LockwoodSTEM

Introduction to Engineering Design

Unit 1: Technical Sketching & Engineering Documentation

Student learning deck • LockwoodSTEM aerospace-aligned IED curriculum

Module

Sketching, measurement, line conventions, views, and documentation.

Skills

Isometric sketching, orthographic projection, dimensioning, and reverse engineering.

Challenge

Document and propose improvements to a 3D printed rocket assembly.

Sketch • Measure • Document • Communicate

Unit 1

Unit 1 Learning Arc

Technical sketching becomes engineering evidence when it is accurate, labeled, measured, and documented.

Lesson range	Focus	Purpose
1.1–1.6	Sketching language	Use line types, isometric views, hidden lines, and centerlines to communicate shape.
1.7–1.10	Views + dimensions	Use orthographic views and dimensions to describe size and geometry clearly.
1.11–1.20	Rocket documentation	Reverse engineer a 3D printed rocket through sketches, measurements, BOM, and notes.
1.21–1.22	Design proposal	Use evidence to propose a rocket assembly improvement and communicate it clearly.

Core idea

You are learning to communicate engineering decisions clearly enough that another person could inspect, build, or improve the design.

Unit 1

Unit 1 Deliverables Map

You will build a documentation package, not just complete isolated sketches.

Checkpoint	Student evidence
Sketching practice	Line conventions, isometric views, hidden-line sketches, centerlines, and shading.
Technical views	Orthographic views, dimensions, bracket sketches, and measurement notes.
Rocket documentation	Reverse-engineering notes, parts list, exploded view, assembly notes, and BOM.
Final proposal	Engineering Change Request and rocket assembly improvement presentation.

Evidence expectation

Each artifact should be dated, labeled, and clear enough to stand alone as engineering evidence.

Unit 1

How Unit 1 Works

Every lesson should improve the evidence you can use later.

What you are practicing

First, learn the visual language engineers use to communicate shape and structure.
Next, apply that language to aerospace-style parts and rocket components.
Then, combine sketches, measurements, views, and notes into a complete documentation package.
Finally, use your evidence to justify one proposed improvement to the rocket assembly.

Remember

A good sketch is not judged by whether it is artistic. It is judged by whether it communicates the design clearly.

Lesson 1.1

Why Engineers Sketch

Why do engineers sketch before they build or model in CAD?

Lesson 1.1

Why Engineers Sketch

Connect today's work to your engineering notebook evidence.

Lesson 1.1

Why Engineers Sketch

Big ideas you should understand before you start the work

Big Ideas

1

Engineering sketches are thinking tools, not art assignments.

2

A sketch captures design intent before time is spent building or modeling.

3

Good sketches make ideas easier to compare, discuss, and improve.

Ask yourself: What would someone else understand from my sketch or documentation?

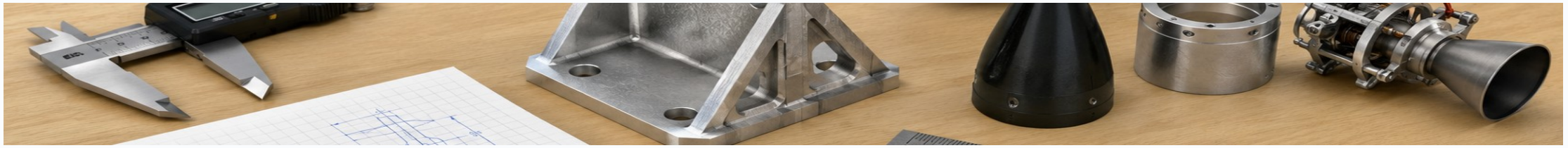
Lesson 1.1

Why Engineers Sketch

Use these moves while you work

Key Moves

Move	What it means
Capture the idea	Sketch the main form before details are added.
Label the function	Show what each feature is supposed to do.
Communicate intent	Use notes and arrows so another person understands the idea.



Lesson 1.1

Why Engineers Sketch

What you should have by the end of the lesson

Evidence Checklist

- ☐ Date and title the sketch page
- ☐ Use light construction lines first
- ☐ Add object lines and labels
- ☐ Explain the design purpose in words
- ☐ Save evidence in your notebook

End-of-Lesson Product

A dated engineering sketch that communicates a design idea clearly enough for another person to understand.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.2

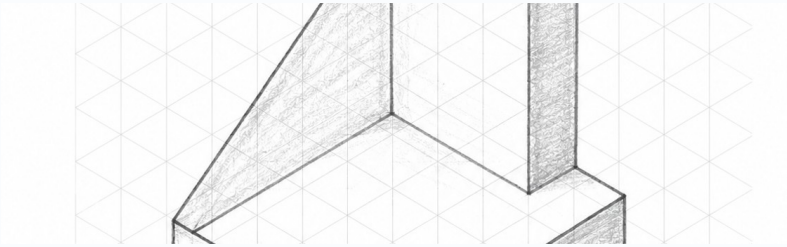
Line Conventions

How do different types of lines help engineers communicate clearly?

Lesson 1.2

Line Conventions

Connect today's work to your engineering notebook evidence.



Lesson 1.2

Line Conventions

Big ideas you should understand before you start the work

Big Ideas

1

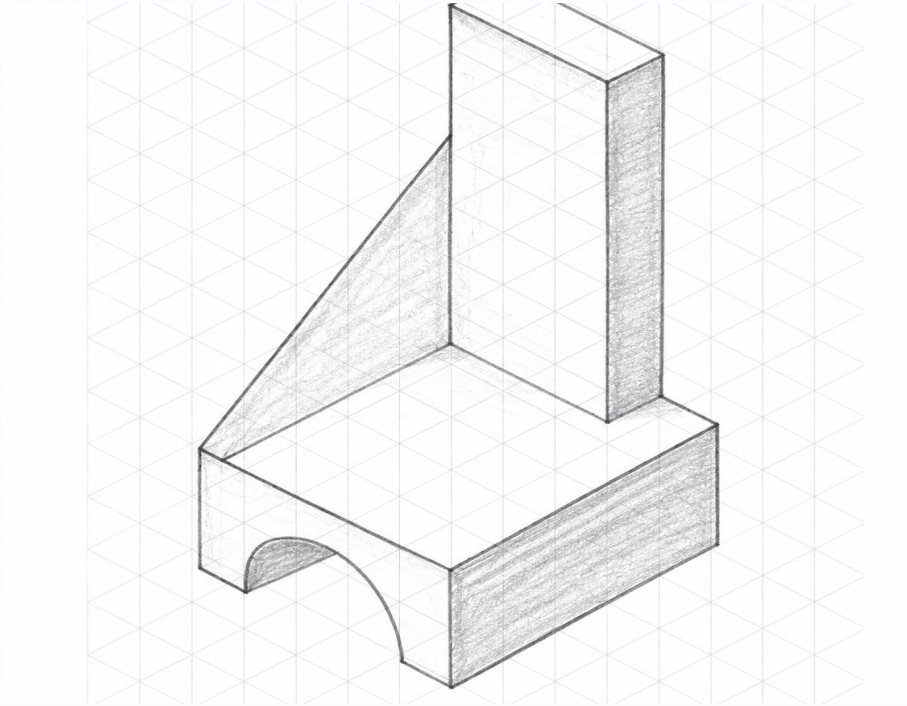
Line types are part of the language of engineering drawings.

2

Object, construction, hidden, center, and dimension lines each have a job.

3

Line weight helps readers tell planning marks from final design geometry.



Ask yourself: What would someone else understand from my sketch or documentation?

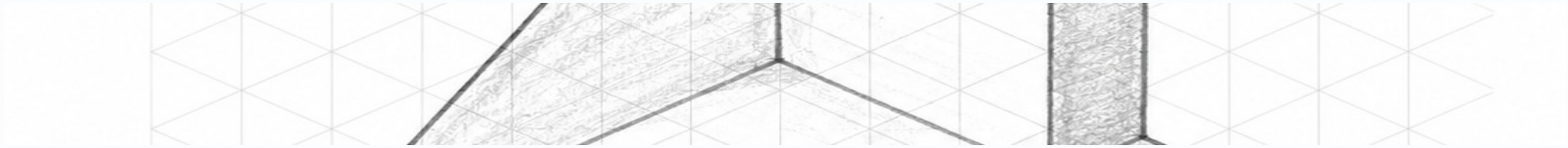
Lesson 1.2

Line Conventions

Use these moves while you work

Key Moves

Move	What it means
Construction lines	Use light lines to plan size, alignment, and spacing.
Object lines	Use dark lines for visible edges and final geometry.
Special lines	Use hidden, center, and dimension lines only when they add information.



Lesson 1.2

Line Conventions

What you should have by the end of the lesson

Evidence Checklist

- ☐ Practice at least three line types
- ☐ Label each line type
- ☐ Use correct line weight
- ☐ Apply lines to an aerospace-style part
- ☐ Correct unclear or inconsistent lines

End-of-Lesson Product

A line convention practice sketch showing the correct purpose and appearance of major technical line types.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.3

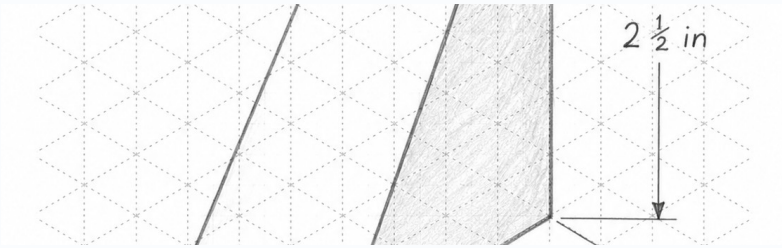
Object Lines & Hidden Lines

How can a sketch show features that cannot be seen from one view?

Lesson 1.3

Object Lines & Hidden Lines

Connect today's work to your engineering notebook evidence.



Lesson 1.3

Object Lines & Hidden Lines

Big ideas you should understand before you start the work

Big Ideas

1

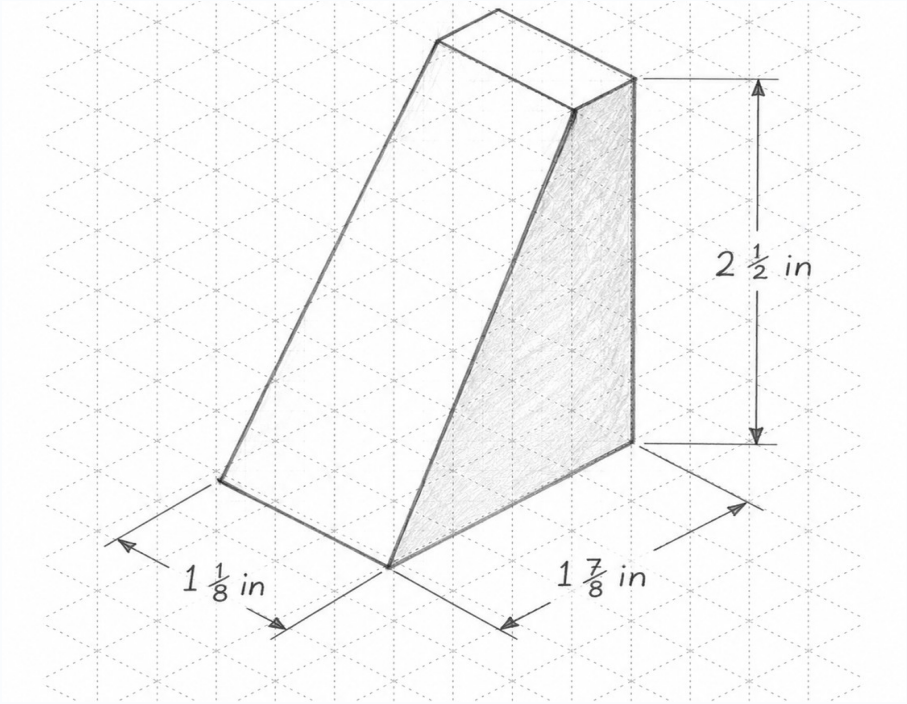
Object lines show visible edges and surfaces.

2

Hidden lines show important internal or blocked features.

3

Hidden lines should clarify geometry, not clutter the view.



Ask yourself: What would someone else understand from my sketch or documentation?

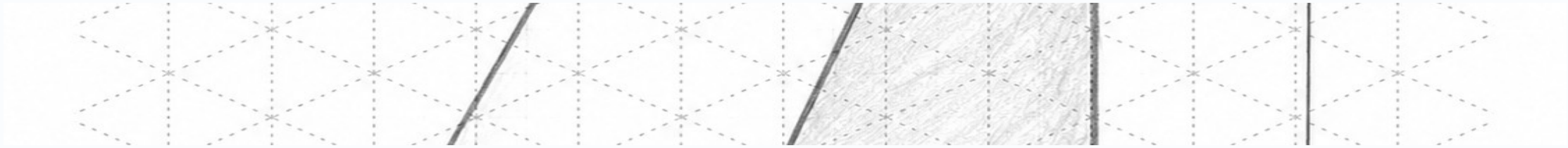
Lesson 1.3

Object Lines & Hidden Lines

Use these moves while you work

Key Moves

Move	What it means
Visible edges	Darken only the edges that can be seen from the chosen view.
Hidden features	Use short dashed lines for holes, slots, or edges behind surfaces.
Clean drawing	Avoid adding hidden lines unless they help the viewer understand the part.



Lesson 1.3

Object Lines & Hidden Lines

What you should have by the end of the lesson

Evidence Checklist

- ☐ Identify visible edges
- ☐ Add hidden lines where needed
- ☐ Keep hidden lines lighter than object lines
- ☐ Explain what hidden features represent
- ☐ Revise confusing sketches

End-of-Lesson Product

A technical sketch using object and hidden lines to communicate visible and non-visible features.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.4

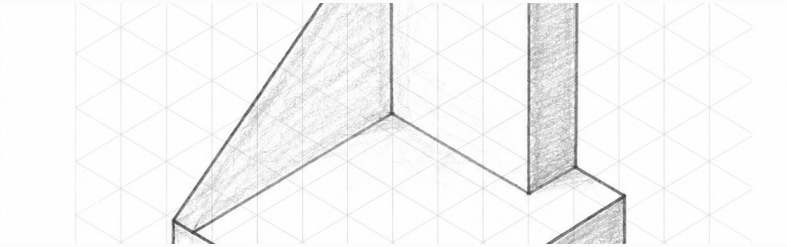
Centerlines & Symmetry

How do engineers show the center of a feature or object in a technical sketch?

Lesson 1.4

Centerlines & Symmetry

Connect today's work to your engineering notebook evidence.



Lesson 1.4

Centerlines & Symmetry

Big ideas you should understand before you start the work

Big Ideas

1

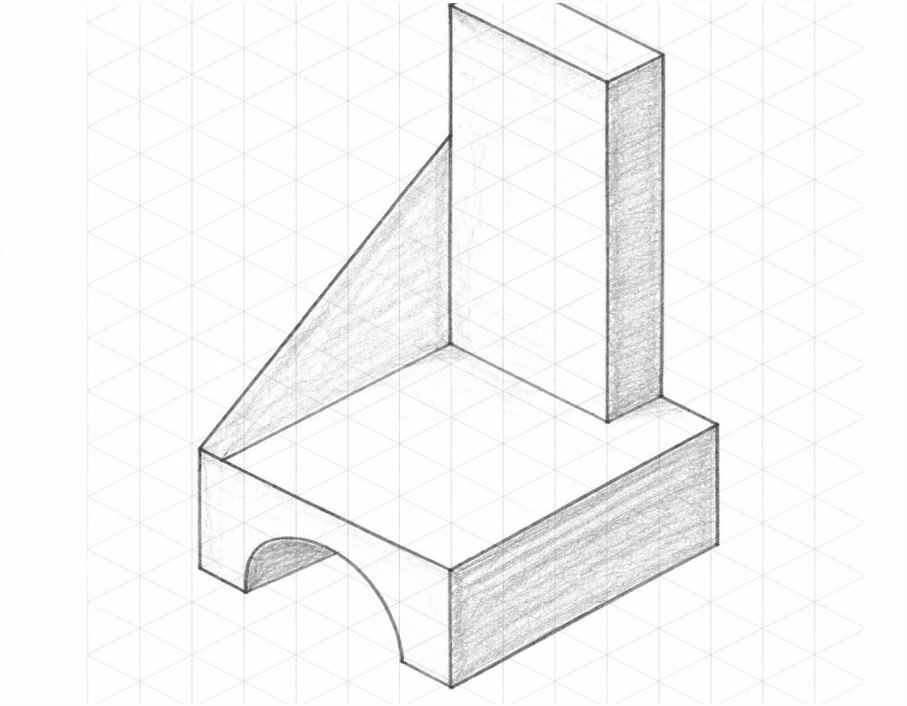
Centerlines mark axes, centers, and symmetry.

2

Circular features and repeated patterns need center references.

3

Centerlines help parts align during modeling, fabrication, and inspection.



Ask yourself: What would someone else understand from my sketch or documentation?

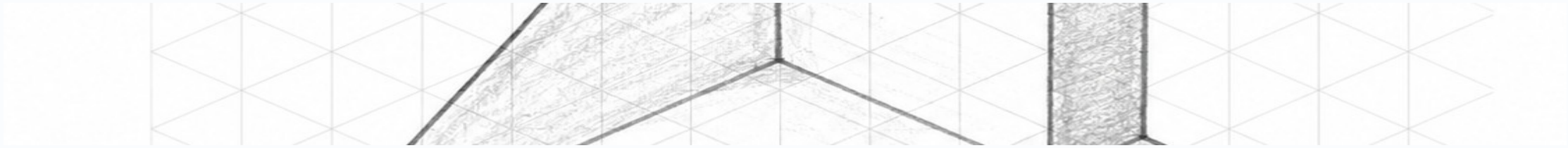
Lesson 1.4

Centerlines & Symmetry

Use these moves while you work

Key Moves

Move	What it means
Find the center	Mark the center of holes, arcs, cylinders, or repeated features.
Show symmetry	Use centerlines to communicate that two sides mirror each other.
Support dimensions	Place dimensions from reliable center references when needed.



Lesson 1.4

Centerlines & Symmetry

What you should have by the end of the lesson

Evidence Checklist

- ☐ Add centerlines to holes or circular features
- ☐ Show symmetry where appropriate
- ☐ Use centerlines consistently
- ☐ Label alignment purpose
- ☐ Check that centerlines do not look like object lines

End-of-Lesson Product

A sketch that uses centerlines to show hole centers, axes, or symmetry clearly.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.5

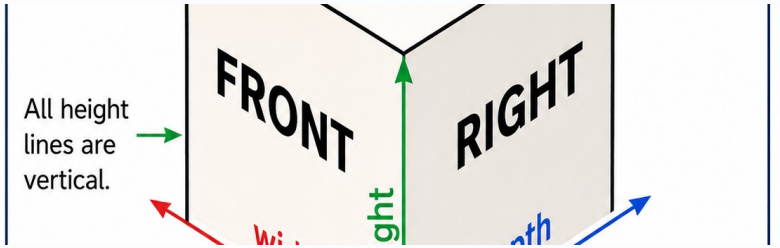
Isometric Sketching

How can engineers show a 3D object clearly on a flat page?

Lesson 1.5

Isometric Sketching

Connect today's work to your engineering notebook evidence.



Lesson 1.5

Isometric Sketching

Big ideas you should understand before you start the work

Big Ideas

1

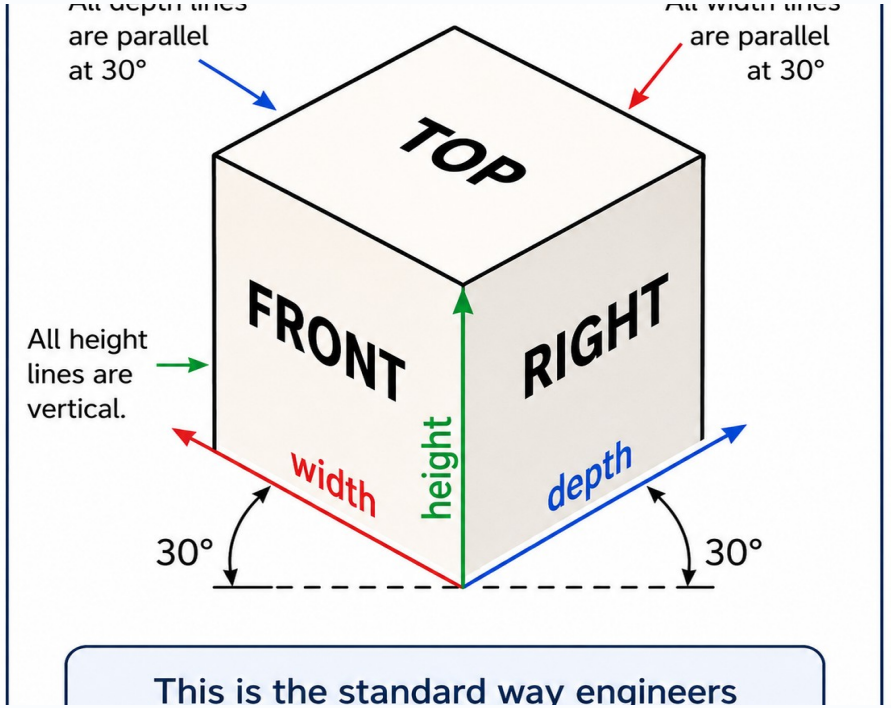
Isometric sketches show width, height, and depth at the same time.

2

Edges follow consistent vertical and angled directions.

3

Proportion and alignment matter more than artistic shading at first.



Ask yourself: What would someone else understand from my sketch or documentation?

Lesson 1.5

Isometric Sketching

Use these moves while you work

Key Moves

Move	What it means
Start with a box	Build the object inside a simple width-height-depth envelope.
Follow axes	Keep vertical edges vertical and depth/width edges at consistent angles.
Add features	Place cuts, holes, and details after the main form is correct.

Lesson 1.5

Isometric Sketching

What you should have by the end of the lesson

Evidence Checklist

- ☐ Create an isometric box or envelope
- ☐ Use consistent isometric axes
- ☐ Add visible edges and features
- ☐ Label the part or design intent
- ☐ Check proportions before darkening lines

End-of-Lesson Product

A clean isometric sketch that communicates a 3D object using consistent axes and visible features.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.5

Isometric Drawing Video Connection

Optional video connection

Video Connection

Isometric Drawing - Simplified

Watch for:
- how the isometric axes are used
- how a 3D form starts from simple shapes
- how proportion and alignment guide the sketch

Scan or Open

Open Video

https://www.youtube.com/watch?v=c_NRuzPs9R8

Lesson 1.6

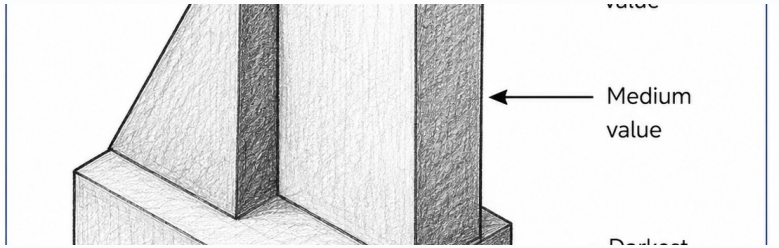
Isometric Circles, Arcs, and Shading

How can engineers show curved features and surface depth in an isometric sketch?

Lesson 1.6

Isometric Circles, Arcs, and Shading

Connect today's work to your engineering notebook evidence.



Lesson 1.6

Isometric Circles, Arcs, and Shading

Big ideas you should understand before you start the work

Big Ideas

1

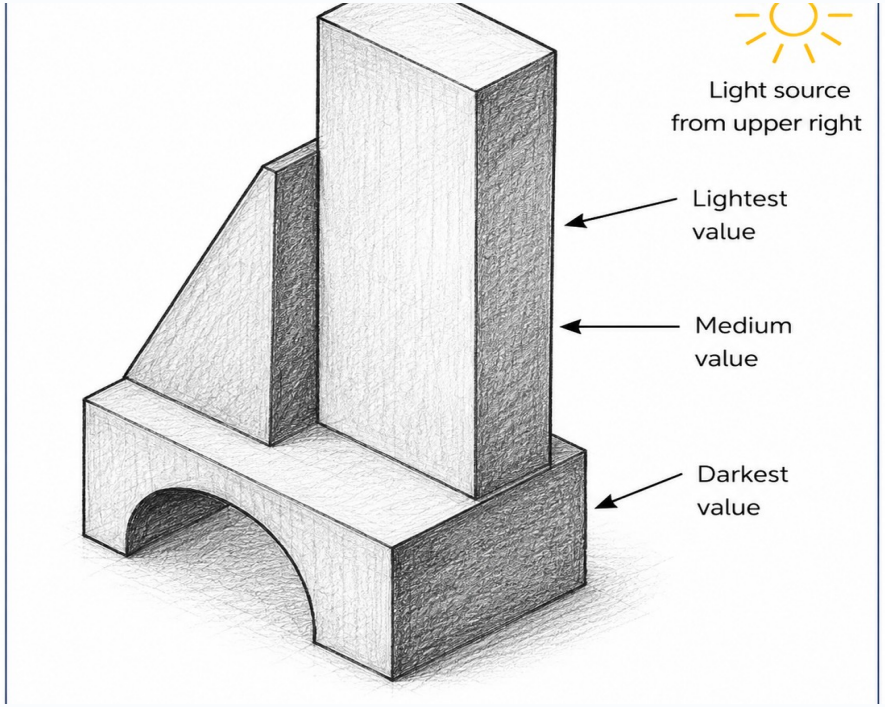
Circles usually appear as ellipses in isometric view.

2

Curved features need careful placement so they still look attached to the part.

3

Shading and value can show surface direction, depth, and form.



Ask yourself: What would someone else understand from my sketch or documentation?

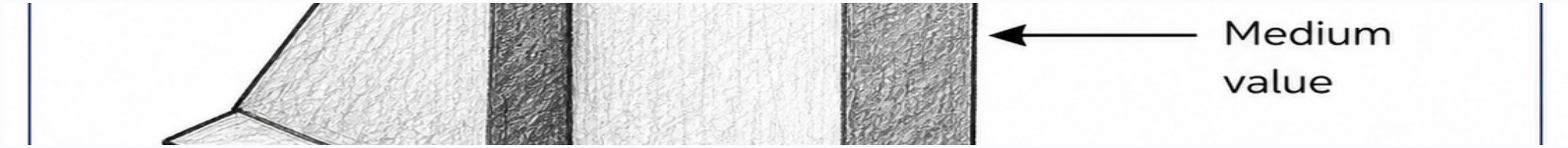
Lesson 1.6

Isometric Circles, Arcs, and Shading

Use these moves while you work

Key Moves

Move	What it means
Curved features	Sketch circles, holes, and arcs as ellipses that follow the surface.
Surface value	Use light, medium, and dark values to show different faces.
Clarity first	Use shading to support the sketch, not hide weak geometry.



Lesson 1.6

Isometric Circles, Arcs, and Shading

What you should have by the end of the lesson

Evidence Checklist

- ☐ Practice at least one curved feature
- ☐ Use a light-to-dark value scale
- ☐ Add shading to show form
- ☐ Keep object edges readable
- ☐ Explain what the curved feature represents

End-of-Lesson Product

An isometric sketch with at least one curved feature and shading that improves form clarity.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.7

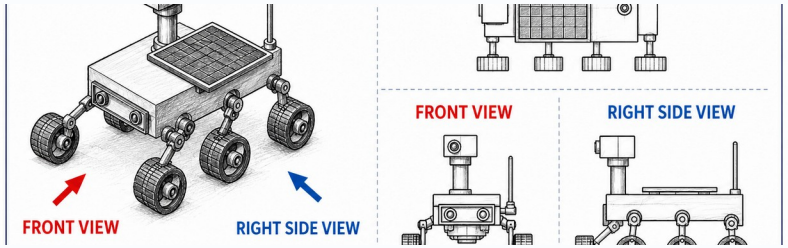
Orthographic Projection

Why do engineers use multiple 2D views instead of only one 3D sketch?

Lesson 1.7

Orthographic Projection

Connect today's work to your engineering notebook evidence.



Lesson 1.7

Orthographic Projection

Big ideas you should understand before you start the work

Big Ideas

1

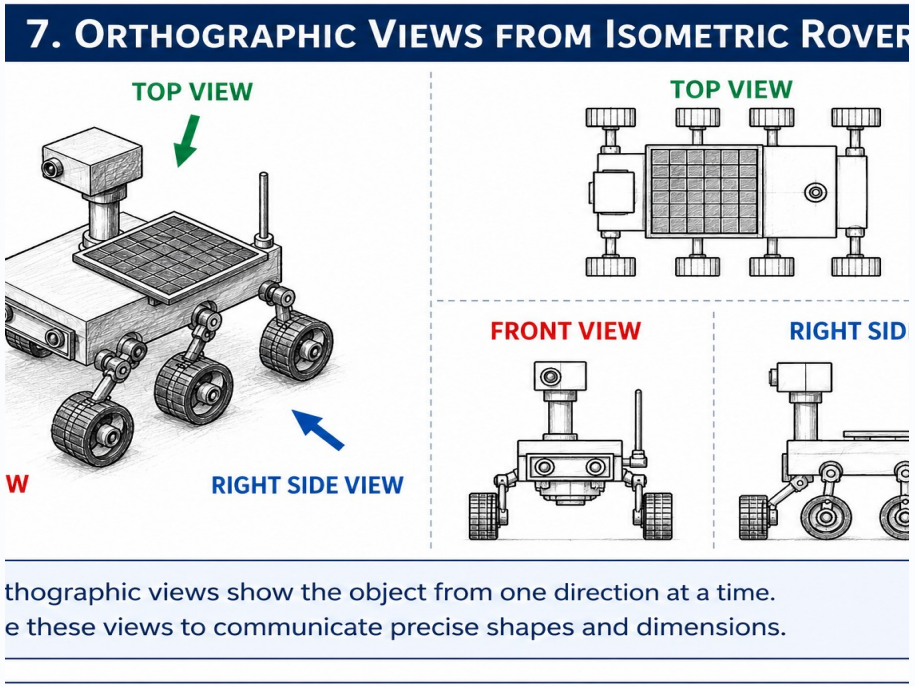
Orthographic projection shows a 3D object as multiple flat views.

2

Each view shows only two dimensions at a time.

3

Multiple views reduce guessing when shape, size, or hidden features matter.



Ask yourself: What would someone else understand from my sketch or documentation?

Lesson 1.7

Orthographic Projection

Use these moves while you work

Key Moves

Move	What it means
Choose views	Use front, top, and right-side views to show the important features.
Align views	Keep matching widths, heights, and depths lined up.
Compare with 3D	Use the isometric view to check if each 2D view makes sense.

Lesson 1.7

Orthographic Projection

What you should have by the end of the lesson

Evidence Checklist

- ☐ Identify front, top, and right views
- ☐ Align the views correctly
- ☐ Show matching features across views
- ☐ Use hidden lines if needed
- ☐ Check the views against the 3D object

End-of-Lesson Product

A basic orthographic layout that shows front, top, and right-side views of the same object.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.7

Orthographic Projection Video Connection

Optional video connection

Video Connection

Beginning Orthographic Projection

Watch for:
- how front, top, and side views relate
- how 3D features become 2D views
- how alignment keeps views accurate

Scan or Open

Open Video

https://www.youtube.com/watch?v=ytwEDvX-l44

Lesson 1.8

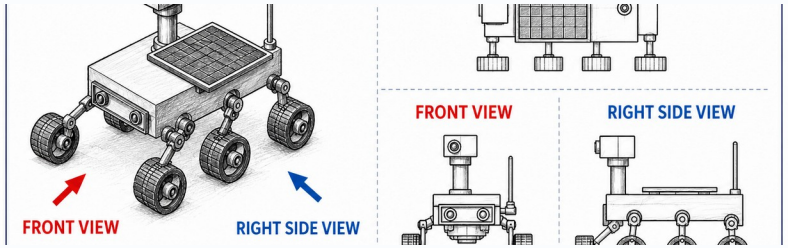
Top, Front & Right Side Views

How do engineers keep multiple views of the same object organized and accurate?

Lesson 1.8

Top, Front & Right Side Views

Connect today's work to your engineering notebook evidence.



Lesson 1.8

Top, Front & Right Side Views

Big ideas you should understand before you start the work

Big Ideas

1

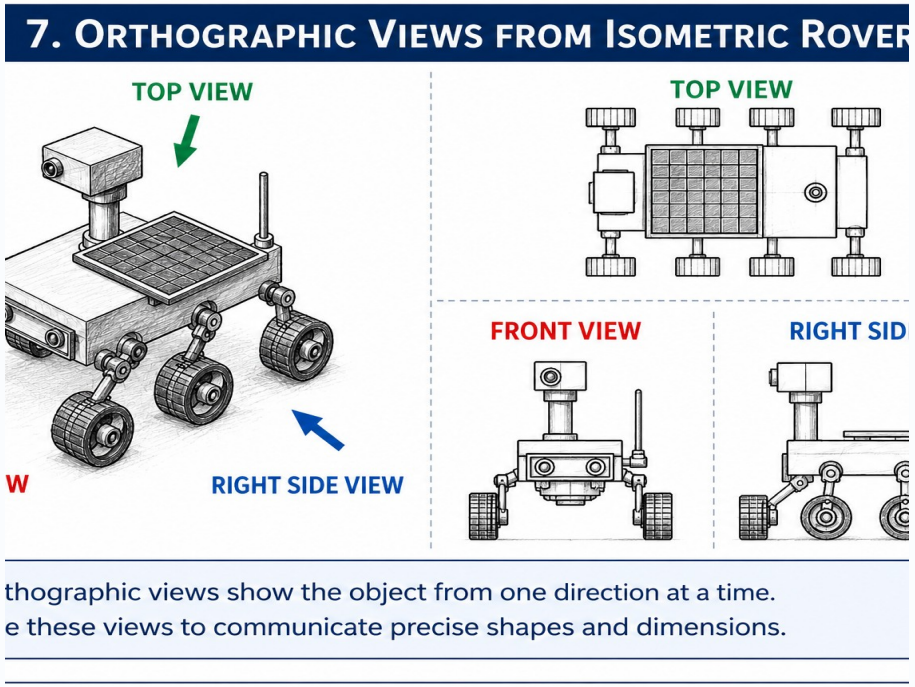
View placement is standardized so drawings are easy to read.

2

The front view anchors the drawing layout.

3

Matching dimensions must align across related views.



Ask yourself: What would someone else understand from my sketch or documentation?

Lesson 1.8

Top, Front & Right Side Views

Use these moves while you work

Key Moves

Move	What it means
Front view	Choose the view that best shows the part shape and function.
Top view	Place it directly above the front view and keep widths aligned.
Right view	Place it directly to the right and keep heights aligned.

Lesson 1.8

Top, Front & Right Side Views

What you should have by the end of the lesson

Evidence Checklist

- ☐ Choose the best front view
- ☐ Place top and right views correctly
- ☐ Project matching edges across views
- ☐ Keep spacing neat and readable
- ☐ Label views if needed

End-of-Lesson Product

A multiview sketch with correctly placed and aligned front, top, and right-side views.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.9

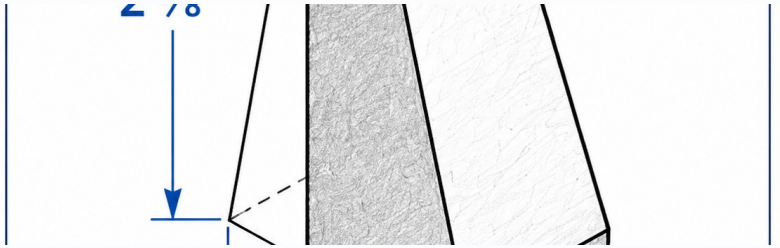
Dimensioning Basics

How do engineers show the size of an object clearly in a drawing?

Lesson 1.9

Dimensioning Basics

Connect today's work to your engineering notebook evidence.



Lesson 1.9

Dimensioning Basics

Big ideas you should understand before you start the work

Big Ideas

1

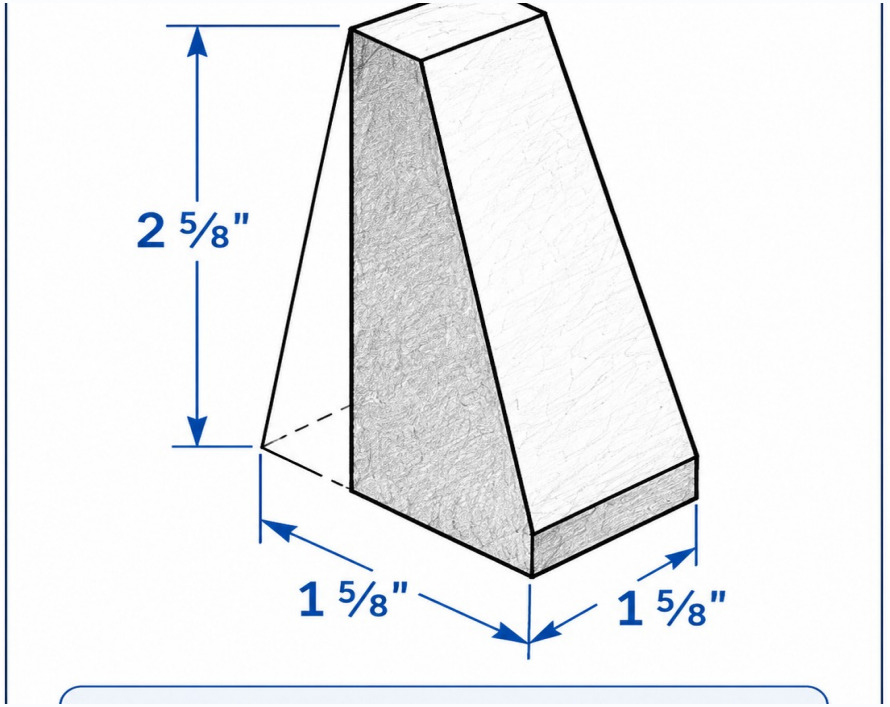
Views show shape, but dimensions show size.

2

Dimension lines, extension lines, arrows, and numbers work together.

3

Good dimensioning avoids missing, repeated, or confusing measurements.



Ask yourself: What would someone else understand from my sketch or documentation?

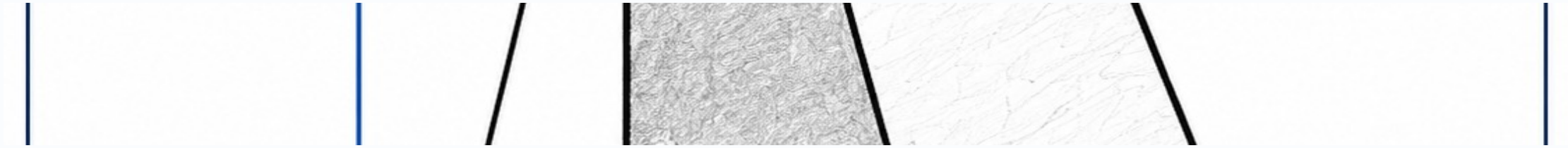
Lesson 1.9

Dimensioning Basics

Use these moves while you work

Key Moves

Move	What it means
Dimension lines	Show the distance being measured with arrowheads.
Extension lines	Connect the measurement to the feature without touching the object line.
Readable values	Place numbers clearly and include units when required.



Lesson 1.9

Dimensioning Basics

What you should have by the end of the lesson

Evidence Checklist

- ☐ Add overall size dimensions
- ☐ Add feature location dimensions
- ☐ Use extension and dimension lines correctly
- ☐ Avoid duplicate dimensions
- ☐ Check that someone could model the part from your drawing

End-of-Lesson Product

A dimensioned technical sketch that communicates the size and important feature locations of a part.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.9

Dimensioning Video Connection

Optional video connection

Video Connection

Engineering Drawing Dimensioning: The Basics Explained

Watch for:

- how dimensions communicate size
- how extension and dimension lines work
- why drawings should avoid missing or duplicate dimensions

Scan or Open

Open Video

https://www.youtube.com/watch?v=Q9kOFtUltqM

Lesson 1.10

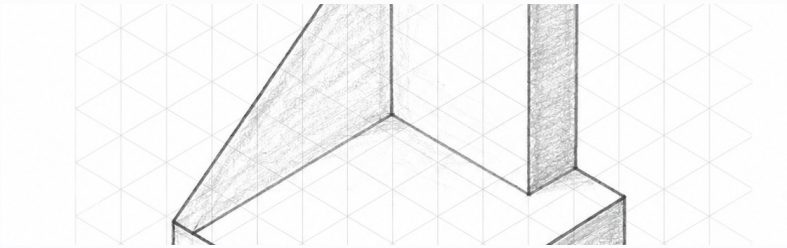
Aerospace Bracket Sketch

How can sketches communicate the shape, features, and size of a part before it is modeled or built?

Lesson 1.10

Aerospace Bracket Sketch

Connect today's work to your engineering notebook evidence.



Lesson 1.10

Aerospace Bracket Sketch

Big ideas you should understand before you start the work

Big Ideas

1

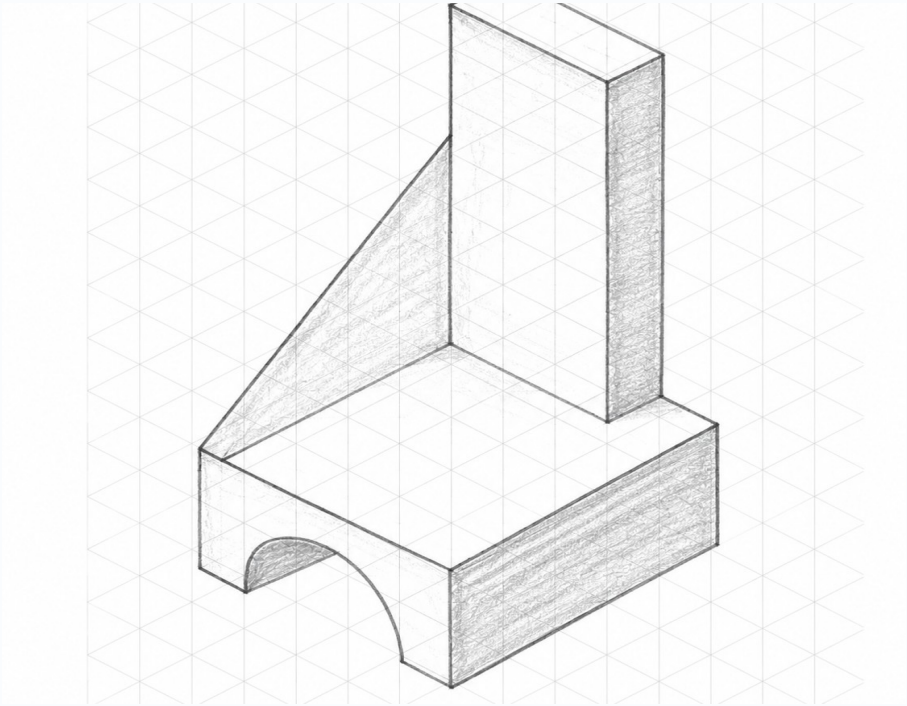
A bracket holds, supports, connects, or aligns other parts.

2

Aerospace brackets often balance strength, light weight, mounting holes, and clearances.

3

A technical sketch should show form, features, and dimensions together.



Ask yourself: What would someone else understand from my sketch or documentation?

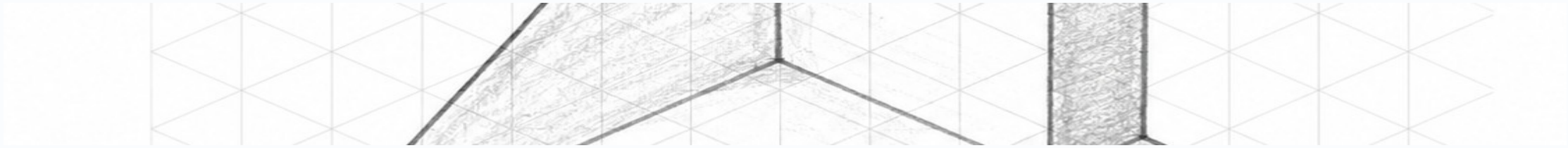
Lesson 1.10

Aerospace Bracket Sketch

Use these moves while you work

Key Moves

Move	What it means
Study the part	Identify holes, supports, cutouts, ribs, and mounting features.
Sketch the form	Use isometric or multiview sketches to show shape clearly.
Add dimensions	Dimension key features needed for CAD or fabrication.



Lesson 1.10

Aerospace Bracket Sketch

What you should have by the end of the lesson

Evidence Checklist

- ☐ Create a bracket sketch
- ☐ Label major features
- ☐ Include important dimensions
- ☐ Use line conventions accurately
- ☐ Explain the bracket function

End-of-Lesson Product

A clear aerospace bracket sketch with labels, dimensions, and line conventions.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.11

Rocket Assembly Reverse Engineering

How can engineers learn from an existing rocket assembly by carefully taking it apart?

Lesson 1.11

Rocket Assembly Reverse Engineering

Connect today's work to your engineering notebook evidence.

Lesson 1.11

Rocket Assembly Reverse Engineering

Big ideas you should understand before you start the work

Big Ideas

1

Reverse engineering means studying an existing product to understand how it works.

2

Each rocket part has a function, fit, and relationship to other parts.

3

Careful disassembly protects evidence and makes reassembly possible.

Ask yourself: What would someone else understand from my sketch or documentation?

Lesson 1.11

Rocket Assembly Reverse Engineering

Use these moves while you work

Key Moves

Move	What it means
Observe first	Record the assembled rocket before removing parts.
Disassemble carefully	Separate parts without damaging connections or losing orientation.
Document fits	Note where parts slide, press, align, or connect.

Lesson 1.11

Rocket Assembly Reverse Engineering

What you should have by the end of the lesson

Evidence Checklist

- ☐ Photograph or sketch the assembled rocket
- ☐ List major parts
- ☐ Record how parts connect
- ☐ Note any fit or alignment issues
- ☐ Keep parts organized for reassembly

End-of-Lesson Product

A reverse-engineering notebook entry showing rocket parts, functions, fits, and initial observations.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.12

Why Documentation Matters

Why is a design not finished when the sketch or model is finished?

Lesson 1.12

Why Documentation Matters

Connect today's work to your engineering notebook evidence.

Lesson 1.12

Why Documentation Matters

Big ideas you should understand before you start the work

Big Ideas

1

Documentation explains what the design is, how it works, and how it was built.

2

Good documentation makes work repeatable and inspectable.

3

Missing notes make future design decisions harder to justify.

Ask yourself: What would someone else understand from my sketch or documentation?

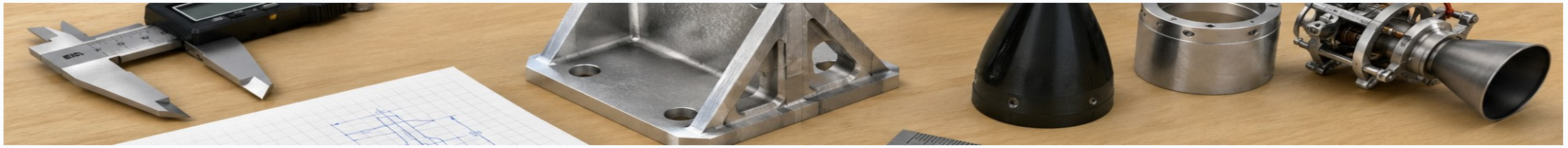
Lesson 1.12

Why Documentation Matters

Use these moves while you work

Key Moves

Move	What it means
Record context	Explain what the part or assembly is supposed to do.
Record evidence	Include sketches, measurements, photos, and observations.
Record decisions	Explain why a design choice or revision makes sense.



Lesson 1.12

Why Documentation Matters

What you should have by the end of the lesson

Evidence Checklist

- ☐ Add clear titles and dates
- ☐ Use labels and captions
- ☐ Record part names and functions
- ☐ Explain connection methods
- ☐ Identify what evidence is still missing

End-of-Lesson Product

A documentation update that makes the rocket assembly understandable without verbal explanation.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.13

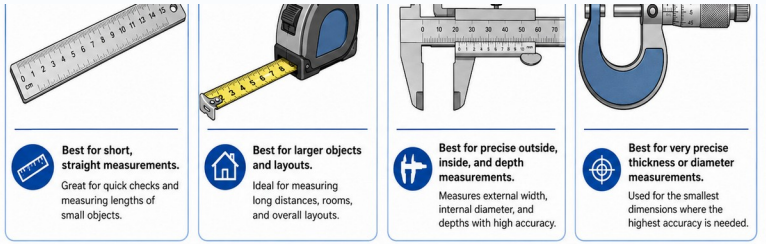
Measurement Tools

How do engineers choose the right tool for accurate measurement?

Lesson 1.13

Measurement Tools

Connect today's work to your engineering notebook evidence.



Lesson 1.13

Measurement Tools

Big ideas you should understand before you start the work

Big Ideas

1

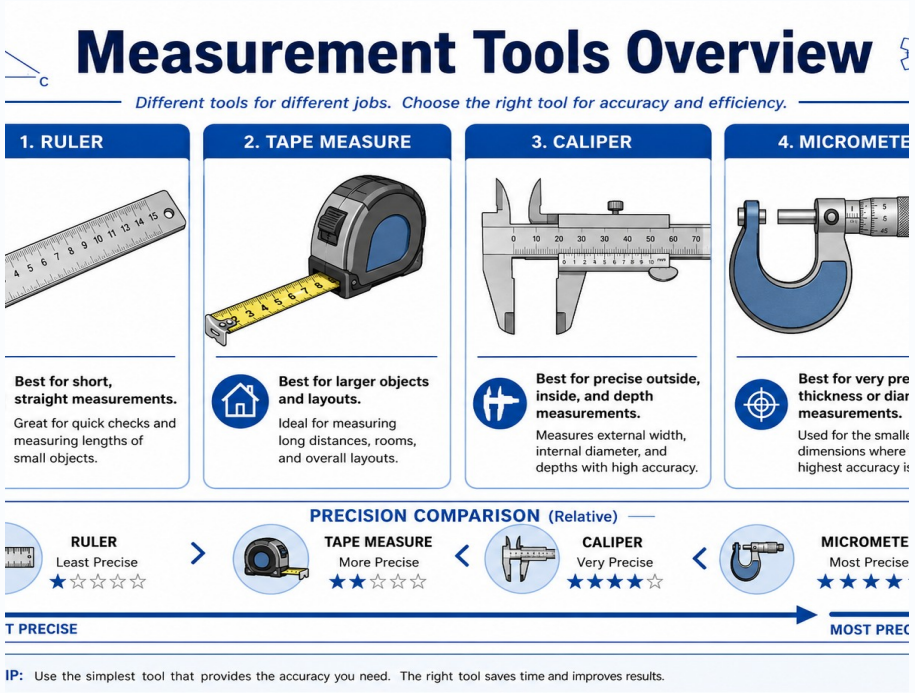
Different measurement tools are accurate for different tasks.

2

A measurement is only useful if the tool, units, and method are clear.

3

Repeated measurements help identify mistakes or variation.



Ask yourself: What would someone else understand from my sketch or documentation?

Lesson 1.13

Measurement Tools

Use these moves while you work

Key Moves

Move	What it means
Ruler / tape	Use for overall lengths and rough layout.
Calipers	Use for inside, outside, depth, and step measurements.
Micrometer	Use for precise thickness or diameter when needed.

Lesson 1.13

Measurement Tools

What you should have by the end of the lesson

Evidence Checklist

- ☐ Choose the correct measuring tool
- ☐ Record units and tool used
- ☐ Take repeated measurements
- ☐ Measure at least one critical rocket feature
- ☐ Note uncertainty or variation

End-of-Lesson Product

A measurement table for rocket parts that includes tool choice, units, and repeated measurements.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.13

Measurement Tools Video Connection

Optional video connection

Video Connection

How to Properly Use Calipers

Watch for:
- outside, inside, and depth measurements
- why the tool should be zeroed
- how to avoid squeezing or tilting the jaws

Scan or Open

Open Video

https://www.youtube.com/watch?v=ply3pIn53Ls

Lesson 1.14

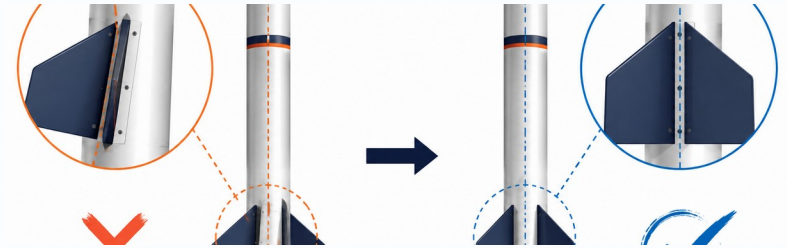
Tolerances

Why do engineers allow some variation in measurements, but not too much?

Lesson 1.14

Tolerances

Connect today's work to your engineering notebook evidence.



Lesson 1.14

Tolerances

Big ideas you should understand before you start the work

Big Ideas

1

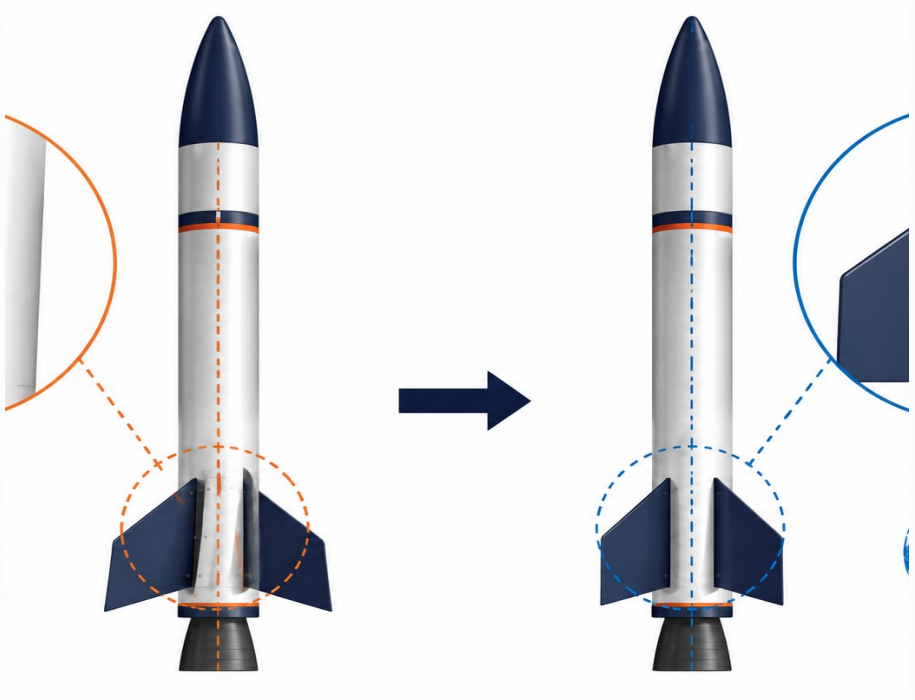
A target dimension is the intended size of a feature.

2

Tolerance is the allowed variation around that target.

3

Fit decisions depend on whether variation still allows the assembly to work.



Ask yourself: What would someone else understand from my sketch or documentation?

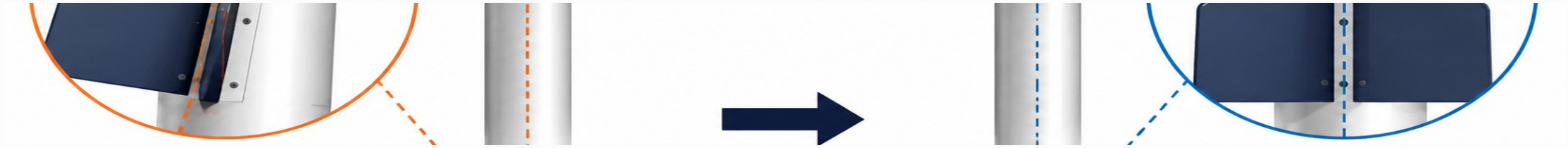
Lesson 1.14

Tolerances

Use these moves while you work

Key Moves

Move	What it means
Target value	Identify the intended size or fit.
Acceptable range	Set upper and lower limits that still allow function.
Fit decision	Decide pass, adjust, or redesign based on evidence.



Lesson 1.14

Tolerances

What you should have by the end of the lesson

Evidence Checklist

- ☐ Identify one target dimension
- ☐ Create an acceptable tolerance range
- ☐ Compare measured values to the range
- ☐ Classify the fit result
- ☐ Explain what should change if the fit fails

End-of-Lesson Product

A tolerance analysis showing whether a rocket part fit is acceptable, too loose, or too tight.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.15

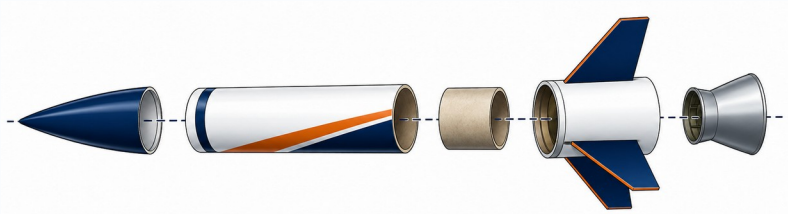
Adhesives & Fasteners

How do engineers decide the best way to connect parts together?

Lesson 1.15

Adhesives & Fasteners

Connect today's work to your engineering notebook evidence.



Lesson 1.15

Adhesives & Fasteners

Big ideas you should understand before you start the work

Big Ideas

1

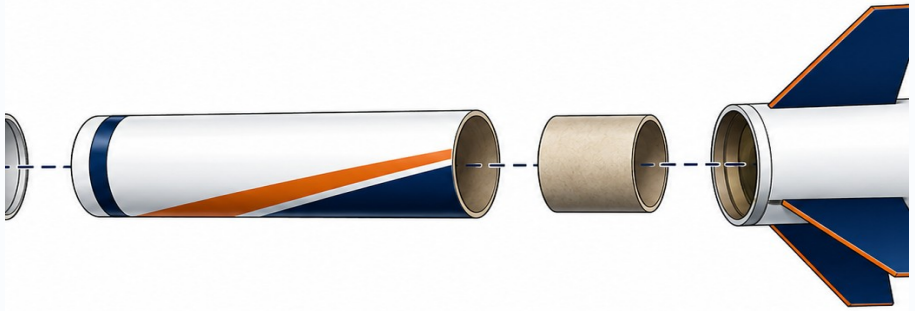
Connections can be permanent, removable, adjustable, or temporary.

2

Adhesives can be quick but may make disassembly difficult.

3

Fasteners and fit-based features can support inspection, repair, and revision.



Ask yourself: What would someone else understand from my sketch or documentation?

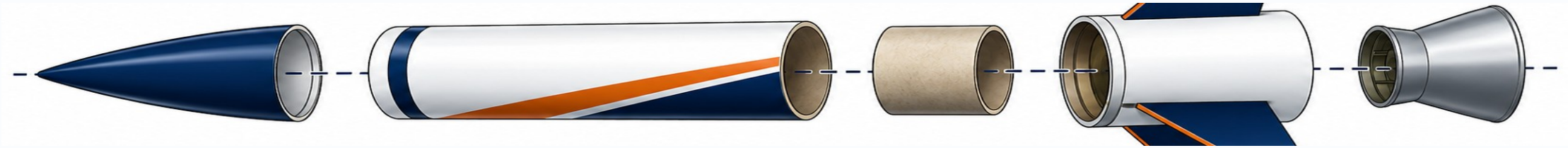
Lesson 1.15

Adhesives & Fasteners

Use these moves while you work

Key Moves

Move	What it means
Choose connection purpose	Decide if the part must be removed later.
Match method to load	Consider strength, alignment, and expected forces.
Document the method	Record whether the connection slides, snaps, presses, glues, or fastens.



Lesson 1.15

Adhesives & Fasteners

What you should have by the end of the lesson

Evidence Checklist

- ☐ Identify rocket connection points
- ☐ Classify each connection method
- ☐ Decide removable vs. permanent
- ☐ Explain one connection trade-off
- ☐ Update assembly notes

End-of-Lesson Product

A connection method table for the rocket assembly that explains how parts attach and why.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.16

Rocket Assembly Systems

How do multiple rocket parts work together as one assembly?

Lesson 1.16

Rocket Assembly Systems

Connect today's work to your engineering notebook evidence.

Lesson 1.16

Rocket Assembly Systems

Big ideas you should understand before you start the work

Big Ideas

1

A part is one individual component of a larger design.

2

A subassembly is a smaller group of parts that work together.

3

The full assembly depends on alignment, fit, order, and function.

Ask yourself: What would someone else understand from my sketch or documentation?

Lesson 1.16

Rocket Assembly Systems

Use these moves while you work

Key Moves

Move	What it means
Part names	Use consistent names for each component.
Subassemblies	Group related parts such as fin section, payload bay, or nose section.
System function	Explain how the parts work together as one rocket assembly.

Lesson 1.16

Rocket Assembly Systems

What you should have by the end of the lesson

Evidence Checklist

- ☐ Identify all major rocket parts
- ☐ Group parts into subassemblies
- ☐ Describe the function of each part
- ☐ Mark connection points
- ☐ Explain the full assembly purpose

End-of-Lesson Product

A rocket system map showing parts, subassemblies, connection points, and functions.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.17

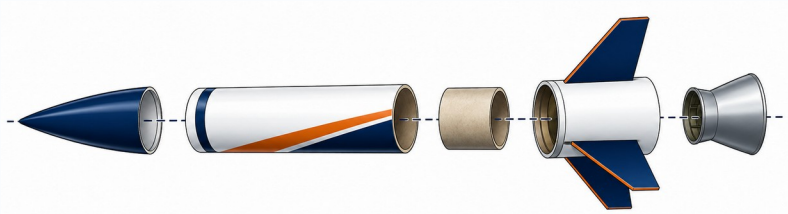
Documenting the Rocket Assembly

What information does someone need to understand or recreate the rocket assembly?

Lesson 1.17

Documenting the Rocket Assembly

Connect today's work to your engineering notebook evidence.



Lesson 1.17

Documenting the Rocket Assembly

Big ideas you should understand before you start the work

Big Ideas

1

Assembly documentation combines labeled sketches, part names, materials, and connection notes.

2

The goal is clarity for a future builder or reviewer.

3

Photos and sketches should be labeled with what they prove.

Ask yourself: What would someone else understand from my sketch or documentation?

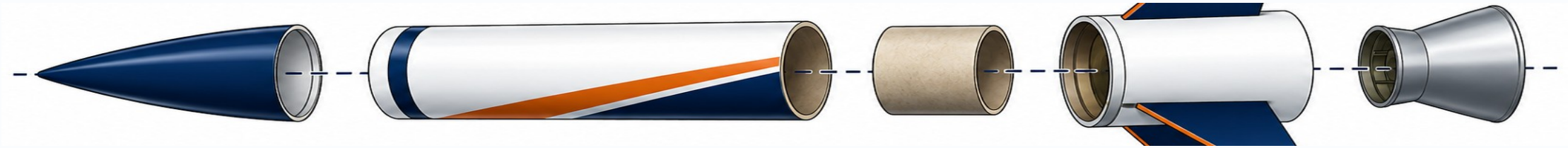
Lesson 1.17

Documenting the Rocket Assembly

Use these moves while you work

Key Moves

Move	What it means
Assembly sketch	Show the rocket assembled with labeled parts.
Parts list	Name each part and record quantity/material notes.
Connection notes	Explain how each part fits, aligns, or attaches.



Lesson 1.17

Documenting the Rocket Assembly

What you should have by the end of the lesson

Evidence Checklist

- ☐ Create a labeled assembly sketch
- ☐ Add a clear parts list
- ☐ Write connection notes
- ☐ Include material or fabrication notes
- ☐ Identify missing documentation

End-of-Lesson Product

A labeled rocket assembly documentation page that explains parts, connections, materials, and purpose.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.18

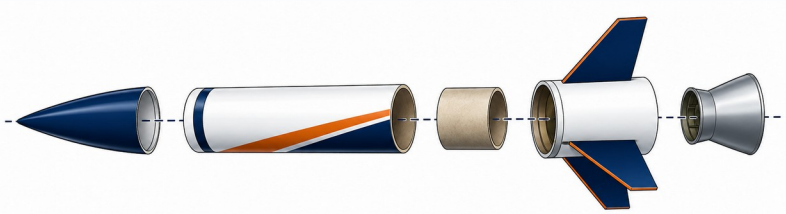
Rocket Exploded View

How can engineers show rocket parts separated without losing how they fit together?

Lesson 1.18

Rocket Exploded View

Connect today's work to your engineering notebook evidence.



Lesson 1.18

Rocket Exploded View

Big ideas you should understand before you start the work

Big Ideas

1

An exploded view separates parts so each component can be seen.

2

Alignment should still show where parts belong in the assembly.

3

Exploded views can communicate assembly order and fit relationships.

Ask yourself: What would someone else understand from my sketch or documentation?

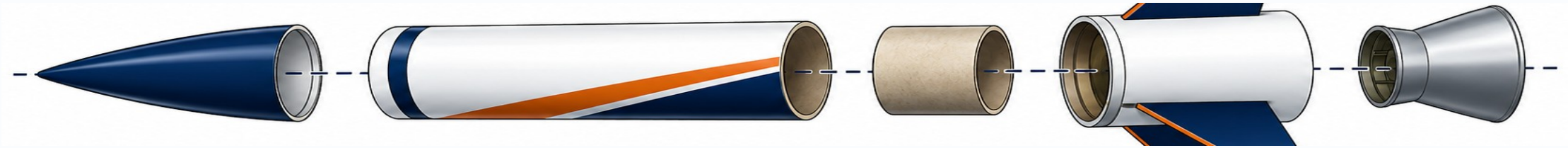
Lesson 1.18

Rocket Exploded View

Use these moves while you work

Key Moves

Move	What it means
Separate along axis	Move parts away from the assembly without changing orientation.
Show alignment	Keep parts visually lined up with where they fit.
Add labels	Use part names, callouts, or item numbers for clarity.



Lesson 1.18

Rocket Exploded View

What you should have by the end of the lesson

Evidence Checklist

- ☐ Create a rocket exploded view
- ☐ Keep parts aligned
- ☐ Label each part clearly
- ☐ Show assembly order if possible
- ☐ Connect view to BOM item names

End-of-Lesson Product

A rocket exploded view showing separated parts, alignment, and clear part labels.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.19

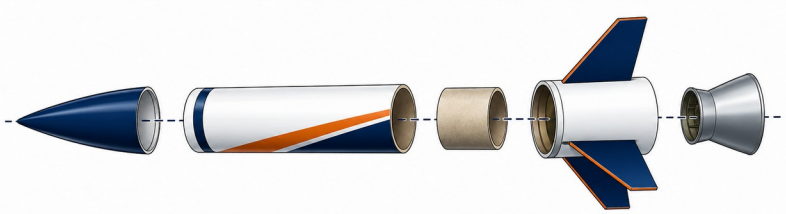
Rocket Bill of Materials

How do engineers keep track of every part needed to build an assembly?

Lesson 1.19

Rocket Bill of Materials

Connect today's work to your engineering notebook evidence.



Lesson 1.19

Rocket Bill of Materials

Big ideas you should understand before you start the work

Big Ideas

1

A Bill of Materials is a structured list of all parts in an assembly.

2

Quantities must match the actual number of parts used.

3

Notes can explain materials, connections, or special features.

Ask yourself: What would someone else understand from my sketch or documentation?

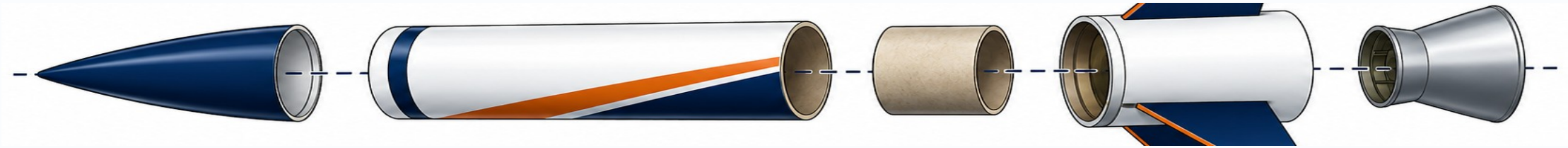
Lesson 1.19

Rocket Bill of Materials

Use these moves while you work

Key Moves

Move	What it means
Item number	Give each part a consistent number or name.
Quantity	Count repeated parts such as fins, rings, or fasteners accurately.
Notes	Record materials, fit type, or special assembly details.



Lesson 1.19

Rocket Bill of Materials

What you should have by the end of the lesson

Evidence Checklist

- ☐ List every rocket part
- ☐ Record quantity for each item
- ☐ Add material or fabrication notes
- ☐ Match item names to exploded view labels
- ☐ Check for missing repeated parts

End-of-Lesson Product

A complete rocket Bill of Materials that matches the exploded view and assembly notes.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.20

Rocket Assembly Notes

How do engineers write reassembly instructions that another team can follow?

Lesson 1.20

Rocket Assembly Notes

Connect today's work to your engineering notebook evidence.

Lesson 1.20

Rocket Assembly Notes

Big ideas you should understand before you start the work

Big Ideas

1

Assembly notes explain order, alignment, fit, and cautions.

2

Good instructions reduce mistakes during rebuilding.

3

Notes should include checks that confirm a step was done correctly.

Ask yourself: What would someone else understand from my sketch or documentation?

Lesson 1.20

Rocket Assembly Notes

Use these moves while you work

Key Moves

Move	What it means
Build order	Write the sequence from first part to final assembly.
Alignment checks	Explain how parts should line up before connecting.
Caution notes	Identify fragile parts, tight fits, or places where force should not be used.

Lesson 1.20

Rocket Assembly Notes

What you should have by the end of the lesson

Evidence Checklist

- ☐ Write a clear assembly sequence
- ☐ Include alignment instructions
- ☐ Describe connection methods
- ☐ Add at least one caution note
- ☐ Check if another team could follow the notes

End-of-Lesson Product

A set of rocket assembly notes that would allow another student to reassemble the rocket accurately.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.21

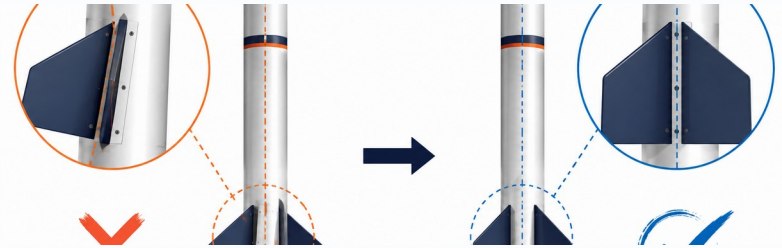
Engineering Change Requests

How do engineers document a proposed design change without losing control of the original design?

Lesson 1.21

Engineering Change Requests

Connect today's work to your engineering notebook evidence.



Lesson 1.21

Engineering Change Requests

Big ideas you should understand before you start the work

Big Ideas

1

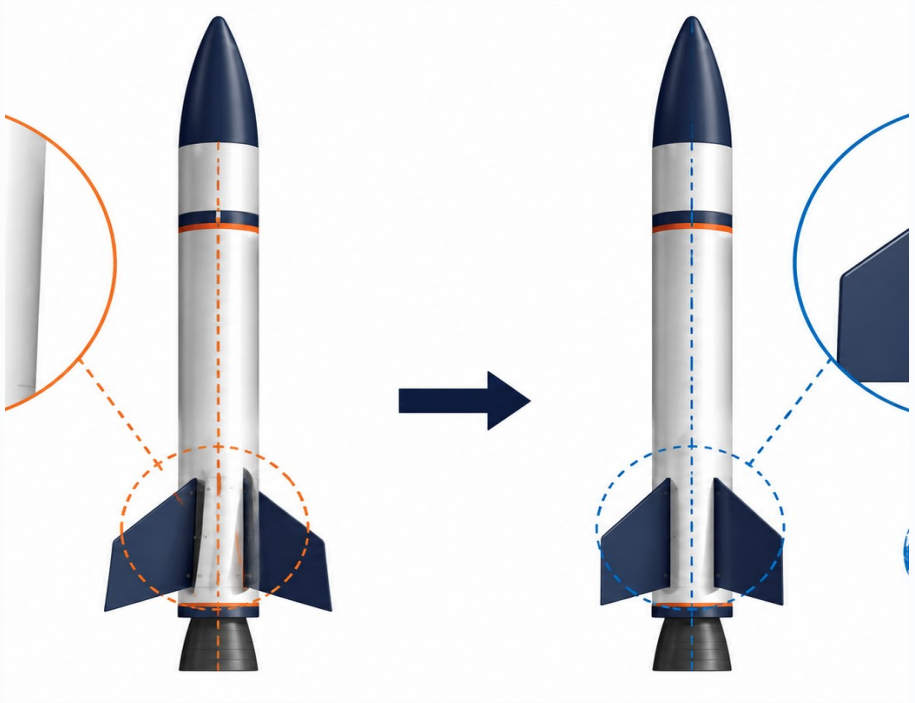
An Engineering Change Request records a proposed improvement.

2

The change should be supported by measurements, fit issues, documentation, or feedback.

3

A change affects parts, materials, assembly order, cost, or performance.



Ask yourself: What would someone else understand from my sketch or documentation?

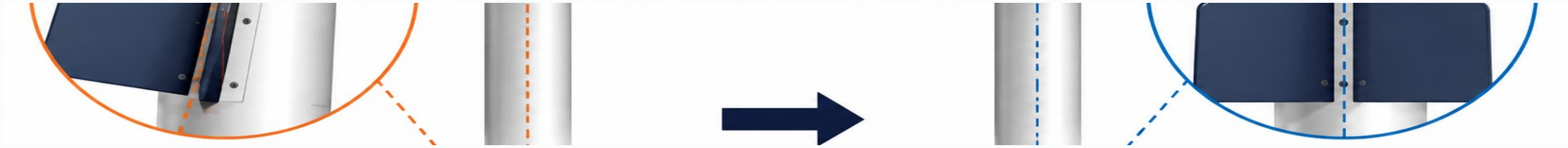
Lesson 1.21

Engineering Change Requests

Use these moves while you work

Key Moves

Move	What it means
State the problem	Describe what does not work as well as it should.
Use evidence	Support the change with sketches, measurements, tolerance data, or observations.
Explain impact	Identify what the change affects and what should improve.



Lesson 1.21

Engineering Change Requests

What you should have by the end of the lesson

Evidence Checklist

- ☐ Identify one rocket assembly improvement
- ☐ Use evidence to justify the change
- ☐ Describe the proposed revision
- ☐ Explain impact on parts or assembly
- ☐ Complete an ECR-style summary

End-of-Lesson Product

An Engineering Change Request proposing one rocket assembly improvement supported by evidence.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

Lesson 1.22

Final Rocket Assembly Proposal Presentation

How can a team justify a proposed rocket assembly improvement using engineering evidence?

Lesson 1.22

Final Rocket Assembly Proposal Presentation

Connect today's work to your engineering notebook evidence.

Lesson 1.22

Final Rocket Assembly Proposal Presentation

Big ideas you should understand before you start the work

Big Ideas

1

A design proposal should connect the original assembly, evidence, and recommended change.

2

Strong presentations explain both strengths and limitations.

3

Engineering communication should be clear, honest, and evidence-based.

Ask yourself: What would someone else understand from my sketch or documentation?

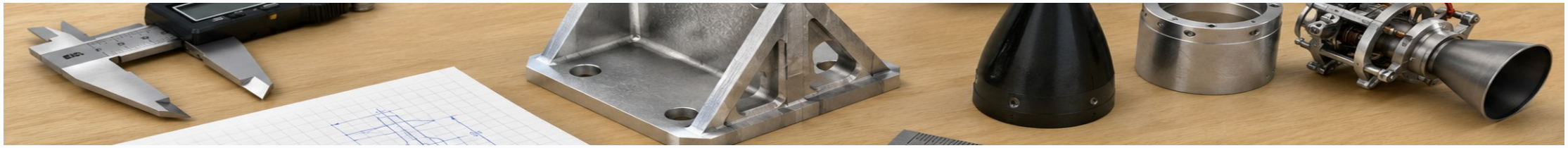
Lesson 1.22

Final Rocket Assembly Proposal Presentation

Use these moves while you work

Key Moves

Move	What it means
Explain the assembly	Describe the original rocket parts, fits, and function.
Show evidence	Use sketches, measurements, BOM, exploded view, and ECR evidence.
Make a recommendation	State the proposed improvement and why it matters.



Lesson 1.22

Final Rocket Assembly Proposal Presentation

What you should have by the end of the lesson

Evidence Checklist

- ☐ Organize the final documentation package
- ☐ Prepare evidence slides or talking points
- ☐ Include the proposed change
- ☐ Explain the expected benefit
- ☐ Practice a clear design conclusion

End-of-Lesson Product

A final rocket assembly improvement proposal supported by sketches, measurements, BOM, exploded view, assembly notes, and ECR evidence.

Ask yourself: Could another student understand what I did today without me explaining it out loud?

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Unit 1 Close

You now have the visual communication tools needed to sketch, measure, document, and propose improvements to aerospace assemblies.

Next: Unit 2 turns sketches and measurements into CAD m