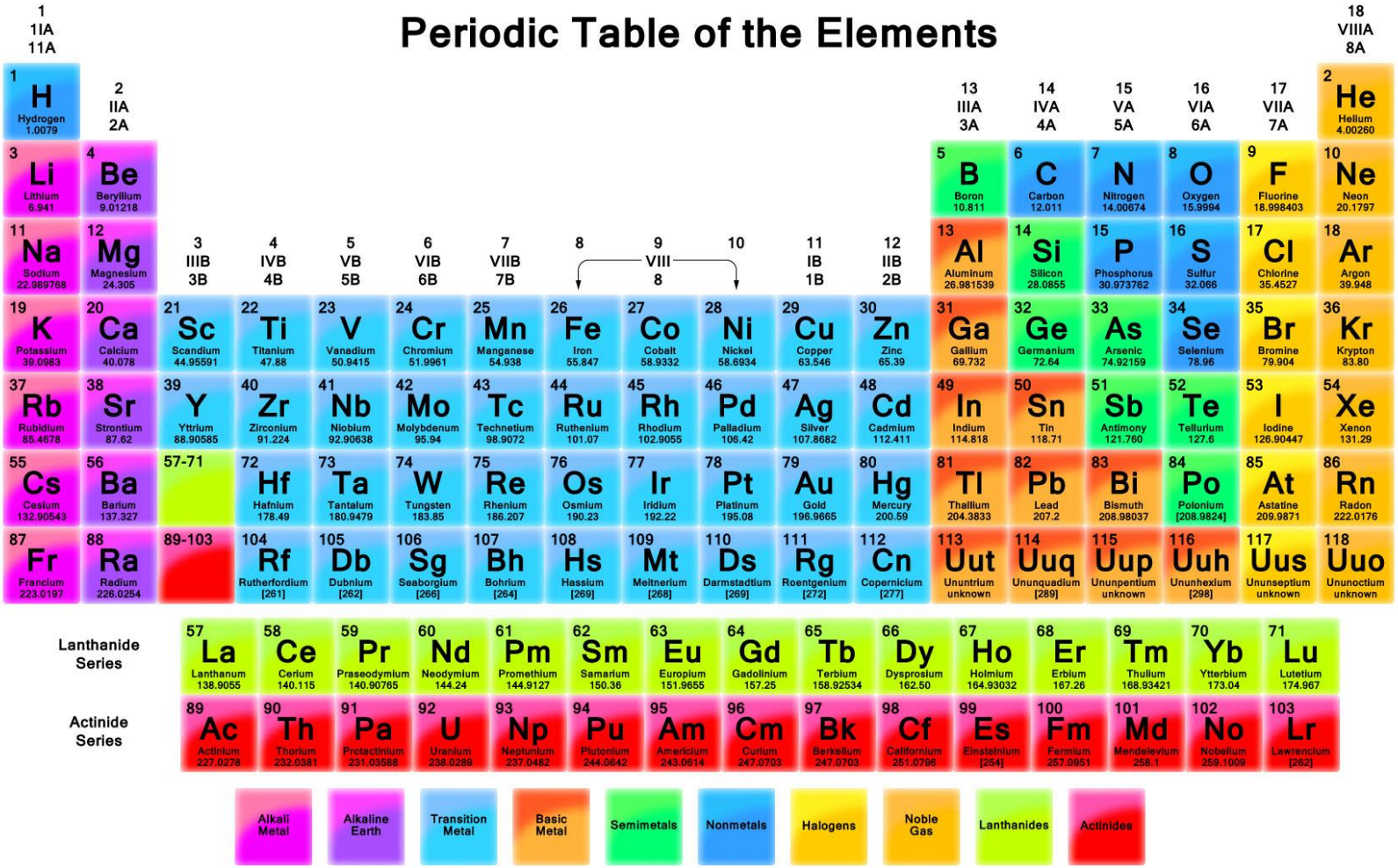
6. Class Discussion: What can you find in your school or in your home that uses the same metals and metallic alloys found aboard the USS KIDD in the same or similar manners?

    _____

    _____

    _____

Periodic Table of the Elements



Teacher's Answer Key

1. Using the Periodic Table on Page 3, find each of the following elements and list their chemical symbol and atomic number:

   a. Iron **Fe 26**

   b. Carbon **C 6**

   c. Copper **Cu 29**

   d. Zinc **Zn 30**

   e. Aluminum **Al 13**

   f. Tin **Sn 50**

   g. Arsenic **As 33**

   h. Lead **Pb 82**

   i. Platinum **Pt 78**

2. What is an "alloy"? **A mixture of a metal and another element.**

3. Name three (3) alloys found aboard the USS KIDD: **steel, brass, bronze**

4. Based on the previous paragraphs, what chemical reaction is of greater concern among all of the metal alloys aboard a ship like the USS KIDD? Give its scientific and common name.

   Corrosion, also known as rust.

5. "Friction" is the force resisting the motion of surfaces sliding against one another. Friction can produce a static electrical charge, as well as heat. In which use aboard the KIDD would the low-friction property of brass be most important?

   Ammunition powder casings – a static electrical charge or generated heat could produce an explosion.

6. Class Discussion: What can you find in your school or in your home that uses the same metals and metallic alloys found aboard the USS KIDD in the same or similar manners?

   Answers will vary but may include the following: steel in the structural framing of the building; copper, brass, or bronze tubing or parts in the plumbing; aluminum siding on a house; aluminum on water fountains; copper in electrical wiring; copper or bronze in the building's hot water heater (identical to a boiler, just with lower temperatures); platinum and copper in electrical components like radios, televisions, game systems, computers (KIDD has radios and a fire control computer).