

Lesson #10: Bonding with Carbon

| Stage 1 – Desired Results | |
|---|---|
| <p>Established Goals: SLO D1: Use the concepts of similarity and diversity for organizing our experiences with the world</p> <p>SLO A5: Describe disciplinary processes used to enable us to investigate and understand natural phenomena and develop technological solutions</p> | |
| <p>Understandings: Students will understand that...The diversity of carbon compounds can be attributed to its bonding characteristics</p> | <p>Essential Questions: What is the basic chemistry of hydrocarbons and how do we TAKE them from earth and MAKE products out of them?</p> <p>SLO D1: How can we use the concepts of similarity and diversity for organizing our experiences with the world?</p> |
| <p>Students will know...</p> <ol style="list-style-type: none"> 1. Describe the structural characteristics of carbon (<i>C11-5-03</i>) 2. Relation between carbon's valence electrons, its position on the periodic table and its ability to bond covalently 2. SLO D1: Use the concepts of similarity and diversity for organizing our experiences with the world <p>Discuss diversity of compounds that are dependent of bonding – graphite, diamond</p> <ol style="list-style-type: none"> 3. Effects of bonding on characteristics of gaseous C compounds CO and CO₂ | <p>Students will be able to...</p> <ol style="list-style-type: none"> 1. Convert from Lewis Dot diagrams to structural formula 2. Discuss the diversity of carbon compounds giving specific examples that attribute that diversity to bonding characteristics of carbon |
| Stage 2- Assessment Evidence | |
| <p>Knowledge:</p> <ol style="list-style-type: none"> 1. Assess knowledge of items 1,2,3 above | <p>Skills:</p> <ol style="list-style-type: none"> 1. Provide students with (or have them draw) Lewis Dot diagrams and have them convert to structural formula 2. Have students report on 4 different carbon compounds and specifically describe how their physical/chemical properties relate to the bonding within them (matching structure and function) |
| Materials Required | |
| <p>Educator Reading: Teacher notes from Manitoba Education, Citizenship & Youth. (2006). Grade 11 Chemistry: A Foundation for Implementation. (Topic 5, page 12,13): Manitoba.</p> <p>HANDOUT: Story of Carbon (Source: unknown) (also reviews the history of organic/inorganic chemistry)</p> <p>Materials for 2 demos: see Educator Notes below (Source: Manitoba Education, Citizenship & Youth. (2006). Grade 11 Chemistry: A Foundation for Implementation. (Topic 5, p. 13,14): Manitoba.</p> <p>Educator Reading: Teacher notes from Manitoba Education, Citizenship & Youth. (2006). Grade 11 Chemistry: A Foundation for Implementation. (Topic 5, page 24,25): Manitoba.</p> | |
| Stage 3 – Learning Plan | |
| <ol style="list-style-type: none"> 1. REVIEW from grade 10 Science <ul style="list-style-type: none"> -covalent bonding -Bohr Models/Lewis Dot Diagrams as needed <p>(Refer to the Teacher Notes) Manitoba Education, Citizenship & Youth. (2006). Grade 11 Chemistry: A Foundation for Implementation. (Topic 5, page 12,13): Manitoba.</p> <ol style="list-style-type: none"> 3. HANDOUT: Story of Carbon <ul style="list-style-type: none"> Direct students to read and complete questions 4. DEMO: Preparation of Methane. DEMO: Preparation of Acetylene. Be sure to discuss the sustainability of doing such demonstrations (ie does it violate any of the 4 guiding ideas? (Source: Manitoba Education, Citizenship & Youth. (2006). Grade 11 Chemistry: A Foundation for Implementation. (p.13,14): Manitoba.) | |
| Homework Learning Activities | |

Extension Learning Activities

See (Source: Manitoba Education, Citizenship & Youth. (2006). **Grade 11 Chemistry: A Foundation for Implementation. (Topic 5, page 24,25): Manitoba.**

This might be an appropriate time to integrate the idea of hydrogenation/dehydrogenation when drawing structural formulae.

Definitions of pyrolysis, cracking, dehydrogenation, addition reaction are given in the teacher notes.

To introduce the organic chemistry sets, students could model the cracking of an alkane to form an alkene and then reverse the reaction (see teacher notes). Of course they might not call the compounds alkanes/alkenes yet but the concept can be introduced at a fundamental level.)

Teacher notes – Carbon

(Source: Manitoba Education, Citizenship & Youth. (2006). Grade 11 Chemistry: A Foundation for Implementation. (Topic 5, page 12,13): Manitoba.

Copyright not obtained

DEMO: Preparation of Methane
DEMO: Preparation of Acetylene

(Source: Manitoba Education, Citizenship & Youth. (2006). Grade 11 Chemistry: A Foundation for Implementation. (p. 13,14): Manitoba.

Copyright not obtained

Teacher notes – Hydrocarbons can be “cracked” and put back together

(Source: Manitoba Education, Citizenship & Youth. (2006). Grade 11 Chemistry: A Foundation for Implementation. (Topic 5, page 24,25): Manitoba.

Copyright not obtained

Student Reading – Story of Carbon

Source: unknown

Copyright not obtained

Questions to Accompany

The Story of Carbon

1. Name 3 forms of the element carbon.
2. Name the 2 divisions of chemistry.
3. Why is organic chemistry no longer limited to living things even though it used to be?
4. What is the current definition of organic chemistry?
5. In which countries are diamonds found?
6. How are diamonds made to be “sparkling” even though they are not when they are taken from the ground?
7. What is diamond used for? Why is it a good substance to use for this?
8. Refer to figure 7.3, which compares the arrangement of carbon in diamond and graphite. In the arrangement of carbon in diamond;
 - a. What “shape” is formed by the bonding?
 - b. How many other atoms of carbon is each carbon bonded to?
9. In the arrangement of carbon in graphite;
 - a. How is the arrangement of the “hexagons” different than in diamond?
 - b. What happens to graphite when a force is applied to it?
10. Where is graphite mined?
11. Describe 3 uses of graphite. (See figure 7.2)
12. How are diamonds made in the lab?
13. How are diamonds made in nature?
14. What is a synonym (word that means the same as) soot? Name 3 uses for soot.
15. Name 2 other forms of powdered carbon and what they are made from.
16. Name 2 fuels that contain carbon.
17. Describe the 3-4 steps in the formation of coal.
18. How do scientists believe that petroleum was formed?
19. Describe 3 ways to produce carbon dioxide.
20. Describe how to produce carbon monoxide.
21. Describe carbon monoxide.
22. How does carbon monoxide “poisoning” harm the body?
23. Name two ways that carbon monoxide poisoning can be avoided.

KEY

1. graphite, soot, diamond
2. organic and inorganic
3. Scientists have found that organic molecules can be synthesized in the lab.
4. the chemistry of carbon compounds.
5. South Africa, the East Indies, Brazil
6. Diamonds are cut in a certain way to make them “sparkle”.
7. Diamonds are used as abrasives (substances used for smoothing, polishing, grinding) (also in mining, they cut rock). Also, diamond saws cut rock. Diamonds are good for these uses since they are one of the hardest known substances.
- 8.a) hexagons are the shape formed.
- b) Each Carbon atom is bonded to 4 other Carbon atoms (except for the ones at the edges)
9. a) The hexagons are arranged in layers instead of in an interlocking pattern.
- b) The layers slide past each other like sheets of paper.
10. Ceylon, Siberia, some parts of U.S., Canada, and Mexico
11. One use for graphite is as a lubricating agent.
It is used in powdered form as a spray in locks.
It is mixed with clay and baked to make the “lead” in pencils. (lead in pencils is NOT made of lead)
12. Diamonds are made in the lab by placing Carbon under pressures of 100,000 kilograms per square cm and temperatures of 2800⁰C.
13. In nature the same conditions as in #12 are needed. These are found about 4300 km below the Earth surface.
14. Carbon black is a synonym for soot. It is used for manufacturing printer’s inks, phonograph records, and show polish.
15. Boneblack is made from bones. Lampblack is made by burning oil or coal gas.
16. coal, petroleum
17. The area is covered in thick vegetation which collects on the floor of the area and decays.
The decaying vegetation is covered with mud, sand and other layers of decaying vegetation.
The pressure of these layers changed the decaying vegetation to coal.
18. The remains of marine plants and animals undergo the same process of compression as in #17.
19. 1) An acid reacts with limestone or marble (calcium carbonate) or baking soda
2) when enzymes of yeast act upon sugars
3) when a carbon compound is burned
20. Burning carbon compounds without an adequate supply of oxygen.
21. Carbon monoxide is an odorless, tasteless, colorless gas.
22. Carbon monoxide combines with the hemoglobin (red part) of the blood. As a result, not enough oxygen can be carried to the cells, and the victim suffocates.
23. To avoid carbon monoxide poisoning, stoves and furnaces should be properly vented. Gasoline engines should not be operated inside a building unless the doors and windows are open.

QUIZ: The Story of Carbon

Each phrase below describes one of the following words. WRITE the most appropriate word form the list below on the line. ONE OF THE WORDS IS USED TWICE.

Boneblack, carbon dioxide, carbon monoxide, coal, diamond, graphite, lampblack, petroleum, soot

1. _____ Formed from decaying vegetation
2. _____ Produced when sugar is acted on by yeast
3. _____ Powdered form of carbon made by burning coal or gas.
4. _____ Combines with the hemoglobin in blood.
5. _____ Thought to have been formed from the remains of marine plants and animals.
6. _____ Used to make printer's ink
7. _____ One of the hardest known substances
8. _____ A form of carbon made from bones
9. _____ Mixed with clay and baked to produce "lead" in pencils
10. _____ Used as an abrasive

Answers for QUIZ: The Story of Carbon

Each phrase below describes one of the following words. WRITE the most appropriate word form the list below on the line. One of the words is used twice.

Boneblack, carbon dioxide, carbon monoxide, coal, diamond, graphite, lampblack, petroleum, soot

1. coal Formed from decaying vegetation
2. carbon dioxide Produced when sugar is acted on by yeast
3. lampblack Powdered from of carbon made by burning coal or gas.
4. carbon monoxide Combines with the hemoglobin in blood.
5. petroleum and animals. Thought to have been formed from the remains of marine plants
6. soot Used to make printer's ink
7. diamond One of the hardest known substances
8. boneblack A form of carbon made form bones
9. graphite mixed with clay and baked to produce "lead" in pencils
- 10 diamond Used as an abrasive