

What's your Stuff?

Lesson Plans by

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Summary

Is a group of materials science lessons for 11th grade high school Chemistry, to be used during the New York State Regents Chemistry unit Bonding. Challenges students to investigate their surroundings, and decipher the type of chemical bonding of the materials with which they live.

Materials

Computers with internet access, ring stands, rings, Bunsen burners, steel plates with hammered depressions, conductivity meters, watch glasses, stirring rods, distilled water, methanol, aluminum foil, silicon chip, potassium chloride, lithium chloride, naphthalene flakes.

Resources

Stephen Sass, *The Substance of Civilization*

www.ccmr.cornell.edu

Material Safety Data Sheets @cornell.edu

www.psrc.usm.edu/index.htm

www.gcsechemistry.com/xex.htm

www.mineralgallery.co.za/enter.htm

Tom Russo, *Chemistry Concepts and Applications*

Google.com

Lecture-Discussion

Today's world (past 100 years) may be distinguished from all previous times in human history (100,000 years) by the capability of direct manipulation of the structure of the materials we employ. Until recently, people had no idea what gave steel its characteristics, and only by comprehending its composition could the countless changes in modern life occur (like the building of long suspension bridges, skyscraper buildings and ultimately our modern cities). New drugs are now designed by investigating the atomic structure of target molecules like enzymes, and then fabrication from scratch begins. Prior to this novel approach, medicines were found serendipitously—by trial and error techniques, people discovered effective medications. Electronic circuits are now miniaturized and utilize switches with no moving parts. Our modern age may well have entered the Silicon Age, even though it appears full of the synthetic fabrics we wear.



Internet activities (Use internet sites for these mini- research projects.)

I. Choose ten (10) items from the following list:

- *Silicon*
- *Polyethylene*
- *Polypropylene*
- *Bone*
- *Wood*
- *Diamond*
- *Graphite*
- *Teflon*
- *Plexiglas*
- *Nylon*
- *Steel*
- *Bronze*
- *Glass*
- *Wrought Iron*
- *Dacron*
- *Rayon*
- *Fiberglass*
- *Rubber*
- *Silk*
- *PVC*
- *Stryofoam*
- *Bullet-proof glass*
- *Ceramic clay*
- *Artificial Ruby*
- *Road salt*

1. Name one use for each material.
2. State the elemental composition of each.
3. State the kind of chemical bonding that holds the material together.
4. Describe the characteristic chemical structure that defines that material.

II. Name one material that is *not* on the above list (in I.) and then:

1. Name one use for your material.
2. State its elemental composition.
3. State the kind of chemical bonding that holds your material together.
4. Describe the characteristic chemical structure that defines your material.

III. For each of the following:

- *The hardest material*
 - *The strongest fiber*
 - *The strongest glue*
1. State the elemental composition.
 2. State the kind of chemical bonding that holds the material together.
 3. Describe the characteristic chemical structure that defines the material.
 4. Explain why the material is so strong.

IV. Name 3 different bulletproof materials and then:

1. State the elemental composition of each.
2. State the kind of chemical bonding that holds the material together.
3. Describe the characteristic chemical structure that defines material.
4. Explain why the material is bulletproof.

V. Name the material that forms the outer shell of the space shuttle, and then:

1. State its elemental composition.
2. State the kind of chemical bonding that holds your material together.
3. Describe the characteristic chemical structure that defines your material.
4. Explain why the material is used in this application.



Laboratory Investigation of Three major Categories of Bonding

Prepare a data table for your findings (make a grid for 6 tests on 5 substances)

The five substances to be tested are:

- *Aluminum foil*
- *Table salt*
- *Mothballs*
- *Road salt*
- *Computer chip*

Perform each of the following 6 tests (Appearance, Melting point, Solubility in Water, Conductivity of Water Solution, Conductivity of Solid, Solubility in Methanol) separately on each substance

1. Describe the appearance and odor of the substance. Record your findings.
2. Place the metal plate with indented wells on a ring attached to a ring stand. Place a small amount of *just one* substance in a well of the indented metal plate. Use the flame of the Bunsen burner to gently heat the underside of the metal plate. Record your findings. If no change occurs, lift the Bunsen burner and heat more intensely. Record your findings. Clean the plate for next substance—be careful! Use tongs! It's hot!
3. Place a very small amount of the substance in a watch glass, and then add a few milliliters of distilled water. Stir. Decide if the substance is soluble, insoluble or partly soluble in water. Record your findings.
4. Add more of the substance to the watch glass from #3 above (already has water and some substance). Stir. Test the water solution (not any undissolved stuff on the bottom) for conductivity with a meter. Record your findings.
5. Clean the prongs of the conductivity meter (rinse with water and wipe) and test the dry solid substance for conductivity. Record your findings.
6. Place a very small amount of the substance in a clean watch glass (rinse with water and wipe), and then add a few milliliters of methanol. Stir. Decide if the substance is soluble, insoluble or partly soluble in methanol. Record your findings.

Assessment

1. What are the three major categories of Chemical Bonding?
2. Which chemical bond type is found in substances with high melting point, solubility in water, poor conductivity, but good aqueous conductivity?
3. Which chemical bond type is found in flammable substances with low melting point and solubility in non-polar solvents?
4. Which chemical bond type is found in substances that exhibit high luster and are good conductors?
5. How do metals and metalloids (semiconductor) differ?
6. How do carbon and silicon compare? Describe location in Periodic Table, appearance, structure and bonding type of each in your answer.

Use a standard format of Title, Objective, Materials, Procedure, Results and Conclusion for your laboratory report.

