WAMC Lab Template

Math Concept(s): geometric constructions
Source / Text: none
Developed by: Jay Connolly E-Mail: jcconnolly@seattleschools.org Date: 6/26/19
Summer Conference 2019

Attach the following documents:

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

Short Description (Be sure to include where in your instruction this lab takes place):

This lesson will take place in the sheet metal shop space at Opp Sky campus, Interagency Academy. Students will transfer preferred paper pattern onto sheet metal, including required fastener laps and cut out using snips. Students will then lay out rivet pattern and pre-drill exposed surfaces for rivets, (laps drilled at assembly). Students will use box and pan brake, drills, pneumatic riveter, and hand tools to form dodecahedron.

Lab Plan

Lab Title: dodecahedron pattern development

Prerequisite skills: sheet metal basic patterning, cutting, and brake forming, drilling, pneumatic riveting.

Lab objective: Reinforce learning in drafting 2D & 3D geometric constructions while also increasing career & technical skill, such as tool use proficiency and materials conservation, for industries where geometry is used.

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

- C-CO 12 Make formal geometric constructions with a variety of tools and methods.

Standards for Mathematical Practice:

- 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

SL--Comprehension and Collaboration (Standards 1, 2)
SL--Presentation of Knowledge and Ideas (Standard 6)
L--Vocabulary Acquisition and Use (Standard 6)
RST--Integration of Knowledge and Ideas (Standards 7, 9)

K-12 Science Standards

INQC: Conclusions must be logical, based on evidence, and consistent with prior established knowledge.
INQF: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.

Technology

4.d. Exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.
6.a. Choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.

Engineering

HS-ETS1-3
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

- ☐ Global Awareness
- ☒ Financial/Economic/Business/Entrepreneurial Literacy
- ☐ Civic Literacy
- ☒ Health/Safety Literacy
- ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION

Creativity and Innovation
- ☒ Think Creatively
- ☒ Work Creatively with Others
- ☐ Implement Innovations

Critical Thinking and Problem Solving
- ☒ Reason Effectively
- ☒ Use Systems Thinking
- ☒ Make Judgments and Decisions
- ☒ Solve Problems

Communication and Collaboration
- ☒ Communicate Clearly
- ☒ Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS

Information Literacy
- ☐ Access and Evaluate Information
- ☐ Use and manage Information

Media Literacy
- ☐ Analyze Media
- ☐ Create Media Products

Information, Communications and Technology (ICT Literacy)
- ☐ Apply Technology Effectively

LIFE & CAREER SKILLS

Flexibility and Adaptability
- ☒ Adapt to Change
- ☒ Be Flexible

Initiative and Self-Direction
- ☒ Manage Goals and Time
- ☒ Work Independently
- ☒ Be Self-Directed Learners

Social and Cross-Cultural
- ☒ Interact Effectively with Others
- ☒ Work Effectively in Diverse Teams

Productivity and Accountability
- ☐ Manage Projects
- ☒ Produce Results

Leadership and Responsibility
- ☐ Guide and Lead Others
- ☐ Be Responsible to Others

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials

- Paper patterns from prior lesson, sheet metal, aviation snips, pneumatic riveter, drill w/1/8" bit, 1/8"x ¼" draw rivets, markers, metal file for any sharp edges, safety glasses

Set-Up Required:

- 10"x10" sheet metal blanks cut, air compressor pressured up & lines run to riveter

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Students will think critically, and problem solve both collaboratively and independently.

Cooperative Learning:

- Students will communicate and interact to share equipment and to advise one another on metal bending sequences.

Expectations:

The creation of the sheet metal dodecahedron will reinforce the math learning that occurred earlier in the unit while linking the concepts to technical and career skills.

Timeline:

- 45 minutes

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- Students will compare 1 piece, 2 piece, 3 piece, and 4 piece patterns in terms of material efficiency and labor efficiency, (cutting & fastening vs. folding). Could these patterns nest in CAD if cut using a plasma table? If dodecahedrons were welded 12 separate pentagons could be cut for maximum nesting efficiency but material would be thicker. How else would changing to welding impact production costs?

Career Applications

- Sheet metal work, patterning & layout in many trades

Optional or Extension Activities

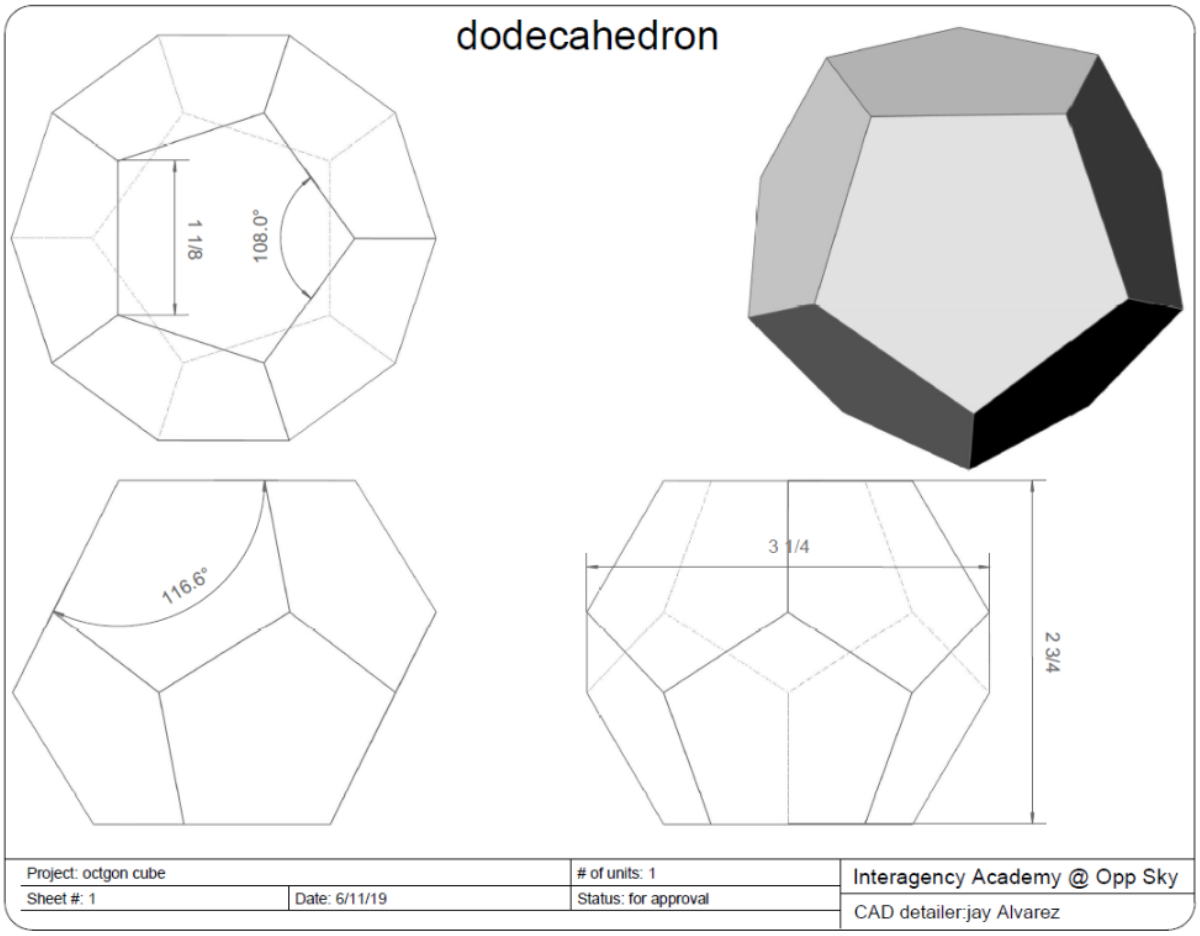
- Students who complete the task early can collaborate on building other platonic solids applying the same skills.

Jay Connolly Lab 1 attachments

Lab Instructions:

1. Bring your safety glasses and the dodecahedron pattern that you created to the work table and select a marker and 10”x10” sheet metal piece.
2. Trace your template onto your metal tight to one corner to maximize usable scrap.
3. Pre-drill marked rivet holes on exposed surfaces
4. Cut out pattern using aviation snips.
5. Plan out bend sequence and mark numerically on interior side. Consult with other students about sequencing.
6. Bend a small scrap from the scrap bin to your dihedral angle: 117 degrees & check it with an angle compass. Use this as a brake guide for each of your bends.
7. Make your 11 face-bends in the order you laid out using the bending break
8. Bend lap tabs using bending tongs.
9. Align joints using a bench vice and drill through under laps at each pre-drilled surface hole setting rivets as you go.
10. File any sharp edges and remove any marker before submitting for grading.
11. Ask your classmates questions about their work. Understand the source of any differences in the results. Assist any peers that are receptive to it.

Student Handout: (produced by CAD student)



Rubric:

This unit is worth 10 point. The completed sheet metal dodecahedron can earn up to 5 points based on the following criterion:

-Accuracy of dimension, symmetry, and angles:

1pt. below standard

2pts. At standard

3pts. Exceeding standard

-Efficient use of time & materials: 1 pnt.

-Effective collaboration & production team skills: 1pnt.