ENGINEERING DRAWING · MODULE 2: 2D AND 3D — UNBOXING 3D SHAPES

Planning Guide

Duration: ~1 Week (3 Class Periods) | Grades 6–8

Georgia Tech · STEM Innovation & Design

Activity Overview and Pacing

Activity	Name	Day	Time	Essential Question
1	What Is a Net? Unfolding and Predicting	Day 1	~50 min	What shape do you get when you unfold a 3D object flat?
2	Drawing and Building Nets	Day 2	~50 min	Can you draw a net that folds back into the original cube?
3	Nets of Multi-Cube Structures	Day 3	~50 min	How does joining cubes change the net?

Activity Descriptions and Materials

Activity 1 — What Is a Net? Unfolding and Predicting | Day 1 | ~50 min

Essential Question: *What shape do you get when you unfold a 3D object flat?*

Students predict what shape a cube makes when unfolded, then cut and tape a net to test their prediction. They discover the defining properties of a valid cube net — exactly six connected squares, one per face, with no overlaps — and connect that completeness to the engineering idea that a drawing must show all faces to give complete information.

Materials:

- Small (1") wooden cubes — one per student
- Blank paper
- One Cube Student Sheet (net to cut and fold)
- Scissors and tape
- Student journals

Activity 2 — Drawing and Building Nets | Day 2 | ~50 min

Essential Question: *Can you draw a net that folds back into the original cube?*

Students draw a net of a single cube to scale on graph paper (1 square per face), label all six faces, then cut and fold to verify it folds into a closed cube. The fold check turns an invalid net into useful debugging information — reinforcing that a design that fails its criteria goes back to the drawing board. Early finishers hunt for a second valid net (there are eleven).

Materials:

- Small (1") wooden cubes
- Graph paper
- Pencils and small rulers
- Scissors and tape
- Student journals

Activity 3 — Nets of Multi-Cube Structures | Day 3 | ~50 min

Essential Question: *How does joining cubes change the net?*

Students place two cubes side by side and predict the net's square count, discovering that the two touching faces become internal and drop the total from 12 to 10. They draw and count exposed versus internal faces, then make the first explicit connection between the number of squares in a net and the surface area of the structure — previewing Module 4.

Materials:

- Small (1") wooden cubes — 2 or more per student
- Graph paper
- Scissors and tape
- Stickers to mark touching faces (scaffold, optional)
- Student journals

Standards Alignment

This module was designed to support the Next Generation Science Standards (NGSS) Engineering Design performance expectations and Science & Engineering Practices, the Georgia Standards of Excellence, and the Common Core State Standards for Mathematics. The tables below summarize the strongest alignment points and where they show up in the module.

NGSS Engineering Design Performance Expectations

Standard	Description	Where It Shows Up	Classroom Connection
MS-ETS1-1	*Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution.*	*Activities 2–3*	*Students treat a complete net — all exposed faces, no more and no fewer — as an engineering constraint; an incomplete net cannot encode complete information about the object.*

Science and Engineering Practices & Crosscutting Concepts

Learning Dimension	Where It Shows Up	Classroom Connection
SEP: Constructing Explanations and Designing Solutions	*Activities 1–3*	*Students predict, test, and construct explanations about which net patterns fold into valid cubes and why joining cubes changes the face count.*
DCI: MS-ETS1-1 — Defining and Delimiting Engineering Problems	*Activity 3*	*Face-counting work shows that a representation with missing information is an engineering problem, not just an academic error.*
CCC: Structure and Function	*Activity 1*	*Unfolding cube structures shows that a net's layout determines whether it folds into the correct object.*
CCC: Scale, Proportion, and Quantity	*Activity 2*	*Students draw nets to scale on graph paper and verify each face's dimensions match the physical cube.*

Aligned Content Standards

Standard	Details
Georgia Standards of Excellence	*Grade 6: EET-1, EET-7 | Grade 7: II-3, II-7 | Grade 8: TS-2, TS-7*
NGSS — MS-ETS1: Engineering Design	*Performance Expectation MS-ETS1-1 (see table above).*
Common Core Mathematics — 6.G.A.4	*Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures.*

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