SCSU CRISP CCSA Kit Pages 2016

Title of Module: ___"The Right Metal for the Job" _____

Subject or Unit of Study: _____Chemistry_____
GRADE LEVEL_____11_____ **LENGTH OF DEMO/LESSON**: _____3 days_____
STUDENT OBJECTIVES
Students will...

Students will be able to understand the characteristics of metals in order to make reasonable and efficient design decisions in a performance task.

NEXT GENERATION SCIENCE STANDARDS

Science practice: Engaging in argument from evidence

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-PS1-3. **Plan and conduct an investigation to gather evidence to compare the structure of at substances at the bulk scale to infer the strength of electrical forces between particles.** [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.]

HS-PS2-6. **Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*** [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [*Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.*]

HS-PS3-2. **Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).** [Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]

MATERIALS

List all materials needed for this lesson/demonstration

Various metals for testing in the inquiry lab (copper, brass, aluminum, steel, iron, silicon, etc) are required. Students will perform a three tests on these materials: three-point-break, thermal expansion, and playdough depression. Playdough will be needed for the latter task. It may also be helpful to have a rind stand with double beams to perform the three point test.

For the performance assessment, students will need these same metals. Ideally students would have access to a machine shop in order to build their selected item. If not available, the students will draw designs and come up with financial estimates for their plans. This may be best done in Excel.

Computer and internet access will be necessary for research into the atomic and microscopic differences between the metals and estimate costs of these materials.

SAFETY

List all safety precautions needed for this lesson/demonstration

Safety precautions should always be taken when using a bunsen burner. If one has access to a machine shop, regulations of the facility must be followed.

LEARNER BACKGROUND

Describe the students' prior knowledge or skill related to the learning objective(s) and the content of this lesson, using data from pre-assessment as appropriate.

There are different kinds of metals. Metals have properties that differentiate them from other materials. Different objects are made of different metals for specific uses.

All materials are made of tiny units called atoms or molecules

LEARNING ACTIVITY OR PROCEDURE:

Explicitly layout the lesson or demonstration

Students test the properties of different metals: Copper, Aluminum, Steel, Brass, Silicon, Iron through the following tests. Students can work through each test in groups or one group can do each test and report out to the class.

Thermal Expansion: Assess the degree to which the material will expand by heating each metal by qualitatively observing how far it rotates the straw.
Three Point Break test: Assess the durability of each metal by measuring how far the weight
Playdough depression: Assess deformation ability by dropping metal cubes from same height and measure depth of depression
Hardness test: Qualitatively assess the hardness of each metal by scratching with another material
Density: Measure mass and volume to determine density
Melting point: Heat each material in a crucible and measure the temperature it heats to… or heat each material to a predetermined material and record what materials melt or soften and which do not
OSHA regulations, toxicity, hazardous waste report:

ASSESSMENT:

Provide an assessment to measure student progress of objectives.

Students will first select a metallic product as their end goal. Students may pick a product from the list below or choose their own. They are responsible for writing a proposal to potential investors that outline their product, provide rationale for why they picked their materials, and include a financial analysis (estimated costs and return on investment).

Which metal would work best for:

- Wiring for twist ties
- Electrical outlet
- Hammers
- Chain
- Anchor

- Drill bit

From student inquiry testing and background research, students should be able to make informed decisions about particular metals and alloys they would choose to build a certain product. Students will come up with blueprints, perform market research, and draft financial estimates for the product. Samples of all these documents will be provided.

ADDITIONAL RESOURCES:

Apply any links or additional information for students or teacher including videos, websites, etc.

Students will use research skills to determine atomic differences as well as intermolecular forces between the metals that contribute to property differences.

TEACHER NOTES:

Describe any tips/tricks for implementing this lesson/demonstration that might be helpful to future educators. Provide answer keys if applicable.

STEM CAREERS:

- Manufacturing
- Tool Operators
- Welding/Soldering
- Aircraft Assemblers
- Engineering Consultants