GEORGIA MIDDLE SCHOOL Instructional Resources

CAREER, TECHNICAL, & AGRICULTURAL EDUCATION

ENGINEERING & TECHNOLOGY

COURSE: Exploring Engineering and Technology

UNIT 3: Material Processing – "What makes paper so strong?"

INTRODUCTION

Annotation:

This unit will provide students the opportunity to practice measuring skills using rulers. Students will also study the process of engineering a structure to support different weights.

Grade(s):

X	6th
	7th
	8th

Time:

Fourteen to fifteen 50 minute class periods

Author:

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Students with Disabilities:

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided appropriately. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation. Many students (both with and without disabilities) who struggle with reading may benefit from the use of text reading software or other technological aids to provide access to printed materials. Many of these are available at little or no cost on the internet.

FOCUS STANDARDS

GPS Focus Standards:

ENGR-EET-1- Students will examine the nature of engineering and technology.
b) Compare the relationship of math and science to engineering & technology

ENGR-EET-5- Students will analyze the designed world of engineering, electronics, manufacturing, and energy systems.
a) Examine Engineering

ENGR-EET-7- Students will develop leadership skills and work ethics.
a) Demonstrate work ethics within the classroom and lab environment

GPS Academic Standards:

M6M2. Students will use appropriate units of measure for finding length, perimeter, area and volume and will express each quantity using the appropriate unit.
a. Measure length to the nearest half, fourth, eighth and sixteenth of an inch.

M6G1. Students will further develop their understanding of plane figures.
d. Interpret and sketch simple scale drawings.

M6G2. Students will further develop their understanding of solid figures.
c. Interpret and sketch front, back, top, bottom and side views of solid figures.

M6N1. Students will understand the meaning of the four arithmetic operations as related to positive rational numbers and will use these concepts to solve problems.
g. Solve problems involving fractions, decimals, and percents.

UNDERSTANDING & GOALS

Enduring Understandings:

Technologists use the materials available to them to design and construct solutions to various problems.

Essential Questions:

- What are the fractions of an inch?
- What three views are included in a multi-view drawing?
- What are two ways that materials can be processed?
- Why is surface area important when designing a platform?
- How does the center of gravity affect the stability of a structure?
- What shape is the strongest and why?

Knowledge from this Unit:

- Reading a ruler to the nearest fraction (1/2, 1/4, 1/8, and 1/16)
- How to process materials to make them very strong
- Multi-view drawings include top, front and side views

Skills from this Unit:

- Read a ruler in inches and fractions of an inch (1/2, 1/4, 1/8, and 1/16)
- Create a multi-view plan for a structure
- Process materials by cutting and folding
- Construct a 3 dimensional structure to solve a problem

ASSESSMENTS

Assessment Method Type:

x Pre-test
x Objective assessment - multiple-choice, true- false, etc.
_x_ Quizzes/Tests
__ Unit test
x Group project
___ Individual project
x Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
__ Self-check rubrics
_x_ Self-check during writing/planning process
__ Journal reflections on concepts, personal experiences and impact on one's life
__ Reflect on evaluations of work from teachers, business partners, and competition judges
__ Academic prompts
__ Practice quizzes/tests
x Subjective assessment/Informal observations
__ Essay tests
_x_ Observe students working with partners
__ Observe students role playing
___ Peer-assessment
__ Peer editing & commentary of products/projects/presentations using rubrics
__ Peer editing and/or critiquing
x Dialogue and Discussion
_x_ Student/teacher conferences
_x_ Partner and small group discussions
_x_ Whole group discussions
__ Interaction with/feedback from community members/speakers and business partners
x Constructed Responses
__ Chart good reading/writing/listening/speaking habits
_x_ Application of skills to real-life situations/scenarios
___ Post-test

Assessment(s) Title:

Measurement Pre-test
Measuring Practice 1 (halves and fourths)
Measuring Practice 2 (eighths)

Measuring Practice 3 (sixteenths)
Measuring Practice 4 (all)
Measuring Post Test
Simple Orthographic Drawing 1
Simple Orthographic Drawing 2
Paper Platform Sketches
Construction and Testing of Paper Platform
Paper Platform - Efficiency Worksheet
Paper Platform Rubric

Assessment(s) Description/Directions:

Measuring Pre-Test: Used to evaluate where the students are initially (If the entire class can attain 80% or higher on the pre-test you should be able to skip the Measuring Practice and move immediately to the Paper Platform Activity – I have never had this happen.)

Measuring Practice Sheets: Review the inch using the Measuring Power Point – allow students to view this while doing the practice sheets. Have the students complete each measuring worksheet to 100% mastery. The only way to learn to measure properly and be able to gain the skill is to continually measure until the practice sheets are perfect. Use a transparency to create master of the measuring sheets to use as your answer key for quick grading of these worksheets. Do not provide all worksheets at one time; students should master one worksheet before moving on to the next.

Measuring Post-Test: Used to evaluate how knowledge gained through this activity. Do not have the PowerPoint visible during this formal evaluation. A comparison can now be made from the pre-test and post-test to see student's growth through this lesson.

Simple Orthographic Sketches: Students will sketch the top, front and side views for various objects from isometric sketches. Sketches should be drawn actual size using the scale information on the worksheet.

Paper Platform Sketches: Students will sketch the top, front and side views for their platform. Sketches should be drawn to actual size and include overall dimensions of length width and height. Platform detail should be shown in the top view.

Construction of Paper Platform: Be sure to have the students measure the structure for length, width and height. Structures should meet the specifications set in the design brief. Have students weigh their structure using a triple beam balance to determine the weight of the structure in grams.

Testing Paper Platform: Platforms will be tested once they are completed and the glue has had time to dry overnight. Begin by placing the structure on the floor and then placing a 30 lb. concrete block on top of the structure (this is the minimum that a structure must support). If the structure supports the concrete block additional weights will be added to the concrete block. A 5 gallon bucket filled with sand to equal 50 pounds, an additional concrete block, another concrete block, and textbooks - in 5 pound increments (be sure to alternate the spines of the books to maintain an even distribution of weight).

Efficiency Worksheet: Convert the weight supported from pounds to grams. (Note: 1 pound = 453.59 grams) Calculate the efficiency of the structure by dividing the weight held in grams by the structure weight. Calculate the surface area for this platform if this was a rectangular shape. Multiply the length by the width. Note: this is the formula for a rectangular surface. If you want to go further you can use the formulas for area of a circle and triangle for actual areas. I have chosen to have the students calculate this as if the structure is a rectangle due to time constraints.

Paper Platform Rubric: Students should complete the rubric once everyone has completed their efficiency calculations.

Attachments for Assessment(s):

Measuring Pre-test
Measuring Practice 1
Measuring Practice 2
Measuring Practice 3
Measuring Practice 4
Measuring Post Test
Simple Orthographic Sketch 1
Simple Orthographic Sketch 2
Paper Platform Design Brief
Paper Platform Efficiency Worksheet
Paper Platform Rubric

LESSON PLANS

- **INTRODUCTION**

1. **Identify the Standards. Standards should be posted in the classroom for each lesson.**

ENGR-EET-1. Students will examine the nature of engineering and technology.
b) Compare the relationship of math and science to engineering & technology

ENGR-EET-5. Students will analyze the designed world of engineering, electronics, manufacturing, and energy systems.
a) Examine Engineering

ENGR-EET-7. Students will develop leadership skills and work ethics.
a) Demonstrate work ethics within the classroom and lab environment

2. **Review Essential Questions.**

- What are the fractions of an inch?
- What 3 views are included in an orthographic or multi-view drawing?
- Name two ways that materials can be processed.
- Why is surface area important when designing a platform?
- How does the center of gravity affect the stability of a structure?
- What shape is the strongest and why?

3. **Identify and review the unit vocabulary.**

Measuring	Processing	Efficiency
Center of Gravity	Surface Area	Design Brief
Orthographic Drawing	Isometric Drawing	Specifications
Minimum	Maximum	Limitations
Alphabet of lines	Sketching	

• LESSON 1: MEASURING IN INCHES (4 TO 5 DAYS)

1. Administer the **Pre-Test**.

   • Remind students that this is a pre-test and not for a grade. However, if everyone attains 80% correct on the pre-test, we will not have to study measuring. Remember that you have learned to measure in the past and this should be a review of something you already know. Tell students that they do not need to circle their answers – that was only done to denote the example on the test.

   • Pass out rulers and pre-test to students. Once students have completed the pre-test begin checking their pre-test using your transparency key. (Print a copy of the pre-test on a sheet of transparency film and then mark the correct measurements using a permanent marker. This can then be used as an overlay on the students test to grade them quickly.) You should be able to determine rather quickly if the students know how to measure of if you need to teach measuring to them. Collect and grade all pre-tests when the students have completed them.

2. Show and discuss the **Measuring PowerPoint**.

   • Review the measuring PowerPoint with students explaining how the inch is divided and the measurement for each mark on the ruler. (Do this each day that you are working on the practice sheets. Repetition will help them learn the markings on the ruler.)

3. Have students complete the **Measuring Practice Sheets**.

   • Remind students how to properly line up the ruler. Many think that zero is the end of the ruler not the first mark. I always explain that a good ruler will have a zero mark – this keeps the end of the ruler from being damaged. If the end is zero, then your ruler may not be accurate.

   • Students should complete Measurement Practice 1 to 100% accuracy before they go on to Measurement Practice 2. Students should complete each Measurement Practice to 100% accuracy. If you have students who finish early, you can have additional measuring practices for them to complete or allow them to continue practicing measuring by using the Ruler Game.
   http://www.rickyspears.com/rulergame/

4. **Measuring Review Game (Deal or No Deal)** - Optional

5. **Measuring Post-Test**

• LESSON 2: SKETCHING DEMONSTRATION & ACTIVITY (2 DAYS)

1. Ask the students, “What is a sketch?”
   Lead the students to identify the definition of a sketch.
   Ask where sketches are used and why are they important.

2. What is an orthographic drawing or sketch?
   Use the PowerPoint Orthographic Projection Multi-View Drawings to discuss and explain Orthographic Drawings
   http://www.authorstream.com/presentation/Tirone-38765-Orthographic-Projection-Multi-View-Drawing-History-Revolving-pr-Education-ppt-powerpoint/
   The PowerPoint covers the following topics

Definition of Orthographic Projection
History of Orthographic Projection
Revolving an object to produce the 6 basic views
Glass Box Theory
Arrangement of Views

3. What is the Alphabet of Lines?
   Use the **Alphabet of Lines PowerPoint** for Basic Sketching to explain about visible, hidden, center, dimension, extension and leader lines.

4. Worksheets – **Simple Orthographic Drawing Worksheets 1 & 2**
   - Students should complete the front top and side views for each isometric drawing. The orthographic drawing should include proper lines including leaders, extension and dimension lines.

• LESSON 3: PROCESSING MATERIALS (1/2 DAY)

For Instructor

1. Review the **Material Procession PowerPoint** before demonstrating the processing of an index card for your students.

Demonstration for Students

2. Show how an index card can not support is own weight when trying to stand it on its edge.

3. Process the card by folding the card in half and then show how it can now support its own weight when stood on its side (Top view is now a V). Add additional index cards on the top of the folded card to show that it can now support more than its own weight.

4. Continue processing the card into a triangle by folding each half in half. Demonstrate that it can hold even more weight.

5. Next unfold the card and cut it is about 1/3" the original height. Demonstrate that this new shorter structure can support as much or more weight than the original (tall) triangle. Less material does more work. Discuss center of gravity and surface area.

6. Using straws and straight pins construct a triangle and a square. Stand the shapes upright on the table and have a student assist you by pushing on the side of the square first. Notice the square collapses – folding at the corners (joints). Repeat the same demonstration with the triangle, notice that it does not collapse – it only slides across the table. Lengthen a straw by inserting one into the other to create a longer straw. Use this new straw to create a brace to go diagonally across the square and then repeat the demonstration. Notice the square does not collapse now. Why is this? Why is the triangle stronger than the square? Less corners, less angles…. Ask students what shape is stronger than the triangle, why?

• LESSON 4: PAPER PLATFORM (4 DAYS)

1. Review the **Paper Platform Design Brief** with class

2. Divide the students into teams of 2 (assigned or student choice)

3. Students should create the orthographic drawings for their structure/platform

4. Once sketches are approved, provide the team with the materials to construct platforms

• LESSON 5: PAPER PLATFORM TESTING (1 TO 1.5 DAYS)

1. Students should measure and weigh their platforms filling in this data on the **Paper Platform Efficiency Worksheet** for later use

2. Teacher should test each structure by place the weights on the structure

• LESSON 6: PAPER PLATFORM CALCULATIONS (1 TO 1.5 DAYS)

1. Students should complete the **Paper Platform Efficiency Worksheet** to determine, weight in grams, efficiency, and surface area.

• ATTACHMENTS FOR LESSON PLANS

Measuring Pre-test
Measuring Practice 1
Measuring Practice 2
Measuring Practice 3
Measuring Practice 4
Measuring Post Test
Measuring PowerPoint
Alphabet of Lines PowerPoint
Orthographic Drawing PowerPoint
Simple Orthographic Drawing 1
Simple Orthographic Drawing 2
Deal or No Deal Measuring Review
Deal or No Deal Measuring Review – Answers & Values
Deal or No Deal Teacher Instructions
Paper Platform Design Brief
Paper Platform Efficiency Worksheet
Material Processing PowerPoint
Orthographic Projection PowerPoint
http://www.authorstream.com/presentation/Tirone-38765-Orthographic-Projection-Multi-View-Drawing-History-Revolving-pr-Education-ppt-powerpoint/

• NOTES & REFLECTION:

PowerPoint – Examples of Paper Platforms – Note: this is for the teacher only. It is not recommended that you show examples to the students because this will cause you to get copies of the examples instead of the students own designs.

CULMINATING PERFORMANCE TASK

Culminating Unit Performance Task Title:

Paper Platforms

Design, construct and test paper platforms to hold a concrete block (included in lessons 1-6)

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Included in Design Brief

Attachments for Culminating Performance Task:

Paper Platform Design Brief
Paper Platform Efficiency Worksheet
Paper Platform Rubric

UNIT RESOURCES

Web Resources:

- The Ruler Game - http://www.rickyspears.com/rulergame/ (Good reinforcement activity for students)
- http://www.authorstream.com/presentation/Tirone-38765-Orthographic-Projection-Multi-View-Drawing-History-Revolving-pr-Education-ppt-powerpoint/

Materials & Equipment:

- Rulers
- Index Cards
- Concrete Blocks
- 5 gallon bucket
- play sand
- Computer system with projector for PowerPoints

21st Century Technology Used:

x	Slide Show Software		Graphing Software		Audio File(s)
	Interactive Whiteboard		Calculator		Graphic Organizer
	Student Response System		Desktop Publishing		Image File(s)
	Web Design Software		Blog		Video
	Animation Software		Wiki		Electronic Game or Puzzle Maker
	Email		Website		