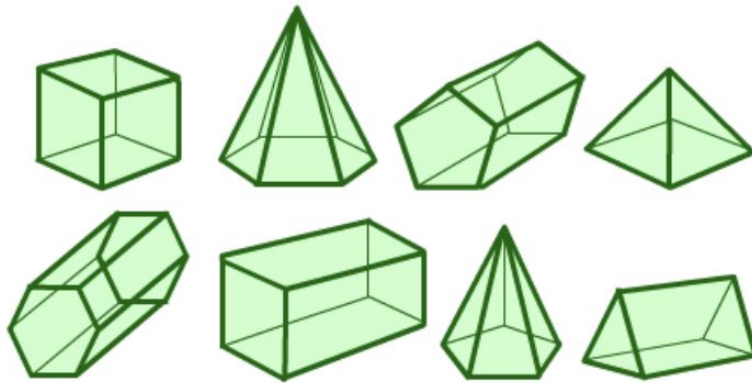


POLYHEDRA INVESTIGATION









Can you arrange the shapes below in a chain so that each one shares a face (or faces) that are the same shape as the one that follows it? (The faces do not have to be the same size.)











How many ways can you find to make a loop (a closed chain) using all the shapes so that each one shares a face (or faces) that are the same shape as the one that follows it?

STRATEGY

1. Arrange the polyhedra shapes into a table and assign a number to represent them in the table we will use to list possible combinations.








	1	2	3	4	5	6	7	8
polyhedra								
	cube	square-based pyramid	hexagonal-based pyramid	pentagonal-based pyramid	triangular prism	hexagonal prism	pentagonal prism	cuboid

2. Determine the faces of each shape to easily identify which shapes will fit into another one.

	1	2	3	4	5	6	7	8
polyhedra								
shape face	square	square triangle	triangle hexagon	triangle pentagon	triangle rectangle	hexagon rectangle	pentagon rectangle	square rectangle

3. Plot possible shape combinations using the face shapes of the polyhedra.

- Cube is the only polyhedra with one face type - we will set this as shape 1
It can only connect either to square-based pyramid or cuboid
- Set the square-based pyramid as shape 2 and determine which shape faces can fit into its triangle face.
- From the shape face table below, we can see that the triangle face of shape 2 can fit either hexagon-based pyramid (shape 3), pentagon-based pyramid (shape 4) or triangular prism (shape 5) because they all have triangular faces.
- Note that the 7th shape in the table can only either be triangular prism (shape 5), hexagon prism (shape 6) or pentagon prism (shape 7) for them to connect to the 8th shape in the combination.
- To complete the loop, we set cuboid as the last shape as it is the only remaining square face that can connect to the cube.

	1	2	3	4	5	6	7	8
								
polyhedra	cube	square-based pyramid	hexagon-based pyramid	pentagon-based pyramid	triangular prism	hexagon prism	pentagonal prism	cuboid
shape face	square	square triangle	triangle hexagon	triangle pentagon	triangle rectangle	hexagon rectangle	pentagon rectangle	square rectangle

							LOOP?	CANT CONNECT		
1	2	3	4	5	6	7	YES			
				7	7	6	YES			
				7	5	6	YES			
			5	4	6	7	6	5	YES	
				6	7	6	7	6	YES	
				7	X	X	no	6,7		
				7	7	X	no	4		
				7	X	X	no	4,7		
				7	6	X	no	4		
			6	5	4	7	4	7	YES	
				7	7	4	4	4	no	4 can connect to 7 but not 8
				7	4	5	YES			
		7		5	X	no	4			
		7		6	7	YES				
		7		7	6	YES				
		4	5	3	5	6	7	YES		
					6	7	6	YES		
				6	5	7	6	7	YES	
			7	3	6	7	5	7	YES	
				5	6	7	5	6	YES	
				6	7	6	7	5	YES	
				7	6	7	6	7	YES	
				7	X	X	no	7,6		
				7	7	X	no	3		
			7	5	3	6	7	X	no	7
				6	6	6	X	X	no	3
				7	X	X	no	3,6		
		7		5	3	6	6	YES		
		7		6	X	no	3 can connect to 6 but not 8			
		7		3	5	YES				
		5	3	4	4	7	6	YES		
					6	X	X	no	6,7	
				6	7	X	no	4		
			4	3	6	X	X	no	4,7	
				4	3	6	7	7	YES	
				7	X	X	no	7,6		
				7	X	X	no	3,6		
				7	6	X	no	3		
				7	4	7	YES			
			6	3	3	X	X	no	3,7	
					7	X	X	no	3,4	
				7	X	X	no	4,3		
		7	4	3	6	6	YES			
		7	X	X	no	4,6				

ANSWERS:

Based on the polyhedra order table above, we can see that there are 18 possible combinations.

	1	2	3	4	5	6	7	8
1	cube	square-based pyramid	hexagonal-based pyramid	pentagonal-based pyramid	triangular prism	hexagonal prism	pentagonal prism	cuboid
2	cube	square-based pyramid	hexagonal-based pyramid	pentagonal-based pyramid	triangular prism	pentagonal prism	hexagonal prism	cuboid
3	cube	square-based pyramid	hexagonal-based pyramid	pentagonal-based pyramid	pentagonal prism	triangular prism	hexagonal prism	cuboid
4	cube	square-based pyramid	hexagonal-based pyramid	pentagonal-based pyramid	pentagonal prism	hexagonal prism	triangular prism	cuboid
5	cube	square-based pyramid	hexagonal-based pyramid	triangular prism	pentagonal-based pyramid	pentagonal prism	hexagonal prism	cuboid
6	cube	square-based pyramid	hexagonal-based pyramid	hexagonal prism	pentagonal prism	pentagonal-based pyramid	triangular prism	cuboid
7	cube	square-based pyramid	hexagonal-based pyramid	hexagonal prism	triangular prism	pentagonal-based pyramid	pentagonal prism	cuboid
8	cube	square-based pyramid	pentagonal-based pyramid	hexagonal-based pyramid	triangular prism	hexagonal prism	pentagonal prism	cuboid
9	cube	square-based pyramid	pentagonal-based pyramid	hexagonal-based pyramid	triangular prism	pentagonal prism	hexagonal prism	cuboid
10	cube	square-based pyramid	pentagonal-based pyramid	hexagonal-based pyramid	hexagonal prism	triangular prism	pentagonal prism	cuboid
11	cube	square-based pyramid	pentagonal-based pyramid	hexagonal-based pyramid	hexagonal prism	pentagonal prism	triangular prism	cuboid
12	cube	square-based pyramid	pentagonal-based pyramid	triangular prism	hexagonal-based pyramid	hexagonal prism	pentagonal prism	cuboid
13	cube	square-based pyramid	pentagonal-based pyramid	pentagonal prism	triangular prism	hexagonal-based pyramid	hexagonal prism	cuboid
14	cube	square-based pyramid	pentagonal-based pyramid	pentagonal prism	hexagonal prism	hexagonal-based pyramid	triangular prism	cuboid
15	cube	square-based pyramid	triangular prism	hexagonal-based pyramid	pentagonal-based pyramid	pentagonal prism	hexagonal prism	cuboid
16	cube	square-based pyramid	triangular prism	pentagonal-based pyramid	hexagonal-based pyramid	hexagonal prism	pentagonal prism	cuboid
17	cube	square-based pyramid	triangular prism	hexagonal prism	hexagonal-based pyramid	pentagonal-based pyramid	pentagonal prism	cuboid
18	cube	square-based pyramid	triangular prism	pentagonal prism	pentagonal-based pyramid	hexagonal-based pyramid	hexagonal prism	cuboid