

Grade level: 7

Course Title: Design & Modeling

Topic/Concept: Measurement & Metrology

Time Allotment: 6 days

Unit Sequence: 1

Major Concepts to be learned:

- Fractional measurement using rulers
- Precision and accuracy
- Importance of measurement in engineering and manufacturing
- History and development of measurement systems
- Introduction to metrology
- Safety procedures and classroom expectations

Expected Skills to be demonstrated:

- Accurately measure to the nearest 1/16 inch
- Read and interpret rulers
- Demonstrate safe classroom/lab procedures
- Explain why accurate measurement is critical in engineering
- Analyze historical developments in measurement systems
- Complete written reflections and discussion questions

PA Standards/Anchors:

Eligible Content:

3.4.7.A 3.4.7.B
3.6.7.A 3.6.7.C
3.7.7.A CC.2.3.7.A.1
CC.2.1.7.D.1

Precision measurement
Standard unit conversion
Engineering communication
Technological literacy
Safe use of tools/materials

Instructional Strategies:

Assessments:

Direct instruction
Demonstrations using IPEVO camera
Guided practice
Video-based learning
Class discussion
Worksheets and hands-on measuring activities
Collaborative learning

Safety contract
Measuring worksheets
Why Measuring is Important” worksheet
Measuring quiz
Discussion questions from “The Last Artifact”
Teacher observation

Grade level: 7

Course Title: Design & Modeling

Topic/Concept: Skimmer Project & Prototype Design

Time Allotment: 5 days

Unit Sequence: 2

Major Concepts to be learned:

- Engineering design process
- Prototype construction
- Testing and redesign
- Technical sketching

Expected Skills to be demonstrated:

- Construct a skimmer prototype
- Follow engineering instructions
- Test and revise designs
- Create orthographic sketches

PA Standards/Anchors:

Eligible Content:

3.6.7.D
3.7.7.B
3.4.7.C
3.6.7.F

Prototype construction
Testing procedures
Technical sketching
Engineering problem solving

Instructional Strategies:

Assessments:

Project-based learning
Demonstration/modeling
Guided construction
Cooperative learning
Trial-and-error testing

Completed skimmer prototype
Test run performance
Activity 1.3.4 packet
Orthographic view drawings

Grade level: 7

Course Title: Design & Modeling

Topic/Concept: Orthographic Projection & Dimensioning

Time Allotment: 7 days

Unit Sequence: 3

Major Concepts to be learned:

- Orthographic projection principles
- Multi-view drawings
- Technical dimensioning standards
- Engineering drawing conventions

Expected Skills to be demonstrated:

- Create orthographic projections
- Properly dimension technical drawings
- Interpret engineering drawings
- Apply drafting standards

PA Standards/Anchors:

Eligible Content:

3.4.7.D
3.6.7.D
3.7.7.C
CC.2.3.HS.A.13

Orthographic projection
Dimensioning conventions
Technical communication
Drafting standards

Instructional Strategies:

Assessments:

Direct instruction
Overhead camera demonstrations
Guided practice
Independent practice
Video tutorials
Peer assistance

Orthographic worksheets
Ortho Parts 1–6
Dimensioning activities
Homework assignments
Teacher observation

Grade level: 7

Course Title: Design & Modeling

Topic/Concept: CAD Modeling w/ Onshape

Time Allotment: 15 days

Unit Sequence: 4

Major Concepts to be learned:

- CAD interface/navigation
- 2D sketching and 3D modeling
- Technical drawing creation
- File management and digital submission
- 3D printing workflow

Expected Skills to be demonstrated:

- Create basic and advanced CAD models
- Apply constraints and dimensions
- Generate orthographic drawings from CAD models
- Submit digital engineering files
- Design original models for 3D printing

PA Standards/Anchors:

Eligible Content:

3.4.7.E
3.6.7.D
3.7.7.D
15.4.8.A
15.4.8.B

CAD modeling
Digital design
Technical documentation
Additive manufacturing

Instructional Strategies:

Assessments:

Teacher-led demonstrations
Guided CAD tutorials
Independent modeling exercises
Video instruction
Project-based learning
Peer collaboration

CAD exercise submissions
Sketch Cube activity
Mallet & Peg Toy model
Student-created OnShape design
3D printed object
Teacher rubric evaluations

Grade level: 7

Course Title: Design & Modeling

**Topic/Concept: Strong Foundation
Challenge**

Time Allotment: 5 days

Unit Sequence: 5

Major Concepts to be learned:

- Structural engineering concepts
- Brainstorming and research methods
- Prototype testing
- Iterative redesign

Expected Skills to be demonstrated:

- Collaborate in teams
- Design and construct structures
- Test structural integrity
- Analyze failures and redesign solutions

PA Standards/Anchors:

Eligible Content:

3.6.7.D
3.6.7.E
3.4.7.C
15.4.8.C

Structural design
Testing methods
Engineering analysis
Team collaboration

Instructional Strategies:

Assessments:

Inquiry-based learning
Collaborative problem solving
Prototype testing
Engineering challenges
Research activities

Prototype performance
Activity packet
Team participation
Reflection and analysis

Grade level: 7

Course Title: Design & Modeling

Topic/Concept: Wing Design Project

Time Allotment: 5 days

Unit Sequence: 6

Major Concepts to be learned:

- Aerodynamics
- Wing area calculations
- Flight variables
- Experimental testing

Expected Skills to be demonstrated:

- Calculate wing dimensions and area
- Design and build paper aircraft
- Analyze flight performance
- Modify designs based on test data

PA Standards/Anchors:

Eligible Content:

3.4.7.A
3.6.7.D
CC.2.3.7.A.1
3.6.7.E

Area calculations
Aerodynamics
Prototype testing
Data collection

Instructional Strategies:

Assessments:

Hands-on experimentation
Mathematical application
Guided design
Performance testing

Wing calculations
Flight performance data
Final flight testing
Project paperwork

Grade level: 7

Course Title: Design & Modeling

Topic/Concept: Bungee Barbie Challenge

Time Allotment: 4 days

Unit Sequence: 7

Major Concepts to be learned:

- Variables and prediction
- Testing and data analysis
- Engineering optimization
- Iterative problem solving

Expected Skills to be demonstrated:

- Predict outcomes using measurements
- Conduct controlled testing
- Analyze experimental data
- Modify designs for improved performance

PA Standards/Anchors:

Eligible Content:

3.4.7.B
3.6.7.D
CC.2.4.7.B.1
3.6.7.E

Experimental design
Data analysis
Measurement applications
Problem solving

Instructional Strategies:

Assessments:

Inquiry-based learning
Experimental testing
Collaborative analysis
STEM challenge activities

Prediction calculations
Testing results
Final challenge performance
Reflection activities