Problem solving using cubes, tri-cubes and sphinx tiles

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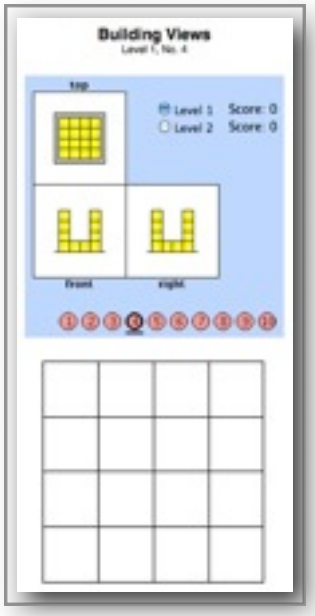
Explore a range of interesting problems that relate surface area, volume, symmetry and algebra. We will make use of some interesting applets created by the Freudenthal Institute in the Netherlands, which give further options to develop problems back in the classroom. (Year 7-10)

Geometrical arrangements of cubes, tri-cubes and sphinx tiles, coupled with the use of computer applets offer rich opportunities for developing algebraic thinking when area, perimeter, volume and/or surface area are considered. Asking questions where more than one right answers is possible allows the notion of 'mathematical elegance' to be explored.

Usage of ICT tools (interactive applets, spreadsheets, dynamic geometry and programming environments such as Scratch) allows students to challenge the robustness and provide evidence of their mathematical thinking in different domains. Each of the tasks below have a well documented version of a lesson available on a subscription basis from Maths 300, accessible on the web from: http://www.maths300.esa.edu.au.

Building Views

The task of Building Views challenges students to use 2 cm wooden cubes and 2 cm multi-link cubes to build a model that is consistent with the orthogonal views (top, front and side views) offered. Isometric dot paper can be used for students to make drawings of their .



20 tasks cards are available for download from:
http://maths-no-fear.wikispaces.com/rekenweb.
The task cards were developed from the interactive **Building Houses with Side Views** applet available from the Freudenthal Institute's repository of Maths resources available at: http://www.fi.uu.nl/rekenweb/en. Each problem may have more than one right answer.

Challenge students to take away or add cubes, while still maintaining the top, front and right views.

Invite students to find solutions using:

- the minimum number of cubes,
- the maximum number of cubes, and
- to record the number of variations in between.

Students can use the isometric dot paper included to draw their solution using the minimum number of cubes.

Students can successfully create isometric drawings if they start with one top face. Looking at a top face on their model from an angle makes is appear like a rhombus (students will often say 'diamond').

The next key step is to draw the vertical lines, making sure that the length on the drawing matches what can be observed on the model made from cubes.

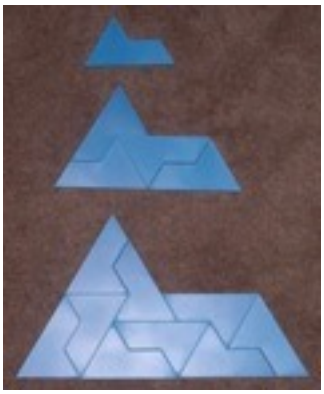
Sphinx tiles

Sphinx tiles offer a wide range of mathematical investigations, especially in the arena of symmetry of algebraic thinking in relation to perimeter and area.

Arrange two sphinx tiles so that their edges are make contact along a full side of the same length gives rise to two questions:

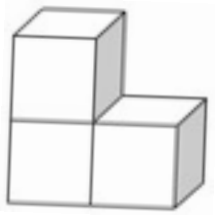
- How many solutions exist?
- How could I convince you I have found them all?

Once all possibilities are accounted for, arrangements can be sorted according to type of symmetry or perimeter. Tasks of this type can be adapted as a sorting tasks (image of sphinx arrangements on cards) with velcro tabs on a carpeted wall or as an IWB file.



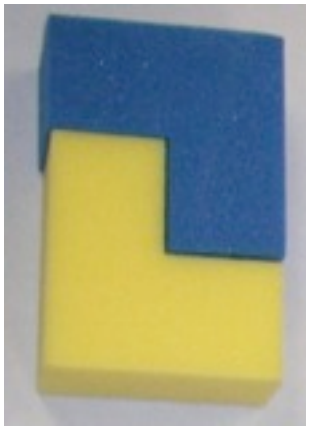
Arranging four sphinx tiles to make a larger sphinx shape challenges many students, but also provides a springboard into exploring what happens to perimeter as further 'self-similar' shapes are generated.

Tri-cubes



Like the name implies, tri-cubes are 3 cube arranged in an L-shape. They can be easily made from 2 cm wooden cubes glued together with PVA glue, dyed with food colouring and stored in zip-lock plastic bags.

A task related to the sphinx tiles can be asked with tri-cubes using similar mathematical structures, but introducing surface area rather than perimeter.



How many arrangements of two tri-cubes can be made where a full face is shared? Arrangements can be drawn on isometric dot paper.

Asking "*What do you think my next question is going to be?*" of students runs a common thread between tasks, and offers feedback to the teacher that students are aware of the 'meta-structure' of a teacher's questioning.

Arranging four tri-cubes to make a larger tri-cube mirrors a challenge related to the self-similar shapes of the sphinx tiles, providing a springboard into relating the surface area of each arrangement.

Building Views

Level 1, No. 5