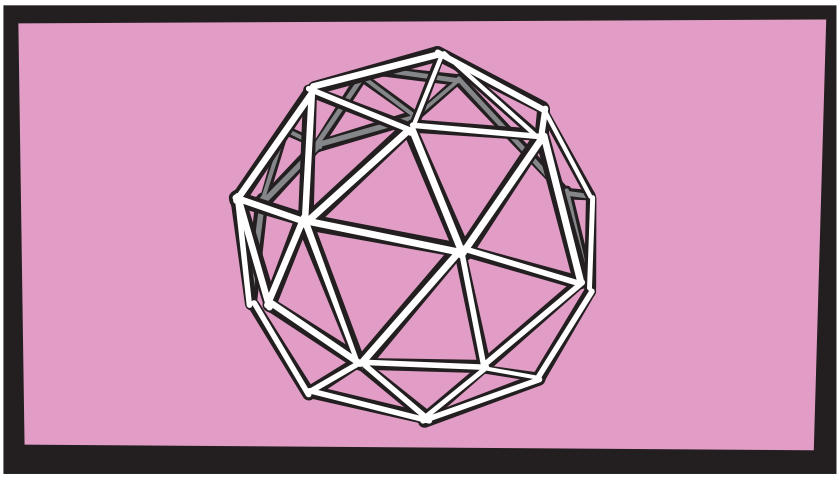
tiny tinkering tasks

Task theme

Structural Engineering Building a Geodesic Dome



Task title

Which shapes make the strongest structures?

Learning outcomes

- To explore the relationship between triangles and other 2D shapes.
- To understand why triangles are fundamental to the way we build our environments.
- To work as a team.

EHoM link

SYSTEMS THINKING

Construct an object or tool requiring the successful interaction between components and subsystems (SEERIH)

EDP link

CREATE

Key Stage/Year Group

UKS2

Resources required

To make an 80cm diameter Geodesic Dome the following resources are required: -

NB: this will allow a class of 30 children to work together to complete one dome. Each child can make both a short and long tube with the teacher making the remaining 5 long tubes, possibly as part of a demonstration process.

- 65 sheets of A4 paper – ideally two colours should be used – 30 sheets for the short (A) tubes and 35 sheets for the longer (B) tubes.
- 15 x 6mm wooden dowel rods approximately 50 cm in length for children to roll the paper around.
- Sellotape – ideally with a dispenser for each pair of children.
- Heavy duty one-hole punch – to be used by the teacher https://www.amazon.co.uk/gp/product/B07NQFSKP6/ref=ppx_yo_dt_b_asin_title_o05_s00?ie=UTF8&psc=1
- Box of paper fasteners
- A protractor
- Felt tip or white board pen for each pair.
- Scissors

How to run the task

1. Engage the children by asking them to draw some regular pentagons using a ruler and a protractor and measuring interior angles of 108°. For guidance you could watch a video on YouTube such as: HTTPS://YOUTU.BE/NNGCJCBOK-G
2. Elicit their understanding by revisiting the properties of regular pentagons (5 equal sides and angles – derived from the Greek πέντε pente and γωνία gonia, meaning five and angle) Ask the children to check their partner's pentagons to see if they meet these criteria by measuring the sides.
3. Explore the pentagon further by asking the children to choose one of their pentagons and split it into triangles. How many triangles are they made up of? What kind of triangles are they?

4. Explain that they are now going to work as a team to create their own sets of pentagons which they will then join together to make a dome shape.

MAKING THE PENTAGONS

5. Elaborate – the children will now use knowledge of the structure of pentagons to make a 3D model. First give each child two pieces of A4 paper (one of each colour) and a wooden dowel rod. Demonstrate how to roll the paper tightly around the rod to create a tube. This should be done diagonally to maximise the length created.
   Positioning the rod across the diagonal and then moving back to the corner before rolling will generate the smoothest tube. This can be done in pairs with one child rolling the paper and the other sticking a piece of Sellotape around the centre of the paper tube to secure.

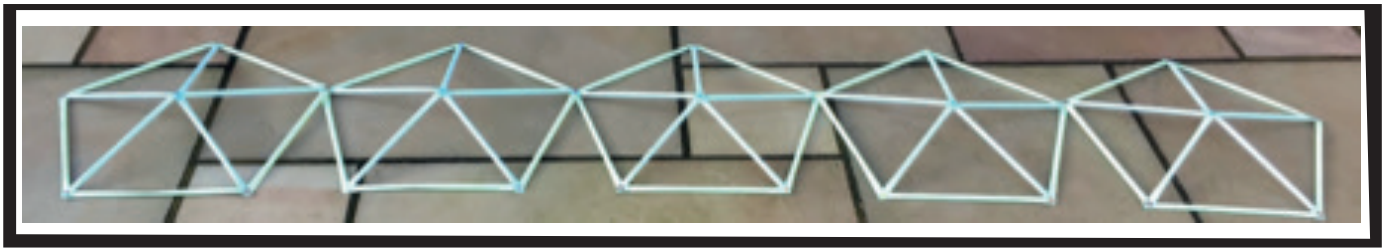
6. Decide which colour is going to be A (short) and B (long). Ask the children to find the middle of the strip (approximately) and draw a small pencil mark for reference. They should then use a ruler to measure 11cm either side of the mark, placing a dot with the felt tip. This will create an overall distance of 22cm and ensure that the tube is equally strong at both ends.
7. Do the same with strip B, this time measuring 12.5cm from the centre. This will create an overall distance of 25cm.
8. Instruct the children to carefully wind some Sellotape around each dot to strengthen the paper. Using the dots as a guide, a hole should be made with the punch at both ends of all the pieces of paper. This could be done by the teacher.
9. Once the holes have been punched the children can trim the ends of tubes making sure that they leave about 0.5cm of paper past the holes; otherwise the structure is likely to tear.

10. To assemble the pentagons themselves you will need 5 short (A) tubes joined at the centre and 5 long (B) tubes around the perimeter. The children will need to work in groups of 5 combining their pieces. Care should be taken when placing the paper fasteners through the holes. The children should be encouraged to maintain consistency by joining the tubes together in the same order – i.e. keeping the short tubes on top. You should end up with 6 pentagons, which are all identical in shape. You can check this by placing them on top of each other.

EXTEND - CONSTRUCTING THE GEODESIC DOME

Once the pentagons have been completed, the dome can be constructed. This will need adult help as it can be quite fiddly.

11. Ask a representative from each group to bring out their pentagon to the front of the class. You will need enough space to be able to lay all the pentagons out in a line.
12. Arrange five of the pentagons in a line, as shown, making sure that the bottom of the pentagons forms a straight line.



13. Join these pentagons together by taking out and reinserting the adjoining split pins. This will form the wall of the dome.
14. Form the 5 joined pentagons into a circular shape and attach the sixth pentagon to the top to make the 'roof'.
15. Finally, use the remaining 5 long (B) tubes to link the base of the pentagon wall together in a continuous 'ring' creating a stable base for the now completed Geodesic Dome.

Top Tips

A 1 metre diameter Geodesic Dome is formed of 6 pentagon shapes joined together, with each pentagon constructed from:

• 5 short (A) tubes joined in the centre

• 5 long (B) tubes around the perimeter of the pentagon

To make the final dome a further 5 long (B) tubes are needed to link the base of the dome together, bringing the total number of tubes to 65.

• 30 short (A) tubes

• 35 long (B) tubes

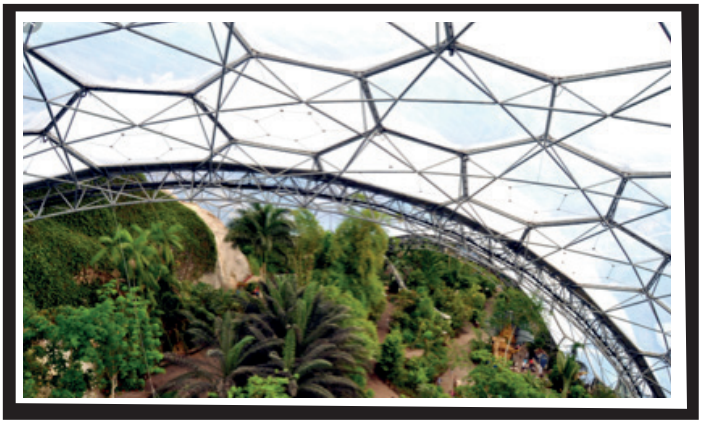
For an 80cm diameter dome: (A) tube = 22cm and (B) tube = 25cm - this size is probably more manageable for the children and fits within the 30cm ruler

For a 1 metre diameter dome: (A) tube = 27cm and (B) tube = 31cm

In simple terms the length of A is 88% the length of B (rounded). To make a smaller or larger dome, just apply this ratio to your different lengths. The diameter of the finished dome will be approximately 3.7 times the length of A.

Evaluate learning

- Once the dome has been successfully constructed, as the children to take a closer look and see if how many different 2D shapes they can identify – they should be able to see triangles, hexagons and pentagons. Are all the triangles the same? Are the hexagons regular?
- Why do you think that triangles are such a strong shape? They are very rigid and cannot be easily deformed when subjected to force: https://www.youtube.com/watch?v=AoS0UvVfxRQ
- Can you think of any uses for your geodesic dome? What other materials could you make it out of? How could you make it waterproof? Show pictures of biodomes at the Eden Project.



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As a practising teacher, Julie has written these 12 tasks to encourage more children to engage in engineering in primary schools. They have been stimulated by real-world engineering and inspirational ideas shared by others. They are linked to the Tinkering for Learning research and development project run by SEERIH.

Find out more about the
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