Growing food : Building silos

Description

This activity draws on the geometry of silos, structures commonly found on local farms. A specification from a manufacturer based in Yorkshire and the Humber forms the basis of the scale model making.

Resources

Scissors, soft drink bottles and other materials for fabricating the structure, glue or adhesive tape, modelling straws or other materials for silo support structure.

Activity 1: Making a model

Making a model is a rich task which offers pupils the opportunity to develop their personal learning and thinking skills. The teacher can adapt the amount of support offered to pupils to suit the needs of individuals or small groups. It is likely to extend over two or three periods. Expanding capacity is available as an extension.

To set the context, pupils could be shown a picture of the silo and questioned about it: What is this? Where have you seen such structures? What materials do you think are stored in the containers? What materials is the structure made from? Why? What mathematical shapes are used in the structure? Why? Do they come in different shapes? Why?

You may wish to give the pupils some time to research answers to these questions using the internet and have a show and tell session where pupils share their findings.

Pupils are challenged to make a scale model of the silo using recycled materials such as an empty drink bottle(s) and other things that would normally be discarded. Using recycled materials means that there will be a range of different size models being constructed. This provides a rich opportunity for working with and thinking about scale measures. Start with a discussion about what a scale model is and why they are used by engineers and designers. Emphasize the importance of making all measurements to scale.

Photo: Peter Smith Associates

One possible approach would be to get the pupils to work in small groups and produce a list of items which could be used to make the model. You could ask them to put together a rough plan or set of instructions for making the model giving consideration to the challenges they face such as : **keeping to scale**, *where to get the items from, how to join the items, division of labour. Alternatively, prior to the lesson, you could ask them to bring in some empty plastic bottles, yoghourt pots and so on and then allow them to choose from the materials supplied.*

If you decide to use a competition format then give the pupils a brief. For example :

- All items must be recycled.
- They will need to state the scale they have used and provide evidence of calculations.
- All components should be to scale, within reason.
- Everyone within the team should be able to explain how the model was made.

Follow the building stage by asking each group to prepare a presentation about their project, detailing what mathematics they have used, what problems they encountered and how those problems were overcome.

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The task can be extended by posing the problem of how to change the silo so that it can hold a further 5m³ of grain. Expect a range of solutions and ask your pupils to justify their choice. Then explain that the manufacturer's solution is to insert extra rings between the top section and the base section. A further extension is to work out the dimensions of a suitable ring for the manufacturer's silo.

Image courtesy: EB Equipment Ltd

At this point there are a number of possible approaches: *The pupils could use trial and improvement to find the height which gives a 5m³ volume to the ring. They could use a spreadsheet to help with the calculations and decide on a reasonable level of accuracy for their solution which they can justify. Alternatively the trials could be graphed and the graph used to find an approximate solution. Pupils who have appropriate algebra skills could rearrange the standard formula and solve for V = 5.*

You may wish to compare approaches to solving the problem and discuss the merits of the different methods. How could pupils check their answers to see if they are sensible?

As an extension you could ask the pupils to work out the volume of the cone.

The mathematics

Scale and ratio, volume of a cylinder, measurement conversions, graphs, substitution into formulae.


Photo: Peter Smith Associates