Is it a plane?

Teacher notes

Why use this resource?

This resource about vectors is an ideal way to get students engaged with how a plane is defined in vector terms and what pitfalls may arise. This could be used as reinforcement after looking at planes or could be used as a way of introducing ways of defining a plane with vectors.

It should be noted that the words used (book, library, stack) to describe different situations are intended to aid visualisation and communication and may not be standard terminology.

Preparation

Sets of cards may be prepared (or tablets/devices for students to access the interactive version).

Possible approach

This activity could take a very active form which we call “vector aerobics” – good ventilation is advised!

Show the card set on the board and ask students to think individually about how these things might define planes. Explain that arm waving is fine! Check everyone understands the distinction between a point, a vector in the plane (simply called a *vector* on the cards) and a vector perpendicular to the plane (called a *normal vector* on the cards).

Distribute the cards and invite students to work in small groups to try to sort them into groups. They can define their own classifications. They are aiming in the longer term to decide which cards define a unique plane and which do not. They might further find ways of sub-dividing the ones that do not define a unique plane. Encourage students to use their arms (or fingers and hands for the less extrovert) to represent vectors and planes. They could be out of their seats doing this.

For a slightly shorter activity that doesn’t explore quite so many options, you could use just the eight cards A, B, D, F, G, H, I and L.

Key questions

- How many ways can you specify a plane in three dimensions?
- Is this vector at a fixed position in space?
- How can you fix this plane in three dimensions?
- If a card does not represent a unique plane what might be going on?
- What extra information would be needed to define a unique plane?

Possible support

More tentative students might need encouragement to get physically involved: using their bodies to represent vectors and planes can help with visualisation. Ask them to represent two parallel vectors with their arms; two non-parallel vectors; a plane. Check that they understand that vectors are free to move in space.

- Thinking about cards A, F and G: do each of these cards define a unique plane? (Can we represent them with our arms to convince ourselves?)
- Can we find similar cards – what is the same, what is different? How can we decide if these represent unique planes?
- Thinking about cards I, J, K and L: if we know a vector which is *normal* to the plane then where is the plane? Is it fixed? What will fix it?
- What is the difference between a pair of points and a vector?

Possible extension

- Can you change one aspect of E and/or K to make them define … a family of planes? … a unique plane?
- Can you change one thing to make A, F, G, I and J into families of planes?
- Can you change one thing to make B, C, D, H and L into unique planes?
- Make some cards of your own for another group to try.