

Crystals and Polymers (CPOL)

CTY Course Syllabus

Day 1

Morning

1. Ice Breakers
 - a. Dynamic Duos
 - b. I like people who...
 - c. Ball toss
2. Rules
 - a. Following ball toss, use index card for students to describe what respect could mean in the classroom. Back in classroom develop rules from ideas on note cards.
3. Honor Code and Computer Use
 - a. Review and students sign
4. Lab Safety
 - a. Lab Safety drama and review rules, students sign

Afternoon

1. Mineral Identification
 - a. Using sets of 20 students work in pairs (Dyn. Duo) ID 20 minerals in the Flinn sets. Use lab notebooks recording characteristics.

Evening

1. Birthstone Project
 - a. Computer lab to research Birthstone

Day 2

Morning

1. Birthstone Project
 - a. Computer Lab: Final time in computer lab for this project. Report can be typed or written with oral report to class at later date (8:45- 10:15)
2. Pre-Test
 - a. Pre- Test (10:30 – 11:00)
3. Crystals
 - a. *Chem Matters* reading: "Breakfast of Crystals." (given as students finished Pre-Test)
4. Mineral Identification
 - a. Continue Identification from Day 1

Afternoon

1. Mineral Identification
 - a. Continue from Day 1 (30 min.)
2. Lab notebooks
 - a. Review requirements for setting up the Projects in the notebook Title, Purpose, Procedure, Observations/data, Discussions, Summary/Conclusion

3. Slow crystal growth
 - a. Set up Cu crystals in a test tube. Long term growth of Cu crystals (slowly developing system). Ref. *The Science Teacher*, Dec. 2009

Evening

1. Cu Crystal
 - a. Complete from afternoon
2. Chemical/physical properties and change
 - a. Discussion of these differences
3. Rapid Crystal Growth
 - a. Rapid crystallization: use microscopes to observe the beauty and wonder of the crystals under magnification. Crystallization of NaCH_3COO .

Day 3

Morning

1. Cu Crystals
 - a. Observations of the Cu crystal
2. Periodic Table
 - a. Review structure of Periodic table with some history
3. Solutions
 - a. Review terms/concept of solution (solute, solvent)
4. Slow crystallization
 - a. Wet lab: making rock candy. Procedure based on *Chem Matters* article.

Afternoon

1. Review info in *Breakfast of Crystals*
 - a. Note the different substances and properties
2. Atomic structure and bonding
 - a. Electrons protons neutrons to electron dot (Lewis) dot structure.

Evening

1. Ionic Bonding
 - a. Discuss how to show ionic bonding (sample problems)
 - b. You tube: The Elements Song

Day 4

Morning

1. Cu crystal observation
 - a. Continue observing from previous days
2. Bonding
 - a. Review ionic bonds and concept of an ion
3. Rapid Crystal growth
 - a. Wet Lab: Sodium thiosulfate crystals Discuss the type of bonding and the formation of the bonds
4. Covalent bonding
 - a. Discuss differences, examples, work sample problems

Afternoon

1. Mineral Identification
 - a. Continuation of mineral identification

Evening

1. Birthstone
 - a. Work on and complete the Birthstone report
2. Periodic table block project
 - a. Introduce the periodic table block project

Day 5

Morning

1. Observe Cu Crystals
 - a. Continuation of Cu crystal growth
2. Ionic vs. Covalent properties
 - a. Wet lab: Solubility. Melting time, conductivity
 - b. Discuss results and note the important trends Conductivity buzzers with post lab

Afternoon

1. Mineral ID quiz
 - a. 10 samples, 1 minute at each sample
2. Slow crystallization
 - a. Begin growth of large Aluminum crystal. Discuss how can the growth rate be changed, relate to the solubility curves
3. Crystal growth
 - a. KDP crystal growing video
4. Special solutions
 - a. Ferro fluids video

Evening

1. Oral presentations
 - a. Rehearsal and presentation of Birthstone report

Day 6

Morning

1. Element Characteristics
 - a. Computer lab 8:45 – 10:15 Periodic Table Live with set of questions to guide use of program
2. Complete Ionic v. Covalent
 - a. Melting time and conductivity results and discussion with buzzer and door chime
3. Evaluation
 - a. First week evaluation on index card: Lab Activities, Classroom learning, Overall

Afternoon

1. Solutions/colloids
 - a. Winter wonderland lab, sat. K_2SO_4 with 70 % isopropyl alcohol.
2. Colloids
 - a. Making a gel lab, Sat. $CaCH_3COO$ and isopropyl alcohol.
 - b. Discuss different colloidal systems, identify them at lunch.
3. Saturated solution
 - a. In groups of 3: Two test tubes, one with water and the other with sat. K_2SO_4 . Determine which test tube has the water? Do the test and explain.

Evening

1. Activities from the Afternoon continued.

Day 7

Morning

1. Review
 - a. Review all results from labs to this point.
2. Heat treating and metal bonding
 - a. Using bobby pins and Bunsen burners to change the temper of the metal. Discuss heat treating results and relationship to molecular scale.

Afternoon

1. Metal Crystals
 - a. Discuss results from the tempering metal lab.
 - b. Memory metal activities and discussion.
 - c. Read *Chem Matters*, "Memory Metal".

Evening

1. Crystal growth
 - a. Work on crystal growth
 - b. Observe $CuSO_4$, $NaCl$, and Alum crystals under magnification.
 - c. Start large Alum Crystal.
2. Periodic Table
 - a. Work on Periodic Table block.
3. Unit Cells
 - a. Work on constructing unit cells from "Crystals"
(mathforum.org/alejandre/workshops/toc.crystal.html)

Day 8

Morning

1. Crystal systems
 - a. Review paper crystal models and $CuSO_4$, $NaCl$, Alum
2. Polymers
 - a. Sodium polyacrylate demo (shifting cups)

3. Cross linking
 - a. Discussion/people demos of monomers bonding to form polymers Homopolymers, Block polymers, random cross linking
 - b. The special nature of carbon (Polyethylene Bonding)
4. Polymer Properties
 - a. Elmer's Glue and Borax Investigation ("Polymers – It's Not Just Polyester," DuPont Honors Teachers)

Afternoon

1. Polymer properties
 - a. Discuss results from the morning lab
2. Elements
 - a. Continue work on element block

Evening

1. Polymer properties
 - a. Plastic grocery bag testing: what properties would make a good grocery bag? Test the bags
2. Bonding in polymers
 - a. Discuss role of plastics in the world, preview to rdg.
 - b. *Chem Matters* rdg. : "Polymers"

Day 9

Morning

1. Science/ Technology/ Society
 - a. Paper vs. Plastic? What is the correct answer when considered globally and sustainably? Small group discussions formulation of a recommendation and debate the possibilities Identify Pros and Cons
2. Super absorbers
 - a. Sodium polyacrylate, "Modifying a Superabsorber" ("Polymers – It's Not Just Polyester." Dupont Honors Teachers)

Afternoon

1. Super absorber
 - a. Discuss results from morning experiment
2. Microscale polymers
 - a. 3 ply carbonless paper forms inquiry. How to make them work and how do they work? Inquiry investigation

Evening

1. Modifying properties of polymers
 - a. Latex eraser challenge, using CaCO_3 , talcum powder, NaCl, NaHCO_3 ...Which combination and in what proportion will make the best eraser? Ref: "Chemistry for Kids", John Idhe
 - b. For eraser challenge assign groups different amounts to use such as .5g, 1.0 g, 2.0 g, 3.0 g, 4.0 g, 5.0 g. Save erasers when complete and let dry for at least two days.

Day 10

Morning

1. Plastics identification
 - a. Identification of plastics 1-6 wet lab

Afternoon

1. ROBOT Competition
 - a. IROB1 vs. IROB2
2. Polymer properties
 - a. Shrinky dinks/polystyrene PETE.
 - b. Rubber Bands Heating/Cooling boiling water in a PETE container

Evening

1. Cross linking in polymers
 - a. Wet lab on different cations effect on cross link strength in hydrogels. Sodium alginate lab, *The Science Teacher*, summer, 2011 "Hydrogel Beads: The New Slime Lab"

Day 11

Morning

1. Crystal Growth
 - a. Observation of the copper crystals in the test tube.
2. Polymer properties
 - a. Finish Plastics identification exp. And discuss results.
 - b. Read *Chem Matters*, "PET Recycling" report conclusion must contain the list of plastics and the most indicative test for that plastic's identification. Check off while others are completing the lab.
 - c. Perform eraser tests, compile, and discuss results
 - d. Set up for nylon fiber in lab notebooks

Afternoon

1. Cross linking
 - a. Review hydrogel lab results and discussion
 - b. Complete Periodic Table blocks

Evening

1. Polymer fibers
 - a. Nylon Rope trick/experiment.

Day 12

Morning

1. Soap making/testing
 - a. Wet lab making soap and test in hard water, ability to emulsify oil, comparison to liquid soap
 - b. Discuss results of lab

Afternoon

1. Large molecules
 - a. Discuss the formation of the sodium stearate molecule and the water/oil connection. (Power Point)
2. Starch testing
 - a. Testing substances for presence of starch
 - b. Discuss structure of starch and carbohydrates

Evening

1. Fats in foods
 - a. Wet Lab: testing the percentage of fats in potato chips, French fries, corn chips (David Katz Exp.)

Day 13

Morning

1. Crystals
 - a. Remove copper crystals from the test tubes and dry.
 - b. Microscopes to observe crystal forms.
2. Fats in Foods
 - a. Review results from the Fats in potato chips, French Fries, and other chips
3. Fats and Oils
 - a. Discuss the natural polymers/biomolecules, define and clarify the terms. The structure of saccharides and disaccharides
4. Fat and Oil molecular structure
 - a. *Chem Matters*: "the Solid Facts About Trans Fats"
 - b. Read and answer questions

Afternoon

1. Crystal matching
 - a. Computer lab to match copper crystals with the crystal forms

Evening

1. Natural Polymers Bio-molecules
 - a. Introduction to possible natural polymers. What are the characteristics of polymers? Power Point
2. Structure of carbohydrates
 - a. Saltines, Saliva and Starch Reaction (Karen Kalumuck , Exploratorium Teacher Institute)

3. Proteins and Amino Acids
 - a. Protein Denaturing (John Idhe, "Chemistry For Kids")

Day 14

Morning

1. Bonding in Fats
 - a. *Chem Matters: The Solid Facts About Trans Fats*
 - b. Discuss the bonding differences in fats and oils, hydrogenation, cis- and trans-differences
2. Polysaccharides
 - a. Review Power Point, Review Starch in Foods Results, Review Saltines, Saliva and Starch Reaction
 - b. Read *Chem Matters*, "Polysaccharides"
3. Denaturing Proteins
 - a. Denaturing egg white experiment. (ref. *Polymer Chemistry: Introduction to an Indispensable Science*, NSTA Press, David Teegarden)

Afternoon

1. DNA
 - a. Intro to DNA
 - b. Videos of RNA, DNA, Protein synthesis in cells

Evening

1. Student Program Evaluations (SPEs)
2. Sugar Structure
 - a. Student program evaluations
 - b. Read *Chem Matters*, "Artificial Sweeteners" and cut out glucose molecule model and search for the triangle of sweetness.

Day 15

Morning

1. Post-Test
 - a. Periodic Table in cookies
2. Elements
 - a. Gee, So, Ha
 - b. Room Clean up and organization of materials