

## Distance and midpoints (3D) - AI/AA SL 3.1

### Intuition Pump for Understanding Distance and Midpoints in 3D:

1. Treasure Hunt Analogy: Imagine a treasure buried inside a cubic block of soil. To locate the treasure, you're given its coordinates relative to the corners of the block. These coordinates help you dig straight down to the treasure, similar to finding a point in 3D space.

2. The 3D Grid: Visualize the room you're in as a large 3D grid. Each corner is a point in space with coordinates  $(x, y, z)$ . The distance between any two corners can be found using the 3D distance formula.

3. Building Blocks: Use building blocks or LEGO to create a simple structure. Identify two blocks and their positions in the 'grid'. Measure the '3D distance' between them with a string or a ruler, introducing the concept of the distance formula in 3D.

4. Midpoint in Real Space: If you have two objects in a room, the midpoint is where you'd stand to be equally close to both. Physically measuring and marking this spot helps solidify the concept of a midpoint between two points in 3D space.

5. 3D Distance Formula: Explain that just like in 2D, where you use Pythagoras' theorem for distance, in 3D, you add another dimension. The formula is an extension:

$$\sqrt{\{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2\}}.$$

6. Midpoint Formula Extension: Just like finding the middle of a line segment in 2D by averaging the x's and y's, for 3D you also average the z's. The midpoint formula becomes  $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}, \frac{z_1 + z_2}{2}\right)$ .

7. Interactive 3D Modeling Software: Use software where students can input coordinates and see the points, the line between them, and the midpoint. This provides a visual representation of the concepts and the ability to manipulate them in a virtual environment.

8. Applying to Astronomy: Relate the concept to how astronomers find the distance between stars and the midpoint of celestial objects, applying it to a larger, more awe-inspiring