

WAMC Lab Template

Math Concept(s):

Source / Text: TeachEngineering

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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 lab takes place in the middle of our introductory unit on orthographic and isometric drawings. Students are introduced to the methods and applications of orthographic and isometric drawing. They then practice recreating objects in a slideshow before using flat patterns to try and recreate a sample object out of paper. The students are given a 3D printed object to draw isometrically and then give the isometric drawing to their partner. Their partner then translates the isometric drawing into a flat pattern, that is then tapped together to form a 3D object that is compared to the original.

Adapted from e4USA and University of Colorado Spatial Visualization Workshop

Lab Plan

Lab Title: Spatial Visualization

Prerequisite skills:

- Measurement.
- Calculating area, surface area and volume of regular geometric shapes.

Lab objective:

- Students will learn about the basics of isometric and orthographic drawing and how these methods allow for designers and engineers to develop and communicate ideas and information.
- Students will create an isometric design to trade with a partner
- Partners will calculate Area, Surface Area and Volume of their design
- Partners will create a flat pattern from the isometric design, construct the 3D model and compare to the original

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

Mathematics K–12 Learning Standards:

- MP.2 Reason abstractly and quantitatively. (HS-ETS1-1),(HS-ETS1-3),(HS-ETS1-4)
- MP.4 Model with mathematics. (HS-ETS1-1),(HS-ETS1-2),(HS-ETS1-3),(HS-ETS1-4)

<https://wa-appliedmath.org/>

Standards for Mathematical Practice:

- Model with mathematics
- Attend to Precision

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

K-12 Science Standards

- Using Mathematics and Computational Thinking

Technology

- 4b. Use digital tools to plan a design
- 4c. Develop & test prototypes

Engineering

- HS-ETS1-4

Leadership/21st Century Skills:

- 2.B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems
- 8.A.3 Utilize time and manage workload efficiently
- 10.B.1.b Manage time and projects effectively

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

- | | | |
|---|---|---|
| <input type="checkbox"/> Global Awareness | <input type="checkbox"/> Financial/Economic/Business/Entrepreneurial Literacy | <input type="checkbox"/> Civic Literacy |
| <input type="checkbox"/> Health/Safety Literacy | <input type="checkbox"/> 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

- Orthographic Paper
- Pencil
- Ruler
- Slideshow

Set-Up Required:

- Load slideshow
- Pass out orthographic paper, pencils, tape and scissors

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

Cooperative Learning:

- Students will work to recreate a 3D object their partners sketched and compare it to the original using orthographic and isometric drawing techniques.

Expectations:

- Students need to be able to create a *precise* drawing of a 3D object that allows their partner to then convert to a flat plan which can be cut out and taped up into a 3D model. The flat plan can also be used for measurement practices such as area, surface area and volume calculations.

Timeline:

- Drawing and construction of their 3D model should take 55 minutes.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- | | |
|------------------------------|------------------|
| • Rapid prototyping/ideation | • Manufacturing |
| • Cross sections | • Robotics |
| • Architectural plans | • Graphic Design |
| • Biomechanics | • Electronics |
| • Control Systems | • Data Analysis |

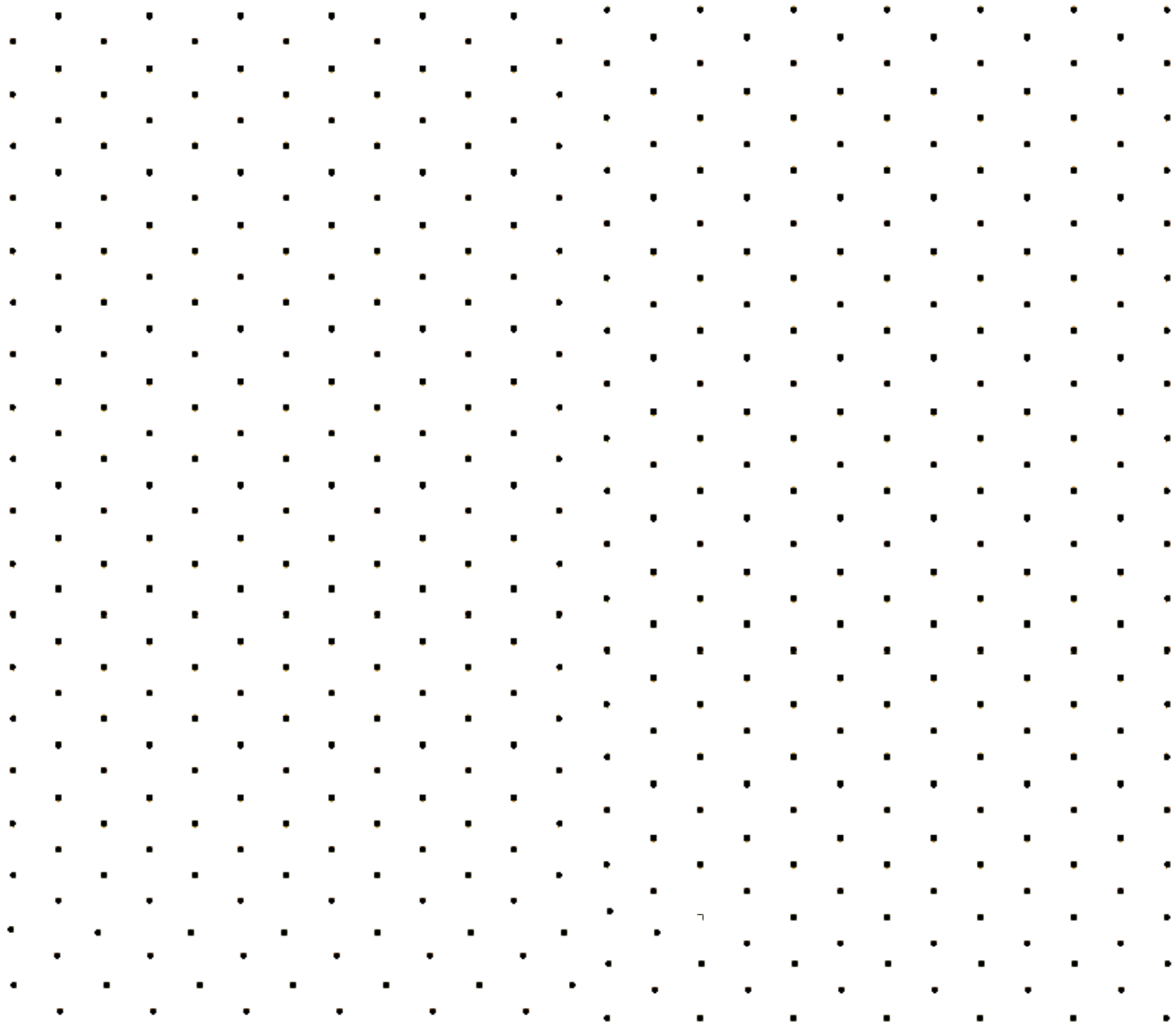
Career Applications

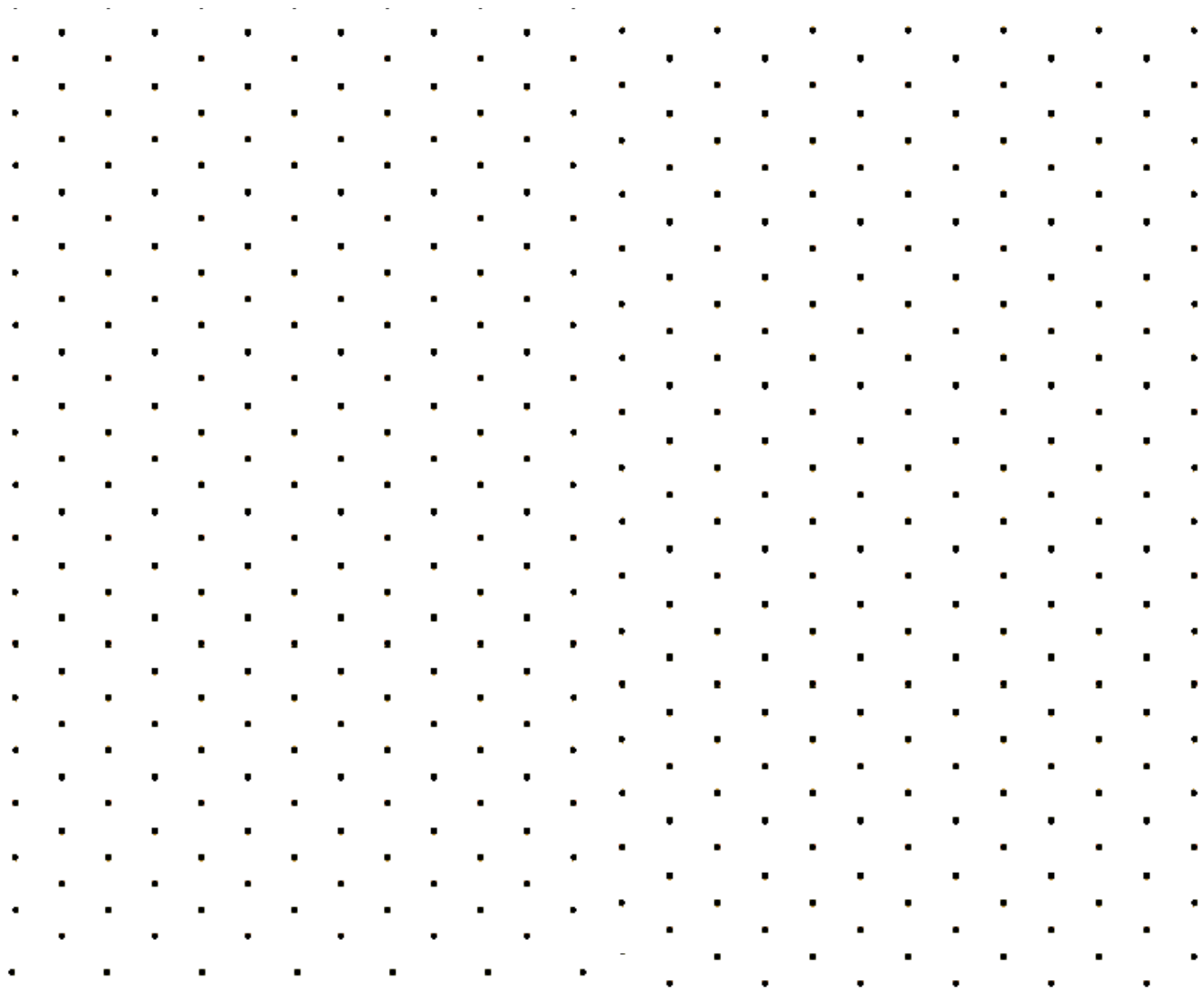
- CAD, Machining, CNC Operator, Engineer, Designer

Optional or Extension Activities

- Ask students to redraw their isometric drawings from different focal perspectives
- Practice with digital tools
 - <https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Isometric-Drawing-Tool/>

<https://wa-appliedmath.org/>



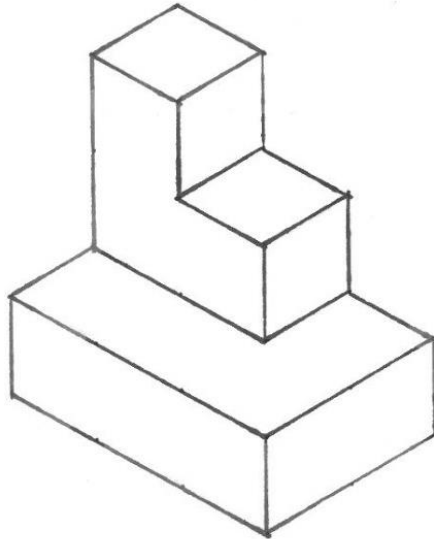


Name: _____ Date: _____ Class: _____

Orthographic Drawings Worksheet

Instructions

Draw the orthographic projections of the following object.



A grid of 13 columns and 10 rows of small black dots, intended for drawing the orthographic projections of the object.

Name: _____ Date: _____ Class: _____

Orthographic Drawings Worksheet **Answer Key**

Instructions

Draw the orthographic projections of the following object.

