

# *Flatland*

## Lesson Plans

### High School Math, Science, & Language Arts

Based on the 1884 novel, *Flatland*, by Edwin A. Abbott

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#### Introduction

One hundred and twenty four years ago the headmaster of the City of London School, Edwin Abbott, crafted a small masterpiece called *Flatland*. Viewed at the time as a satirical look at Victorian society, values, and self imposed limitation, the book introduced the reading public to the geometry of higher dimensions decades before Einstein wowed the world with his theories.

In addition to his career as an educator and administrator, Abbott wrote forty-five books reflecting his wide-ranging interests – from a primer on home schooling to theology, from explorations of illusion and miracles, to this, his only book on mathematics.

Aware of the Victorian era development of dimensional analogy through the work of Gustave Fechner, Hermann von Helmholtz, and Bernard Reimann, and inspired by his own discussions and letters with mathematicians Charles Howard Hinton and Howard Candler, Abbott devised a tale that brilliantly brought the unfathomable to a layman's understanding, and challenged society's assumptions about space and time. The power of this little book has never diminished and today, mathematicians and physicists everywhere still rank *Flatland* among their life-long favorites.

# Twenty years before Einstein

## Standards:

The reading of *Flatland* allows students the opportunity to extend beyond the material usually expected and to study mathematical concepts through literature. In so doing, it allows students to see the correlations in learning between mathematics and literature ([Geometry Using Literature](#))– analytical thinking, understanding rules of evidence, identifying and solving problems, posing questions, constructing relationships, and communicating and supporting results.

Standards: [CLE 3102.1.6](#); [CLE 3103.1.6](#); [CLE 3108.1.6](#).

## Lesson Plan I Exploring Flatland and Beyond

### Objectives:

As a result of this lesson, students will

- Understand the role of satire
- Recognize the satirical elements of *Flatland* and the society Abbott addresses through the narrative of A-Square.
- Explore ways Abbott's description of *Flatland* can be expanded to real world events and issues.
- Recognize society's "penalties" for non-conformists and seekers of Truth.

### Activity:

#### Higher Math as Satire

Ask students to look at the definition to the right and cite specific examples of these elements as applied by Abbott in commentary on English Victorian society.

***Satire*: a literary work in which human vice or folly is attacked through irony, derision, or wit.**

Ask students to identify characteristics of Victorian society being attacked in the novel with regard to the following:

- Class structure
- Subjugation of women
- Morality
- Conformity
- Stereotyping/ prejudice
- Limitations of class mobility
- Self-imposed limitations
- Adherence to tradition
- Beauty
- Truth
- Concepts of space/time
- Views of revolt and descent
- Micro (small) vs. Macro (universal) thinking
- Safety of the “known” vs. the risk of the “unknown”

As students identify these Victorian characteristics, they should cite examples within the text which provides commentary on the particular characteristic.

## **Activity:**

### **Exploring A-Square’s Narrative:**

#### *“Configuration Makes the Man”*

- In a world of limited space, peopled by two-dimensional geometrical forms, how do the citizens determine class hierarchy?
- How does “fog” assist in this recognition?

#### *“The Colour Revolt”*

A-Square provided the reader with a lengthy commentary on the “colour revolt” and the impact of the proposed “Universal Colour Bill” on notions of equality.

- Describe the cultural and political changes initiated by the colour revolt.
- What events/strategies led to the failure of the Universal Colour Bill?
- How did Pantocycus use the power of speech to his advantage?

#### *“My Initiation into the Mysteries of Space”*

A-Square permitted himself to move beyond the familiar to embrace new ideas, but in so doing, he discovered the self-imposed limitations of those he encountered.

- Compare the reaction of Space and the reaction of Flatland citizenry to new ideas.
- Describe how the use of hierarchy, pressure, tradition, etc, were used to squelch and punish A-Square.

- Provide historical examples of other attempts to punish those who bring new cultural, political or scientific discoveries to the world.

## Lesson Two

### Dimensional Thinking

#### Objectives:

As a result of this lesson students will:

- See comparisons between *Flatland* and the teachings of Plato.
- Recognize the use of mathematics to describe the world.
- Understand how the arts anticipate mathematical and scientific discoveries.
- Explore new ideas in dimensional thinking.



Generations of readers have compared *Flatland* with the writings of Plato, specifically, *The Myth of the Cave* and *Myth of the Four Metals*. The following activity explores these comparisons.

#### Activity:

#### Abbott and Plato

Both Abbott and Plato address the notion of how we react when we become aware of concepts that challenge tradition or our ability to fully comprehend. We accept some ideas without question (such as how electricity works, or how the picture comes through the television); while other ideas we ignore or repulse because they horrify (atomic weaponry), challenge (chaos theory), or call into question our own long-held beliefs.

In addition, we may find, as did A-Square, that the world is not always welcoming of new ideas and discoveries. Ideas can be squelched as a challenge to power or tradition; messengers can be ostracized, penalized, imprisoned, or killed. Those who dare to step out (artist, politician, scientist, or ordinary citizen) do so at great personal and professional risk. But the risk-takers expand our notions of the world and of our own possibilities. Have students cite examples.

Ask students to read Plato's *Myth of The Four Metals*. How does this compare with the hierarchical system of Flatland? Do students believe Plato's notion of a perfect society is just or unjust? Why?

*Cosmology: from the Greek *cosmos* (meaning order) and *logos* (meaning reason or plan), it is the study of the universe and mankind's place in it.*

Ask students to read Plato's *The Myth of The Cave*. How does the reality of the cave dwellers compare to the reality of the citizens of Flatland? What is necessary for each society to expand their knowledge?

How does each story address the following quotation by author John Caris: "...many dimensions exist and each is a modified or distorted reflection of a higher or lower one."

## Activity:

### Mathematics: Did the Greeks have it right?

Over the doorway of his famous Academy, Plato placed a warning: *Let no one without geometry enter here*. The words reflected a Greek view of the world that can be traced back to the Pythagoreans, that number was the basis of everything and that mathematics formed the core of all nature, all proportion, all harmony and beauty. The ancients recognized that number, pattern, rhythm, balance, and symmetry permeated every aspect of life. Do your students agree?

Assign students the task of discovering the mathematical components of various areas of interest by keying in topics such as:

- Math and nature
- Math and beauty
- Math and music
- Math and poetry
- Math and computer games
- Math and film special effects
- Math and art

- Math and sculpture
- Math and architecture
- Math and games
- Math and sport
- Math in literature

Can students think of other areas to investigate?

Ask students to report their findings on these topics.

## Activity

### ***“Beam me up, Scottie”*: Expanding our thinking**

Like Abbott’s flatlanders or Plato’s cave-dwellers, we are limited by our own concepts of reality as *earthlings* and as individuals. But occasionally, like A-Square, someone dares to look beyond their reality. We expect this of mathematicians and scientists, but oddly, many times the first to make the transition are the painters, writers, and musicians.

We have already seen how higher dimensional thinking appears in the writings of Plato and Abbott. Other writers such as George Orwell, H.G. Wells, Jules Verne, Mary Shelley, Lewis Carroll, Madeleine L’Engle, and Frank Herbert anticipated scientific discoveries. Recently too, Simon Schama’s *The Power of Art* and Leonard Shlain’s *Art and Physics* illustrate how many scientific theories (those “wow” moments, such as Einstein’s theories) find their way into art often decades before their *discovery* and presentation to the world by physicists and mathematicians.

In citing just a few examples, we find the fourth dimension can be seen in *Les Femmes d’Alger* (1907) by Pablo Picasso while his later Cubist paintings dissolved form and rearranged planes. Likewise, Cézanne played with the reality of light; Marcel Duchamp’s *Nude Descending Staircase* anticipated the movement in multi-frame photography by superimposing successive movements over one another; and Salvador Dali expanded the notion of the fourth dimension (and computer graphic design) with his 1954 *Crucifixion*.

Unlike Plato’s cave dwellers and Abbott’s flatlanders with little access to information beyond a limited sight line, today’s student has computer graphics, the Hubble telescope, and Hollywood special effects to remind us that there are yet worlds to be explored and discoveries to be made and to open young minds to the possibilities of multiple dimensions (some scientists think there are as many as eleven dimensions).

Such expanded thinking also invites students to consider their own limited realities. A-Square expanded his world by daring to look beyond the familiar while his fellow flatlanders remained in self-imposed limitation. Invite students to consider their

own self-imposed limitations and to discuss ways in which they, too, can expand their thinking about the possibilities for their own lives through

- **Reading:** what books, journals etc., will help them to reach their goals or keep them abreast of what's new in their area of interest?
- **Skill development:** what activities, volunteer opportunities, internships, seminars, etc. will assist in reaching goals?
- **Mentors:** who is already doing what they want to do and how can they learn what this person has to teach?
- **Networking:** how can students begin networking, making connections to learn the skills and find the mentors and opportunities they need?
- **Funding:** what are the ways students can expand their thinking to find funding opportunities for their goals?
- **Resources:** what resources are available in our community right now and how do students find those resources?

Brainstorming this way will help students to realize opportunities already exist to empower them and enable their opportunities for amazing futures – to move their own lives to a new dimension.

**Resources:**

If you cannot find a copy of the novel, *Flatland*, it is available on line in its entirety. Check these sites:

<http://www.eldritchpress.org/ea/FL.HTM>

<http://www.geom.uiuc.edu/~banchoff/flatland/>

Tony Robbins, *Shadows of Reality: The Fourth Dimension in Relativity, Cubism, and Modern Thought* (Yale Univ. Press, 2006).

For a great look at a computerized four dimensional object, check out the Magic Cube 4D at:

<http://www.superliminal.com/cube/cube/htm>.

This site also provides additional links.

**Davidson County teachers using the *Flatland* novel and lesson plans who wish to show their students the new animated DVD *Flatland*, should contact DeeGee Lester at 615-862-8431.**

