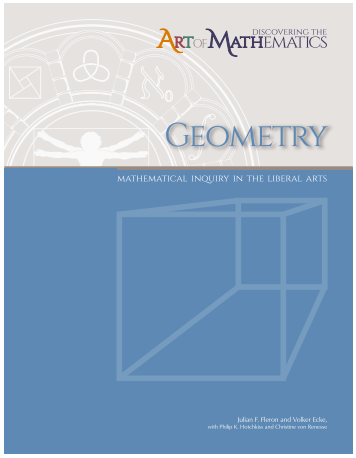
The following is excerpted from:

Discovering the Art of Mathematics: Geometry



By Julian F. Fleron and Volker Ecke, with Philip K. Hotchkiss and Christine von Renesse

As with all of our learning guides, this book is freely available online at

`http://www.artofmathematics.org/books/`

Discovering the Art of Mathematics (DAoM) is an NSF supported project that supports inquiry-based learning (IBL) approaches for mathematics for liberal arts (MLA) courses.

The DAoM curriculum consists of a library of 11 inquiry-based learning guides. Each volume is built around deep mathematical topics and provides materials which can be used as content for a semester-long, themed course. These materials replace the typical lecture dynamic by being built on inquiry-based investigations, tasks, experiments, constructions, data collection and discussions.

DAoM also provides a wealth of resources for mathematics faculty to help transform their courses. Extensive online resources include volume specific teacher notes and sample solutions, classroom videos of IBL in action, sample student work, regular blogs about teaching using IBL and a regular newsletter. Opportunities for supported reviewing and beta testing are also available.

For departments interested in IBL, DAoM offers traveling professional development workshops.

Full information about the *Discovering the Art of Mathematics* project is available at

`http://www.artofmathematics.org`

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Use the excerpt below to explore for yourself how our materials can engage students in mathematical inquiry.

The Flatland Game

Sphere's visit to A Square in Flatland began a journey of enlightenment. We would like to put ourself in A Square's position and see how we can be enlightened. We'll do so via the **Flatland game**.

> **Flatland Game Goal** Determine the identity of a solid object from a series of parallel cross sections taken at regular intervals.

1. Can you guess what secret solid makes the cross sections shown in the first series of clues in Figure 1 as it passes through Flatland? If so, explain what the solid is and how you know its identity. If not, describe what you can ascertain about the solid from its cross sections.
2. Can you guess what secret solid makes the cross sections shown in the second series of clues in Figure 1 as it passes through Flatland? If so, explain what the solid is and how you know its identity. If not, describe what you can ascertain about the solid from its cross sections.
3. Can you guess what secret solid makes the cross sections shown in the third series of clues in Figure 1 as it passes through Flatland? If so, explain what the solid is and how you know its identity. If not, describe what you can ascertain about the solid from its cross sections.

Determining what a solid is from a sequence of clues is the *inverse problem* of finding the cross sections of a solid. Both are important problems. The Flatland game will give you practice with both - allowing you to move from Spaceland to Flatland and back.

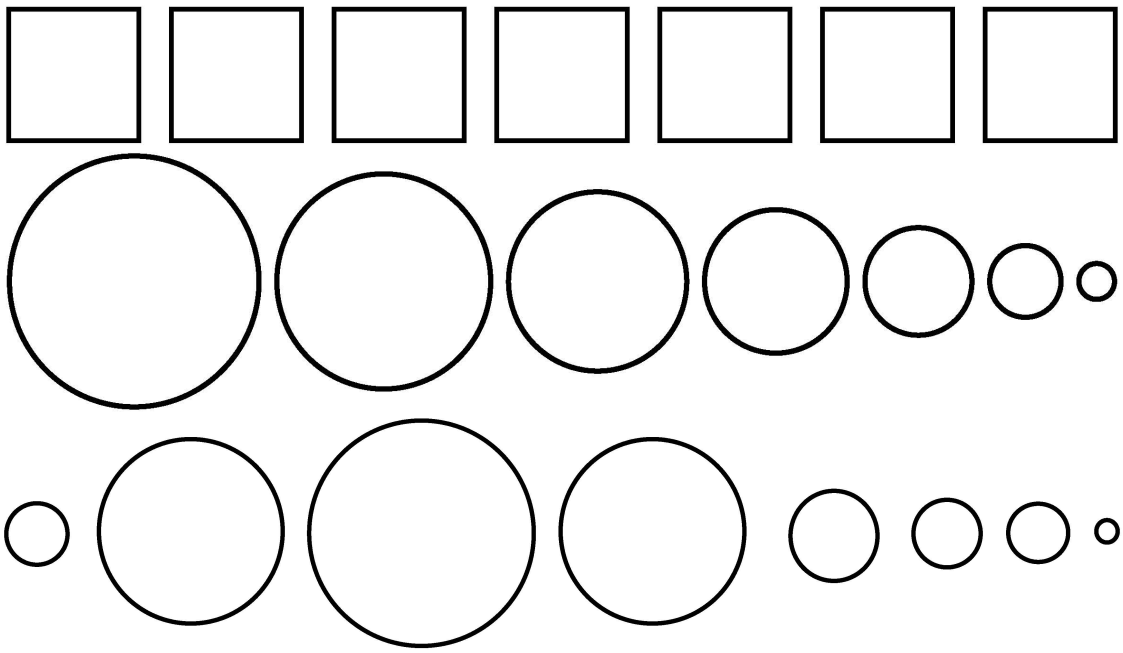

Figure 1: Three sets of clues for Flatland Games.

Rules and Roles for the Flatland Game

1. Choose a team of **radiographers**. This can be a single person or a small team where an illustrator has been elected.
2. Choose teams of **builders**. Teams can consist of a single person if necessary; it is best if a few small teams compete.
3. The game starts with the radiographers secretly determining a solid object from Spaceland whose identity will be the focus of the game.
4. The illustrator for the radiographers then begins play by drawing a single cross section, as viewed from above, of the secret solid.
5. The builders attempt to guess the identity of secret solid.
6. The illustrator for the radiographers then draws another cross section of the secret solid. This cross section must be parallel to earlier cross sections and the cross sections must be revealed consecutively as they would if the object actually passed through Flatland.
7. Steps 5 and 6 are repeated until:
   - **a.** a team of builders correctly guesses the identity of the secret solid, in which case they are declared the winner, or,
   - **b.** there are no more cross sections to draw and the radiographers are declared the winner.

4. Play the Flatland game. Draw the clues in your notebook and describe how the game went, noting any interesting geometrical issues that arose.
5. Play the Flatland game again with the same teams, recording the clues and any observations in your notebook.
6. Now switch roles. Let one of the teams of builders become the radiologists. Play two more games, recording the clues and any observations in your notebook.
7. Play a few more Flatland games, letting each team have a chance to be the radiographers. Each time record the clues and any observations you have in your notebook.
8. Compare your roles as radiographer and builder. Were there similar skills you needed? Were there similar challenges? In which did you learn the most about geometry?
9. Hopefully the radiographers weren't too tough. Name some objects whose identity would be really, really hard to determine in the Flatland game. Explain why they would be so hard.