SUPPORTING ADULT GUIDANCE

Analysing 2D and 3D Properties

2D and 3D Shapes. For any supporting adult — teacher, practitioner, parent or carer. **You do not need to be a mathematics specialist to support this lesson.**

What this lesson does

The learner describes 2D shapes and 3D solids by their properties — faces, edges and vertices — and discovers that a prism's structure is fixed by its base. The emphasis is on **seeing countable structure** that stays true however a shape is turned, not on naming shapes by sight.

Driving Question: *What stays true about a shape, however we turn or draw it?*

The mathematics, in plain terms

Three words describe any solid: a **face** is a flat surface; an **edge** is a straight line where two faces meet; a **vertex** is a corner where edges meet (more than one are *vertices*). A prism's structure follows from its base: a prism with an n-sided base has $n + 2$ faces (two bases and n rectangles), $3n$ edges and $2n$ vertices. For every prism, faces + vertices – edges = 2. Curved solids differ — a cylinder has two flat circular faces and a curved surface (which is *not* a flat face); a sphere has one curved surface, no edges and no vertices.

Counting what you cannot see

The commonest slip is counting only the faces, edges and vertices visible from the front. The single most useful habit is to turn the solid over in the mind — or to handle a real object — and count the hidden parts too. The second is to look for *structure* rather than to name by sight: once a learner sees that the base decides a prism's counts, they can predict for a shape they have never met, which is exactly the reasoning this unit is built on.

The shape of the lesson

Timings are invitations, not deadlines. A learner may need much longer on one phase and skim another — that is expected. Each Cornerstone is given an honest mathematical role here:

Cornerstone	Its role here	Invitational timing
Connection	The base of a prism decides its faces, edges and vertices — change the base and the whole structure changes with it.	~15 min
Movement	Sweeping a flat polygon through space to build a prism — the cross-section stays the same all the way along.	~8 min
Reflection	Being a shape detective: deducing a solid from a few well-chosen properties.	~10 min
Creativity	Designing a solid from a chosen set of faces, and inventing clues for it.	~5 min

Rest	A pause to notice which single property was most useful for telling two solids apart.	~4 min
Nutrition	Intellectual (Mode B): this lesson feeds spatial reasoning and the confidence that a property stays true however a shape is turned.	~3 min

Common misconceptions, and gentle repairs

These are the sticking points to expect. In every case, the aim is a question that returns the thinking to the learner — never to supply the answer.

Counting only the parts you can see

The learner forgets the hidden faces, edges and vertices. Repair: “Turn the solid over in your mind — have you counted the faces at the back and underneath too?”

Confusing edges and vertices

Or faces and edges. Repair: “An edge is a straight line; a vertex is a corner point. Point to one of each on this solid.”

Thinking properties change when a shape is turned

Repair: “If you tip the solid onto a different face, does it gain or lose any faces? What stays exactly the same?”

Counting a curved surface as a flat face

On a cylinder or cone. Repair: “A face has to be flat. Which surfaces here are flat, and which is curved?”

Treating every prism as brand new

Not using the pattern. Repair: “How many corners has the base? Each becomes two vertices — can you predict the total before counting?”

Protecting the support pathway

The lesson offers support in a deliberate order: **Socratic prompt** → **first try** → **hint** → **second try** → **worked solution**. The worked solution for each question stays locked until the learner has used the prompt, used the hint, and checked two answers. This is by design: the steps *are* the learning.

Please hold this line

Do not read the worked solution aloud, or talk a learner straight to the answer, while it is still locked. If they are stuck, use the Reconnection Routes, the prompt and the hint, or ask one of the repair questions above. Arriving at a correct line of reasoning — even slowly — is worth far more than being handed the result.

Reconnection Routes

If an earlier idea is blocking progress, the lesson’s Reconnection Routes offer short recaps of exactly the prerequisites this lesson needs: naming 2D shapes, right angles, and the faces of a solid. A learner can choose one independently, or you can invite one without requiring it. Using a route is part of learning, not evidence of falling behind, and it always returns the learner to their place.

Supporting through questions: an example

Keep the counting — and the hidden parts — with the learner:

- “Point to a face. Now an edge. Now a vertex.”
- “How many corners has the base? So how many vertices will the prism have?”
- “Have you counted the faces you cannot see from the front?”
- “Is any surface curved? Remember, a face has to be flat.”

If they stall, that is the moment for a Reconnection Route or the lesson’s prompt and hint — not for the answer.

Questions you might have

“They keep mixing up edges and vertices.”
Edge = a straight line where two faces meet; vertex = a corner point. Ask them to trace an edge with a finger and touch a vertex — the physical difference makes it stick.

“Do they need to memorise n + 2, 3n, 2n?”
Understanding *why* — the base decides everything — matters more than memorising. If they can predict the counts for a base they have not met, that is the goal.

“Their count is different from mine — who is right?”
Recount together, including the faces and edges hidden at the back and underneath. Miscounting the parts you cannot see is by far the most common cause.

Keeping things regulated and calm

- Keep to one clear step at a time; there is no time pressure and no benefit to speed.
- Treat a wrong or unfinished answer as information for the next step, never as failure.
- Let the learner choose how to record — typed, written, drawn, spoken or annotated.
- If frustration rises, it is fine to pause and return later; the lesson holds their place.
- Avoid any language about age, school year or pace as a judgement of ability.

Recognising progress

Progress is described as Approaching Proficiency → Developing Proficiency → Proficiency → Refining Proficiency across understanding, application, communication and reflection. These describe where a learner is right now, not labels of what they are. Real understanding shown in part is still real understanding, even while other pieces are still settling.

Where they are	What it can look like
Approaching Proficiency	Beginning to engage; names some features and makes a start with support.
Developing Proficiency	Carries out the method with prompts; can explain part of the reasoning.

Proficiency	Works through independently and explains why each step is true.
Refining Proficiency	Applies the idea confidently to a new or unfamiliar case, and could teach it to someone else.

A note on evidence

Evidence can be captured in whatever form suits the learner — a photo of working, a short spoken explanation, an annotated Scratchpad image, or a written solution. There is no single required format. Incomplete work is information for the next connection, never a failure: it tells you exactly where to begin next time. The aim is a true record of the learner's thinking, not a tidy performance.

If a learner is stuck or distressed

Slow the pace and reduce the load: return to one concrete, familiar case and a single small question. Offer a Reconnection Route. Remind them they can pause and come back. A short, successful, low-stakes step rebuilds confidence more reliably than pushing through. Connection before curriculum — always.

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