ENGINEERING DRAWING · MODULE 1: SEEING AND SHOWING 3D OBJECTS

# Planning Guide

Duration: ~1 Week (4 Class Periods) | Grades 6–8

Georgia Tech · STEM Innovation & Design

## Activity Overview and Pacing

| Activity | Name | Day | Time | Essential Question |
|---|---|---|---|---|
| **1** | Why Drawing? The Communication Problem | Day 1 | ~45 min | Why do engineers need a shared drawing language? |
| **2** | What Do You See? Observation Sketching | Day 2 | ~45 min | What information does a drawing communicate — and what does it leave out? |
| **3** | Sketching to Communicate: Partner Challenge | Day 3 | ~45 min | Can your drawing give someone else enough information to reconstruct what you built? |
| **4** | Pulling It Together: Annotated Sketches | Day 4 | ~45 min | How do words and labels make a drawing more complete? |

## Activity Descriptions and Materials

### Activity 1 — Why Drawing? The Communication Problem | Day 1 | ~45 min

**Essential Question:** *Why do engineers need a shared drawing language?*

Students each draw the same large cube structure their own way, then hang the drawings for a gallery walk that surfaces how differently everyone represented the same object. A class discussion draws out that no single informal drawing gives enough information to rebuild the structure exactly. The activity closes by introducing the core 3D vocabulary — face, edge, and vertex — using a single cube.

**Materials:**

- Large cardboard cubes, pre-assembled — 4–6 for the class structure.
  NOTE: If you don't have cardboard cubes, file boxes can also work here. Just note to students that the structure is comprised of rectangular prisms rather than cubes.
- Blank paper (not graph paper)
- Tape or magnets to hang student drawings
- One small (1") wooden cube for the vocabulary demonstration
- Engineering Design Logs / student journals

### Activity 2 — What Do You See? Observation Sketching | Day 2 | ~45 min

**Essential Question:** *What information does a drawing communicate — and what does it leave out?*

Students practice observation sketching with structures of increasing complexity — one cube, then two, then three — asking after each sketch whether the drawing gives enough information to understand what they drew. A peer review has partners describe a structure from the drawing alone, revealing which information is most often missing or unclear.

**Materials:**

- Small (1") wooden cubes — 3 per student
- Blank and graph paper
- Pencils
- Optional light source for shadow-tracing scaffold
- Student journals

### Activity 3 — Sketching to Communicate: Partner Challenge | Day 3 | ~45 min

**Essential Question:** *Can your drawing give someone else enough information to reconstruct what you built?*

Each student builds a multi-level structure and documents it with a drawing only — no showing the original. Partners then attempt to rebuild the structure from the drawing alone. Comparing the rebuild to the original surfaces exactly what a complete drawing needs (all sides, consistent scale, a way to show depth) and sets up the cliffhanger for the 3-view standard in Module 3.

**Materials:**

- Small (1") wooden cubes — 4–6 per student
- Graph paper
- Pencils
- Student journals

### Activity 4 — Pulling It Together: Annotated Sketches | Day 4 | ~45 min

**Essential Question:** *How do words and labels make a drawing more complete?*

Students build a final structure and sketch it from at least two angles, adding annotations — vocabulary labels, dimension notes, written descriptions, and a face count — to make the drawing as complete as possible. A gallery walk closes the module and bridges to the formal engineering notation of Modules 2 and 3 and the surface-area work of Module 4.

**Materials:**

- Small (1") wooden cubes — 4–6 per student
- Graph paper
- Pencils and small rulers
- Tape or magnets for the gallery walk
- 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. If your state uses different standards, align using the descriptions in the tables below.

### 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 1, 3* | ***Students experience that informal drawing without a shared convention cannot reliably communicate 3D information — framing a shared drawing language as a design constraint.*** |
| *MS-ETS1-2* | ***Evaluate competing design solutions using a systematic process to determine how well they meet criteria and constraints.*** | *Activities 3–4* | ***Students evaluate their own and classmates' drawings for communicative completeness — does the drawing give enough information to reconstruct the object?*** |

### Science and Engineering Practices & Crosscutting Concepts

| Learning Dimension | Where It Shows Up | Classroom Connection |
|---|---|---|
| SEP: Constructing Explanations and Designing Solutions | *Activities 1–4* | ***Students investigate how flat drawings encode 3D information and construct explanations for why some drawings communicate more completely than others.*** |
| DCI: MS-ETS1-1 — Defining and Delimiting Engineering Problems | *Activities 1, 3* | ***Gallery and partner activities show that drawings without a shared convention cannot reliably communicate — motivating the standardized approach Module 3 provides.*** |
| CCC: Structure and Function | *Activity 3* | ***A drawing's structure (which views are shown) determines whether it functions as a complete representation of the object.*** |
| CCC: Scale, Proportion, and Quantity | *Activity 4* | ***Students add dimension notes and draw to scale, preserving the proportions of each face of the physical cube structure.*** |

### 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 Expectations MS-ETS1-1 and MS-ETS1-2 (see table above).* |

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