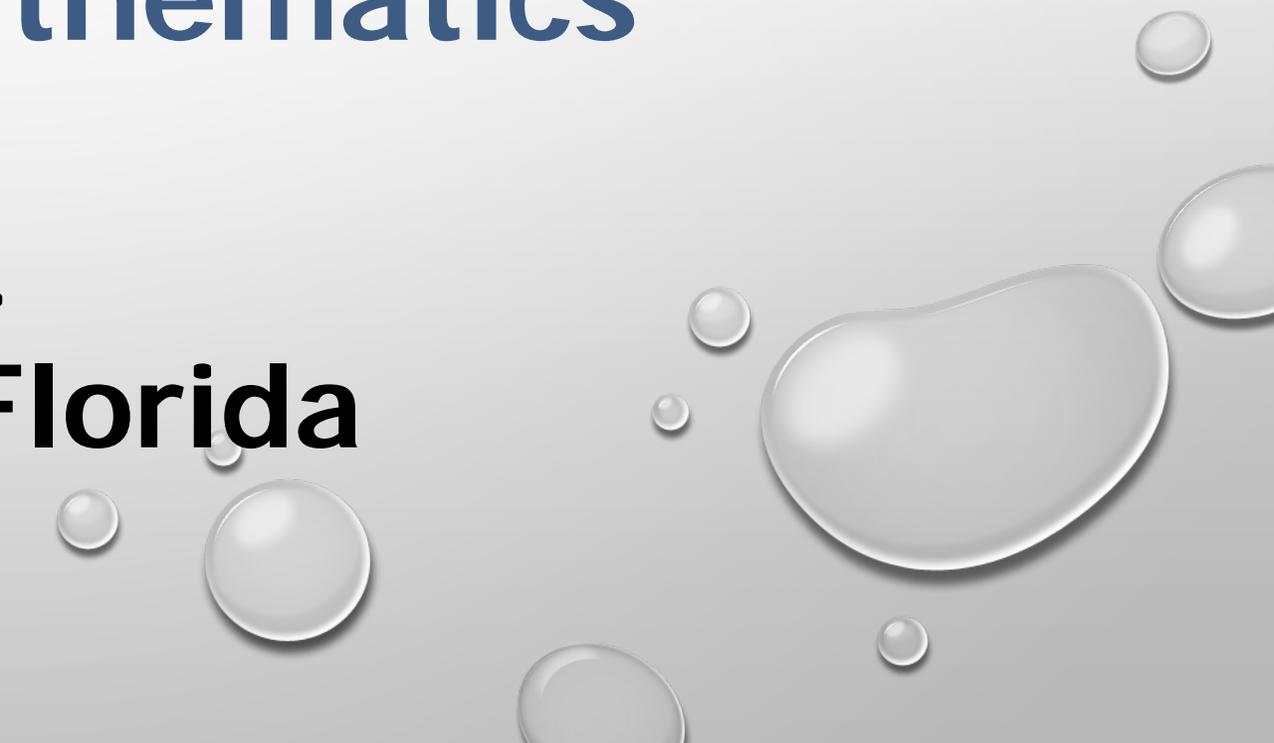




# STEAM

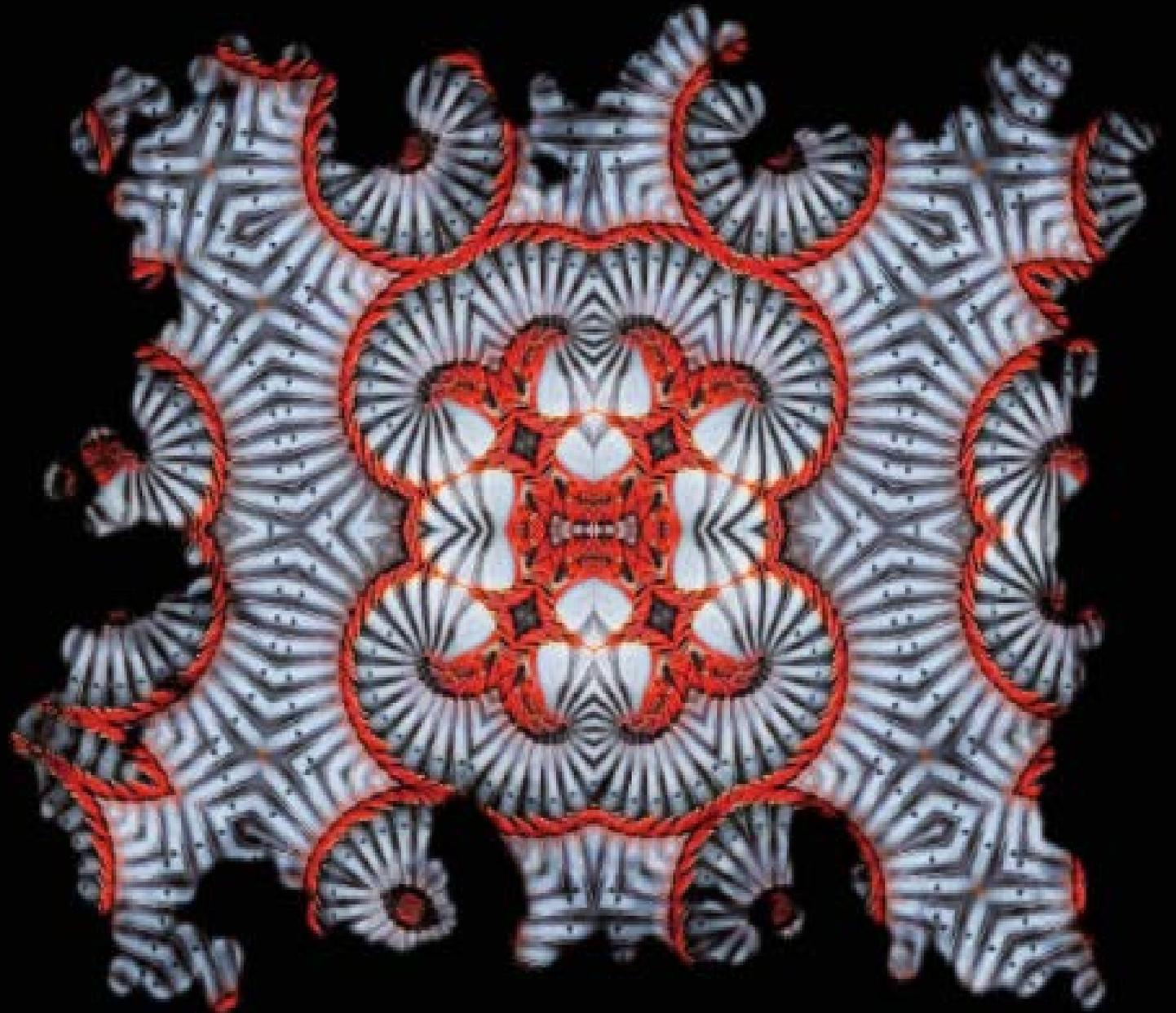
## Finding a Connection Between Art and Mathematics

**Joni Pirnot, Ph.D.**  
**State College of Florida**





Michael Kern  
uses abstraction  
to remove fear  
and help people  
see beauty.



**Rainbow Millipede**  
produces the toxin  
hydrogen cyanide  
to protect itself.

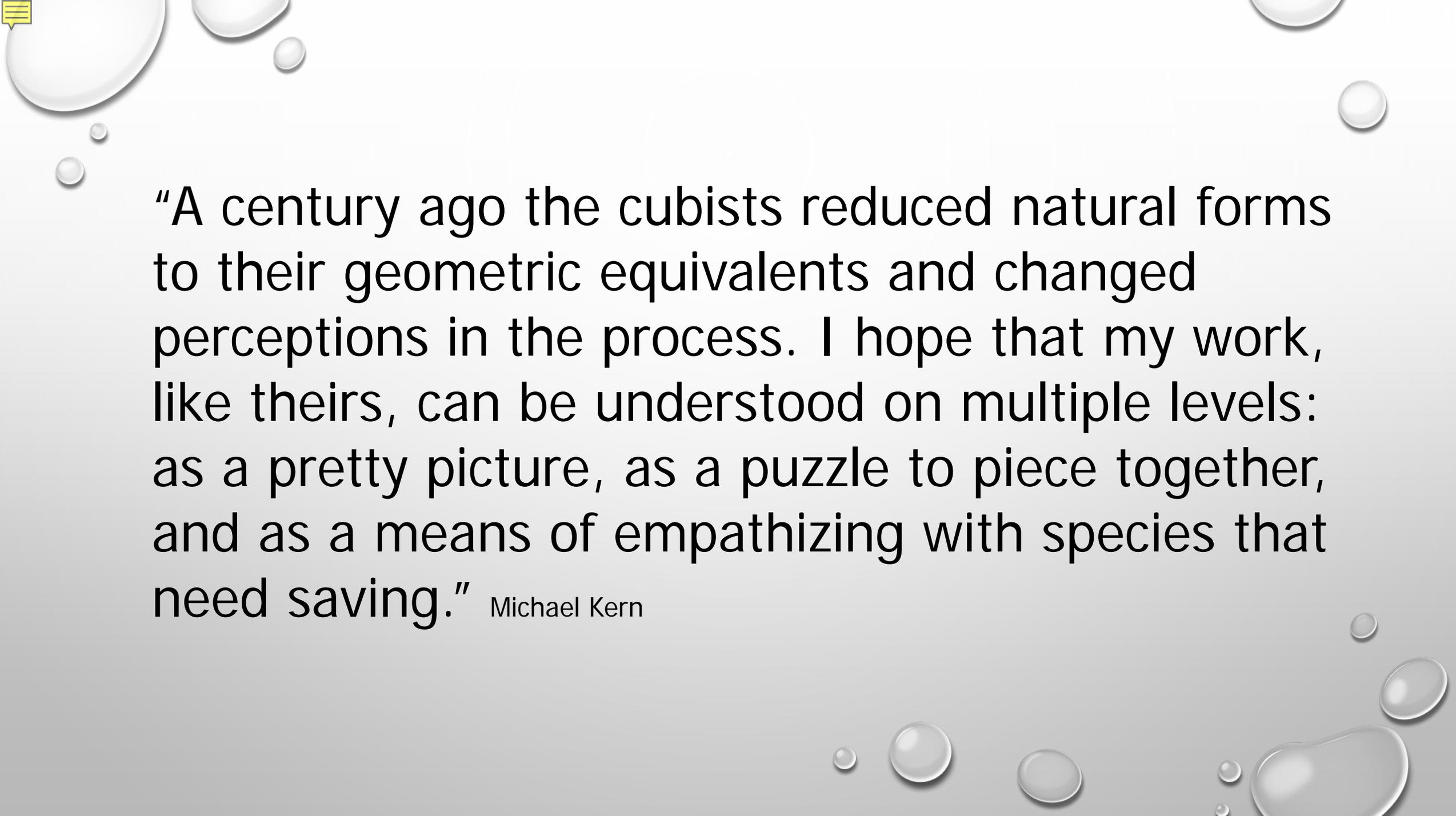




# **STEM + Art = STEAM**

Art and design provide the innovation needed to transform the 21st century just as science and technology transformed the last century.





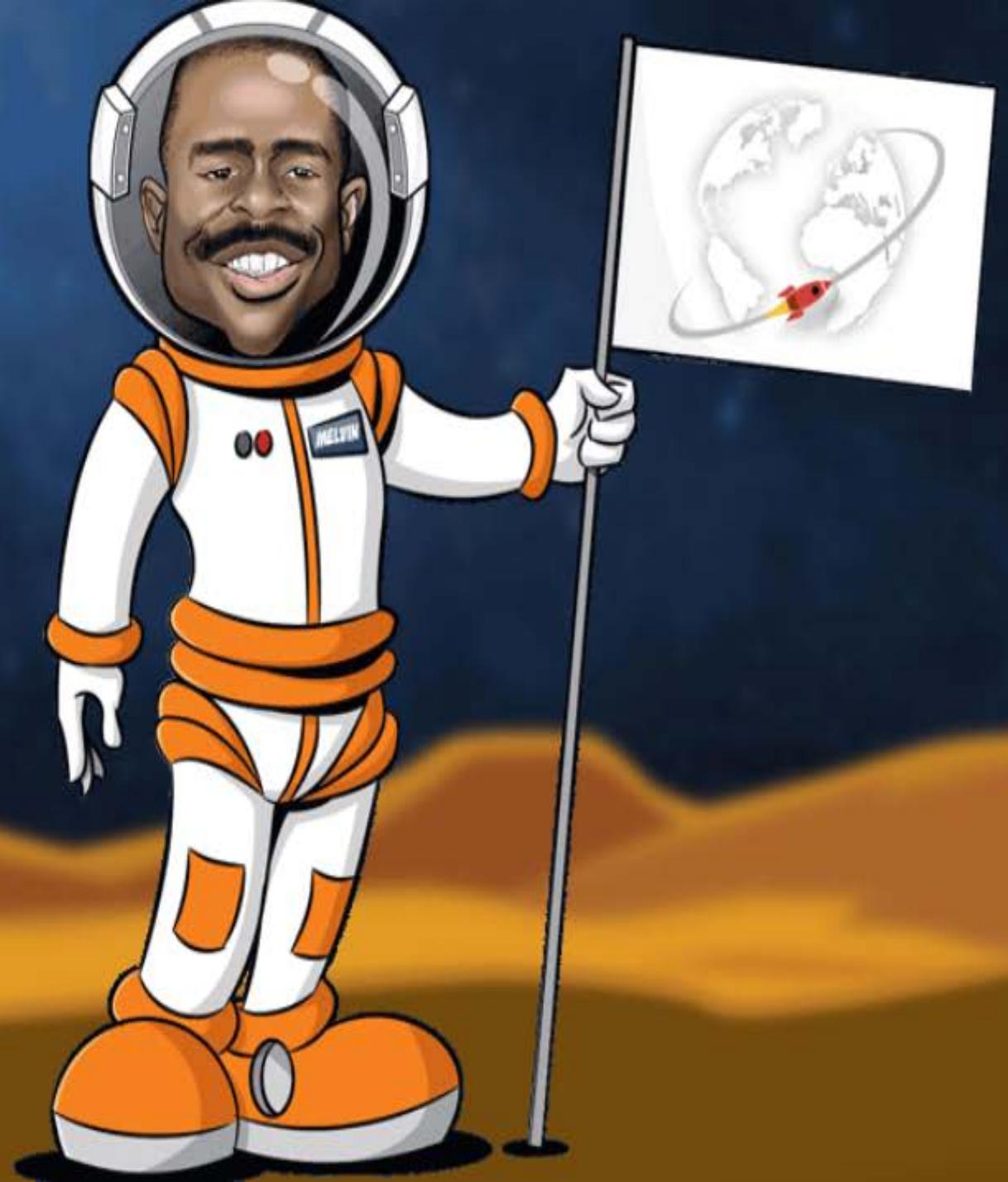
"A century ago the cubists reduced natural forms to their geometric equivalents and changed perceptions in the process. I hope that my work, like theirs, can be understood on multiple levels: as a pretty picture, as a puzzle to piece together, and as a means of empathizing with species that need saving." Michael Kern

# Stemtosteam.org

- The goal is to foster the true innovation that comes with combining the mind of a scientist with that of an artist.
- Rhode Island School of Design advocates for adding art and design to the national agenda of STEM education and research in America.

# LELAND MELVIN

ASTRONAUT S.T.E.A.M. EXPLORER





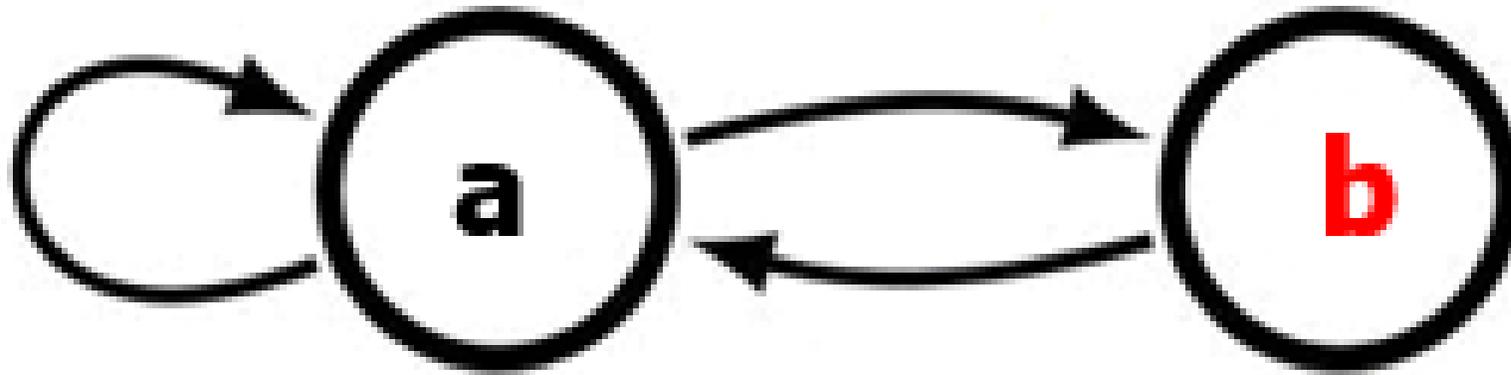
# Leland Melvin

- Served as the co-chair on the White House's Federal Coordination in STEM Education Task Force to develop the nation's 5-year STEM education plan
  - Now uses his life story as an athlete, astronaut, photographer, and musician to help inspire the next generation of explorers to STEAM careers
- 

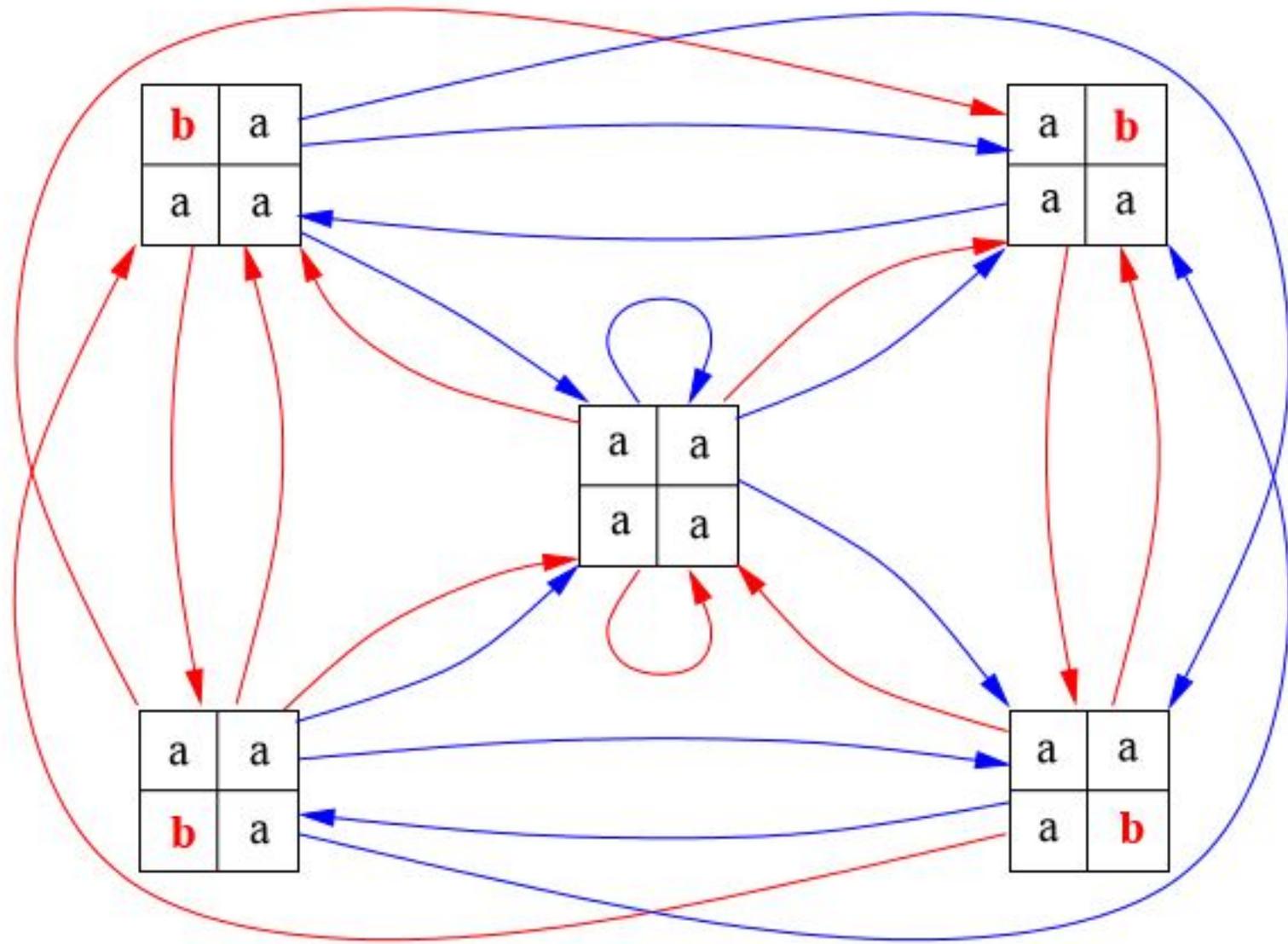


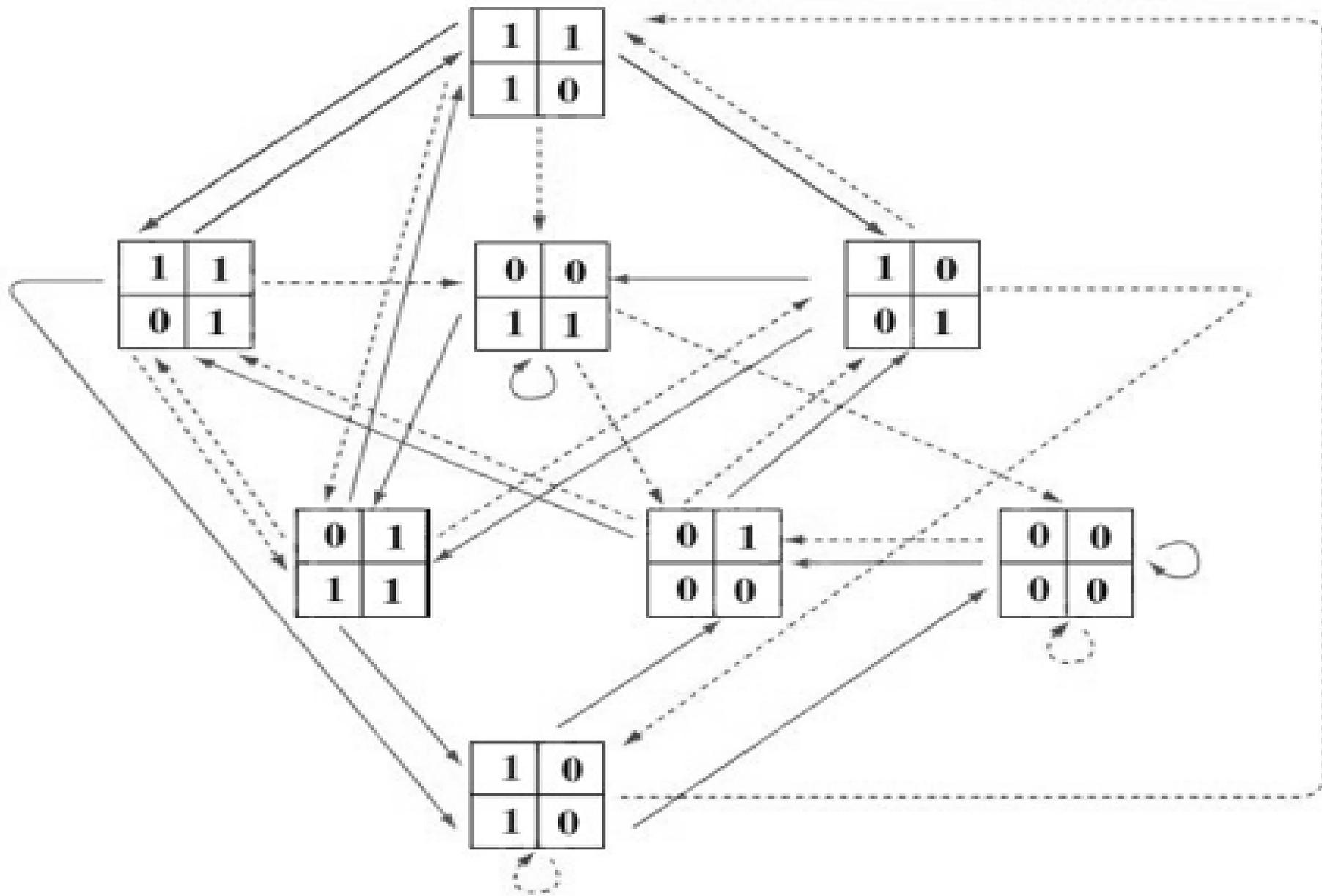
# Finite-state Automaton

Mathematical model of computation



	$\varepsilon$	0	1	00	01	10	11	001	010	100	0100	0010	1001
$\varepsilon$	$\varepsilon$	0	1	00	01	10	11	001	010	100	0100	0010	1001
0	0	00	01	11	001	010	11	11	0010	0100	00	11	01
1	1	10	11	100	11	11	11	1001	11	11	11	10	11
00	00	11	001	11	11	0010	11	11	11	00	11	11	001
01	01	010	11	0111	11	11	11	01	11	11	11	010	11
10	10	100	11	11	1001	11	11	11	10	11	100	11	11
11	11	11	11	11	11	11	11	11	11	11	11	11	11
001	001	0010	11	00	11	11	11	001	11	11	11	11	11
010	010	0100	11	11	01	11	11	11	010	11	0100	11	11
100	100	11	1001	11	11	10	11	11	11	100	11	11	1001
0100	0100	11	01	11	11	010	11	11	11	0100	11	11	01
0010	0010	00	11	11	001	11	11	11	0010	11	00	11	11
1001	1001	10	11	100	11	11	11	1001	11	11	11	10	11

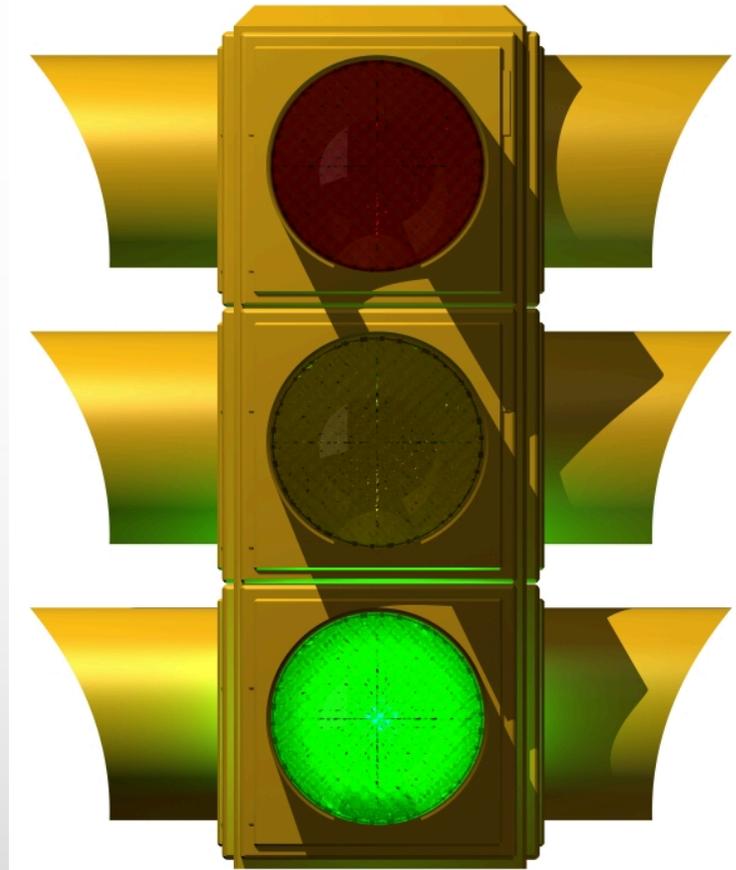






- 
- Start here.
  - Out of the blue\*
  - Remember this!

Green is the most restful color for the human eye. It has a strong emotional correspondence with safety.

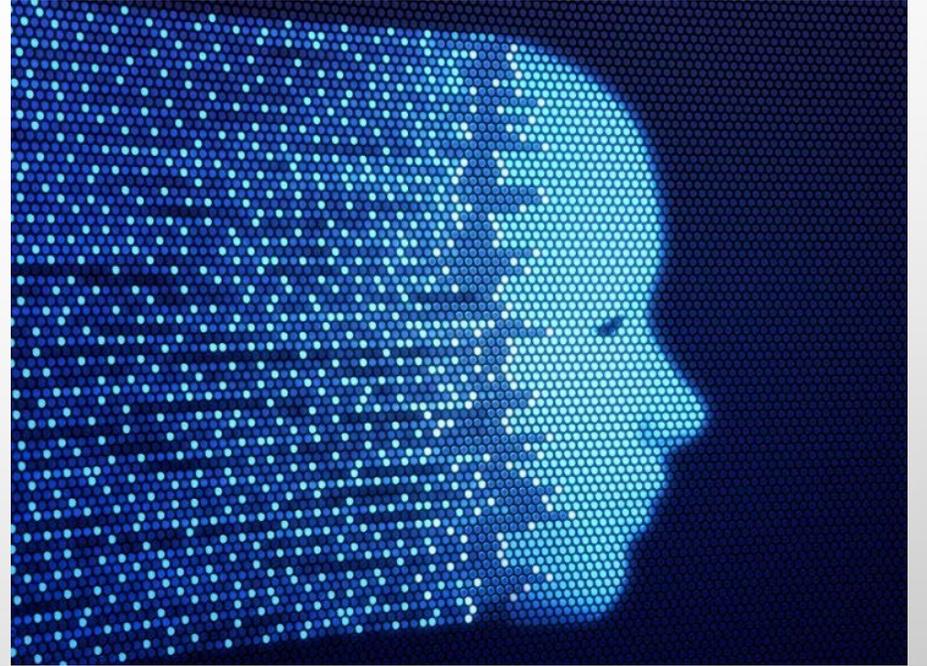


Start here ●

$$\frac{4}{4 - x^2} + \frac{2}{x^2 - 3x + 2}$$

$$\frac{4}{(2 - x)(2 + x)} + \frac{2}{(x - 2)(x - 1)}$$

Blue symbolizes wisdom,  
confidence, and intelligence.  
It is used to suggest  
consciousness and precision.



Out of the blue ★

$$\frac{4}{2 - \sqrt{5}} \cdot \frac{2 + \sqrt{5}}{2 + \sqrt{5}}$$

Red has high visibility, stimulating people to take action. It is associated with energy, power, and determination.



Remember this !

$$\frac{4 - x^2}{x^2 - 3x + 2}$$

$$\frac{(2 - x)(2 + x)}{(x - 2)(x - 1)}$$

$$\frac{-1 \cdot \cancel{(2 - x)}(2 + x)}{\cancel{(x - 2)}(x - 1)}$$

ex. 
$$\frac{(x^2+5) \cdot 2}{(x^2+5)(x-4)} + \frac{3+x}{x^2+5} = \frac{(x^2+5) \cdot 2 + (3+x)(x-4)}{(x-4)(x^2+5)}$$

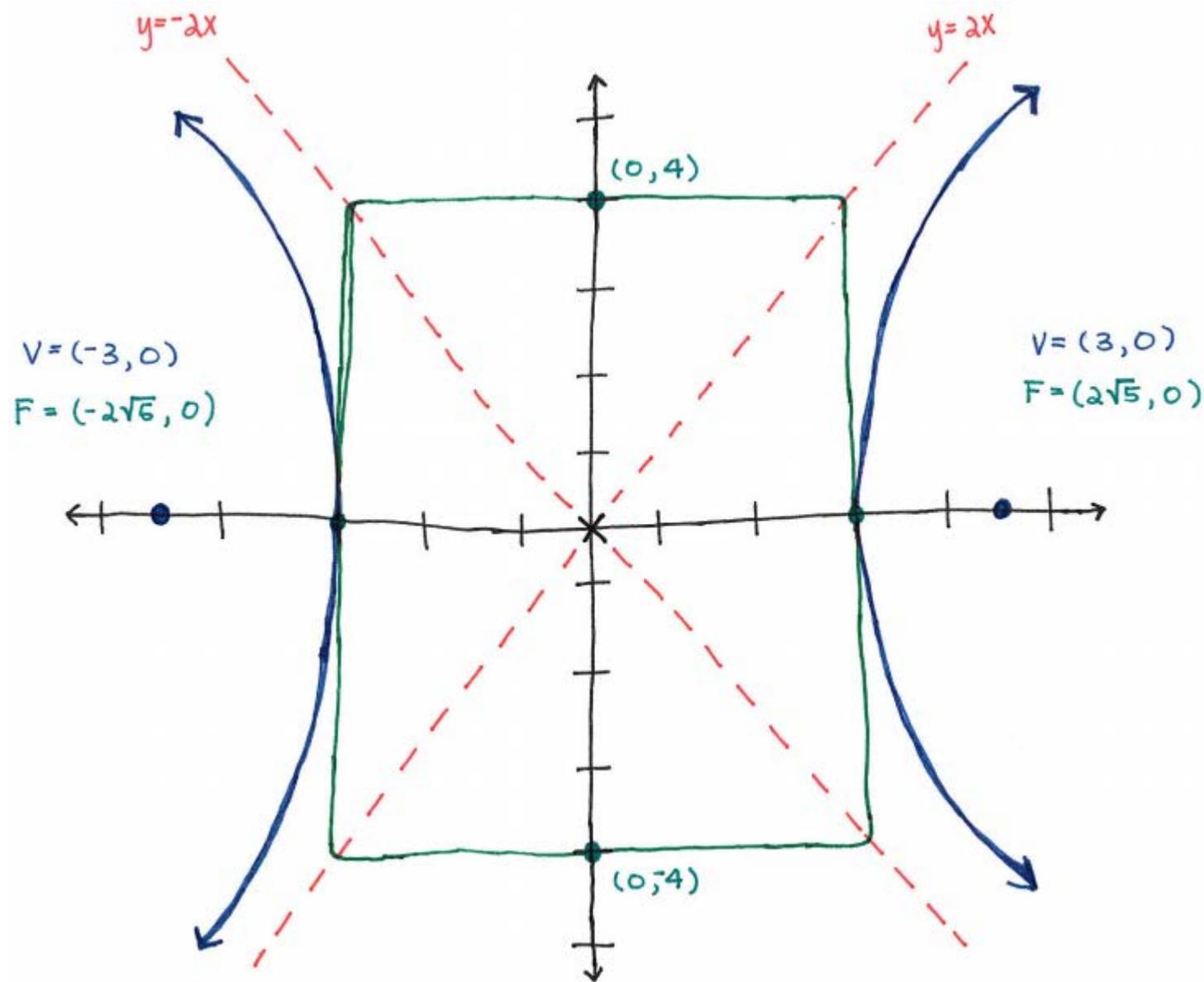
$$\frac{3x^2 - x - 2}{(x-4)(x^2+5)}$$

... fraction decomposition is this process in reverse.

① turn this into an equation! 
$$\frac{3x^2 - x - 2}{(x-4)(x^2+5)} = \frac{A}{x-4} + \frac{Bx+C}{x^2+5}$$

② use LCD to clear fractions! 
$$(\cancel{x-4})(\cancel{x^2+5}) \quad (\cancel{x-4})(x^2+5) \quad (x-4)(\cancel{x^2+5})$$

$$3x^2 - x - 2 = A(x^2+5) + (Bx+C)(x-4)$$



$$4x^2 - y^2 = 16$$

$$\frac{4x^2 - y^2}{16} = 1$$

$$\frac{x^2}{4} - \frac{y^2}{16} = 1 \quad \frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2}$$

$$a^2 = 4 \quad b^2 = 16$$

$$a = 2 \quad b = 4$$

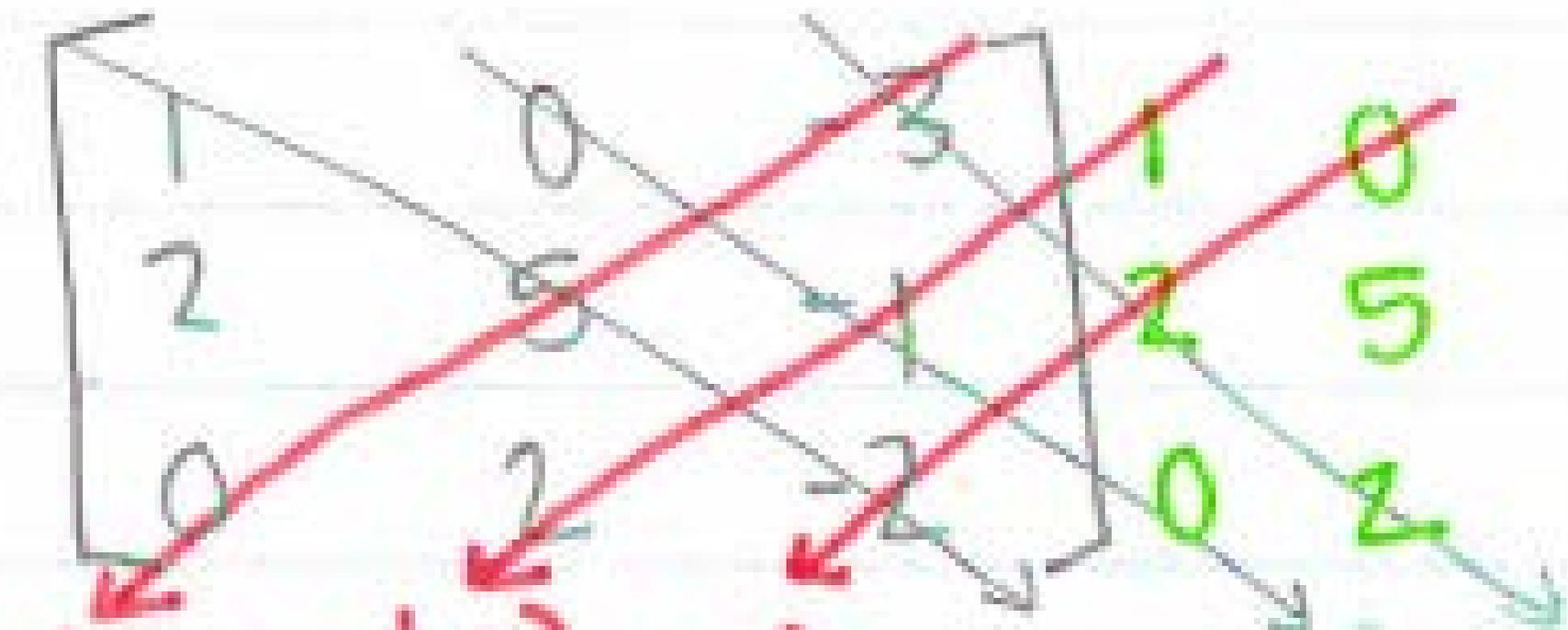
$$(4)^2 = c^2 - (2)^2$$

$$16 = c^2 - 4$$

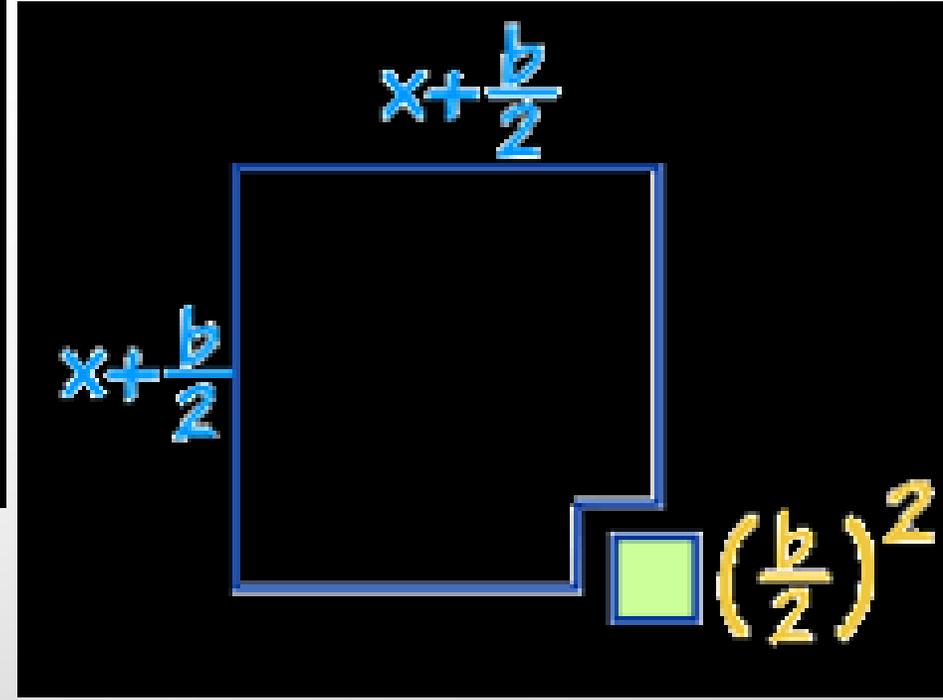
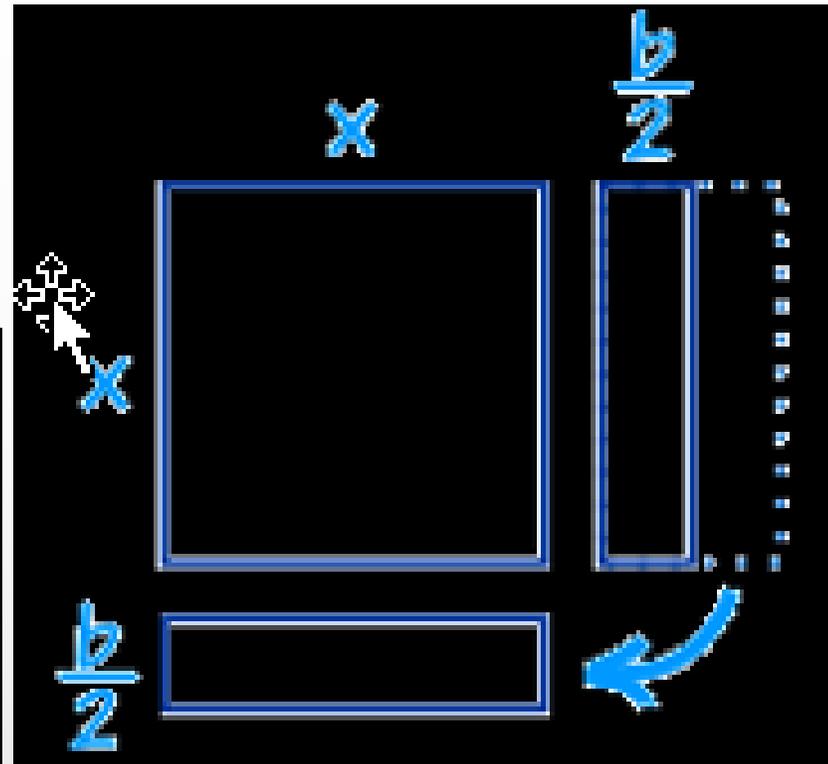
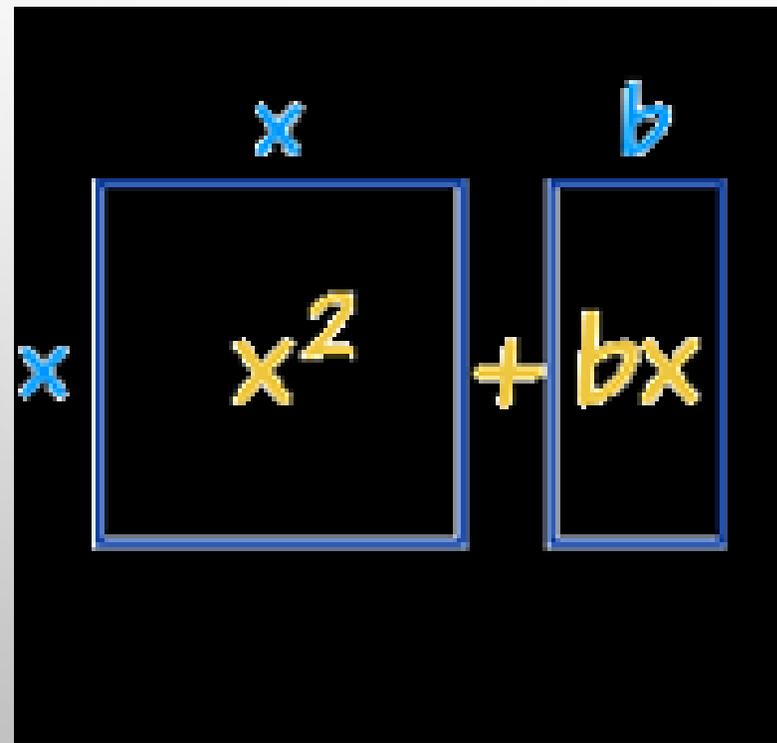
$$20 = c^2 \quad c = \sqrt{20}$$

$$b^2 = c^2 - a^2$$

$$c = 2\sqrt{5}$$



$$0 + -(-2) + 0 + -10 + 0 + -12 = -20$$



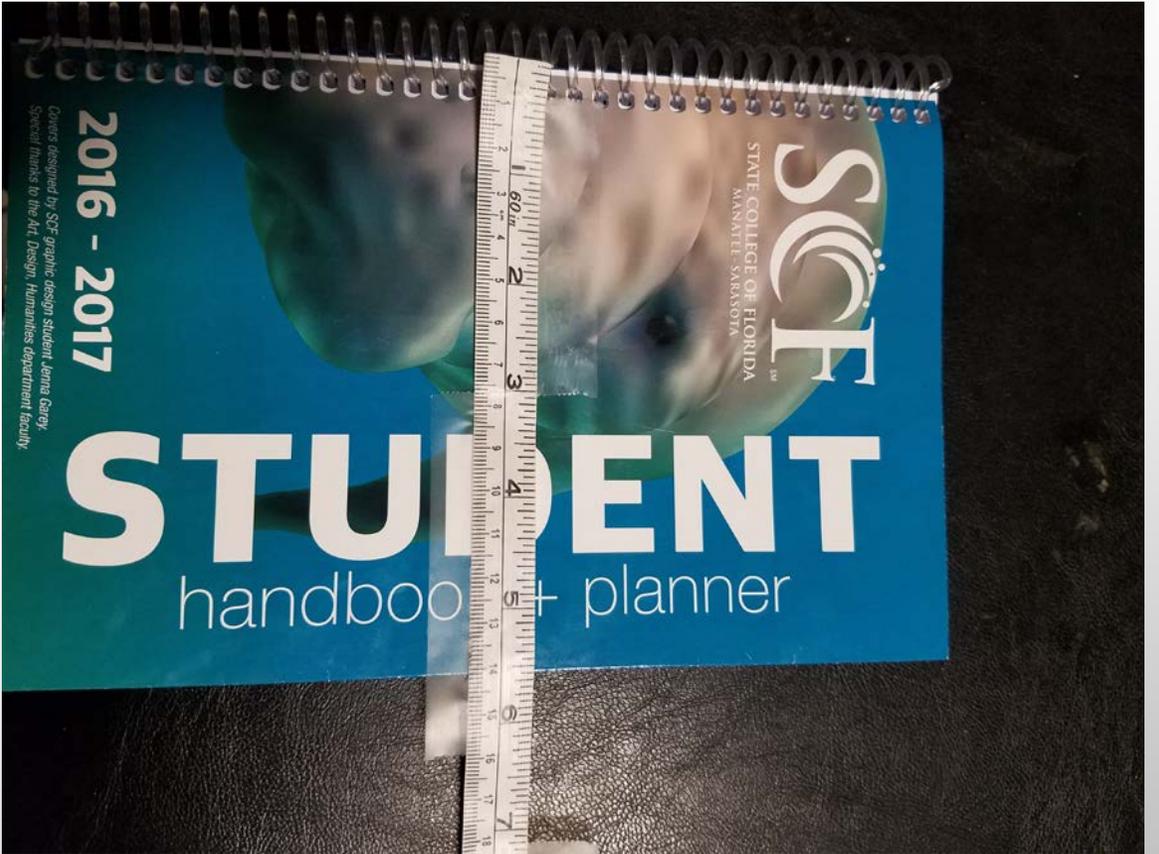
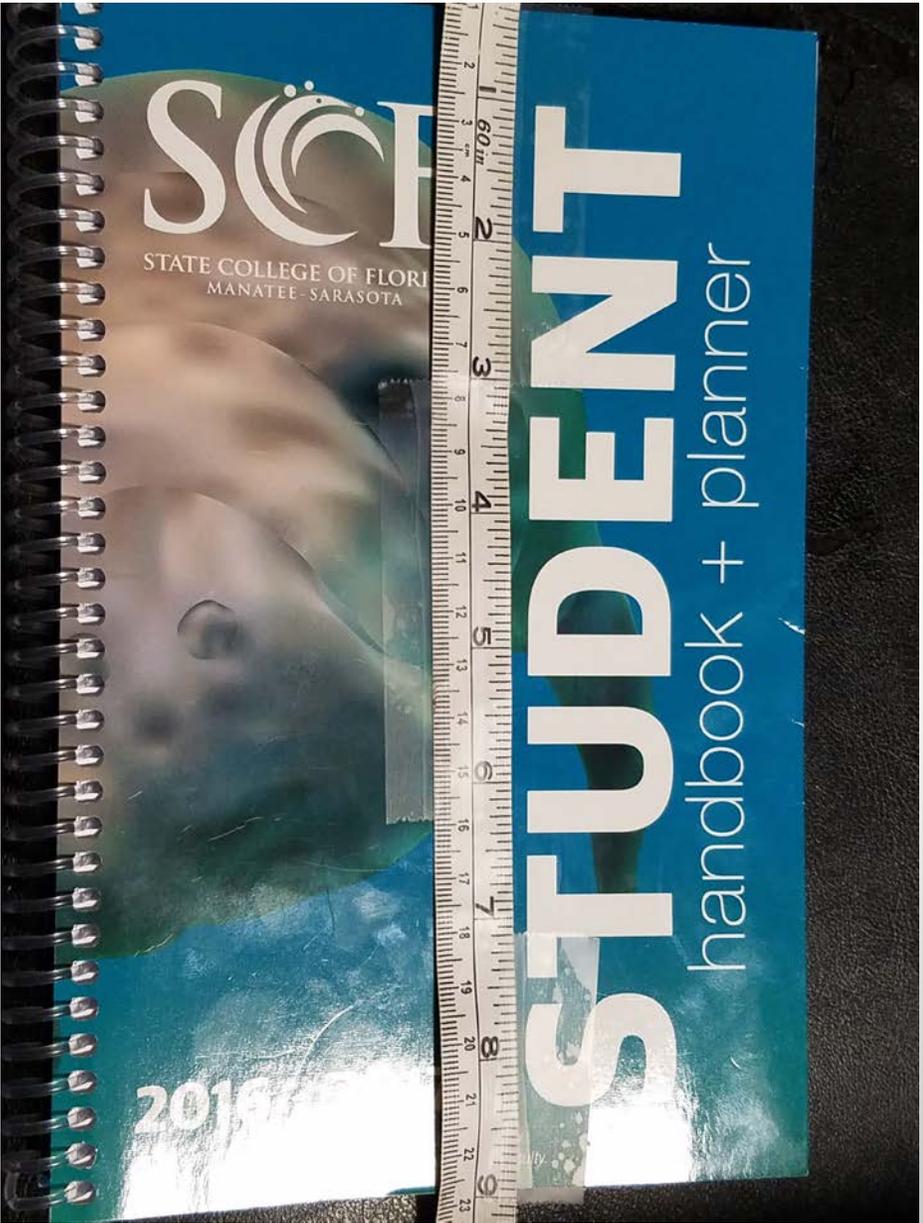
A *ratio* is the quantitative relationship between two amounts, and a *proportion* is an equation that sets two ratios equal to one another. Proportions are extremely useful in everyday life! For example, suppose you want to find the height of a tree in your back yard that has been struck by lightning and now needs to be cut down without falling on the house. At a certain time of day, if a 12-inch ruler has a shadow that is 17 inches long and the shadow of the tree is 291 inches, then the proportion  $x/291 = 12/17$  tells us that the height of the tree is  $291 * 12/17 = 205.41$  inches (about 17.12 feet).

Use this Discussion board to document the process of finding the height of a specific object by setting up a proportion of shadows. Provide a diagram to outline the process and take photos of the items being measured. It's a liberal arts class, so let's get creative! Be sure to include the unit of measurement and calculate all values to two decimal places.

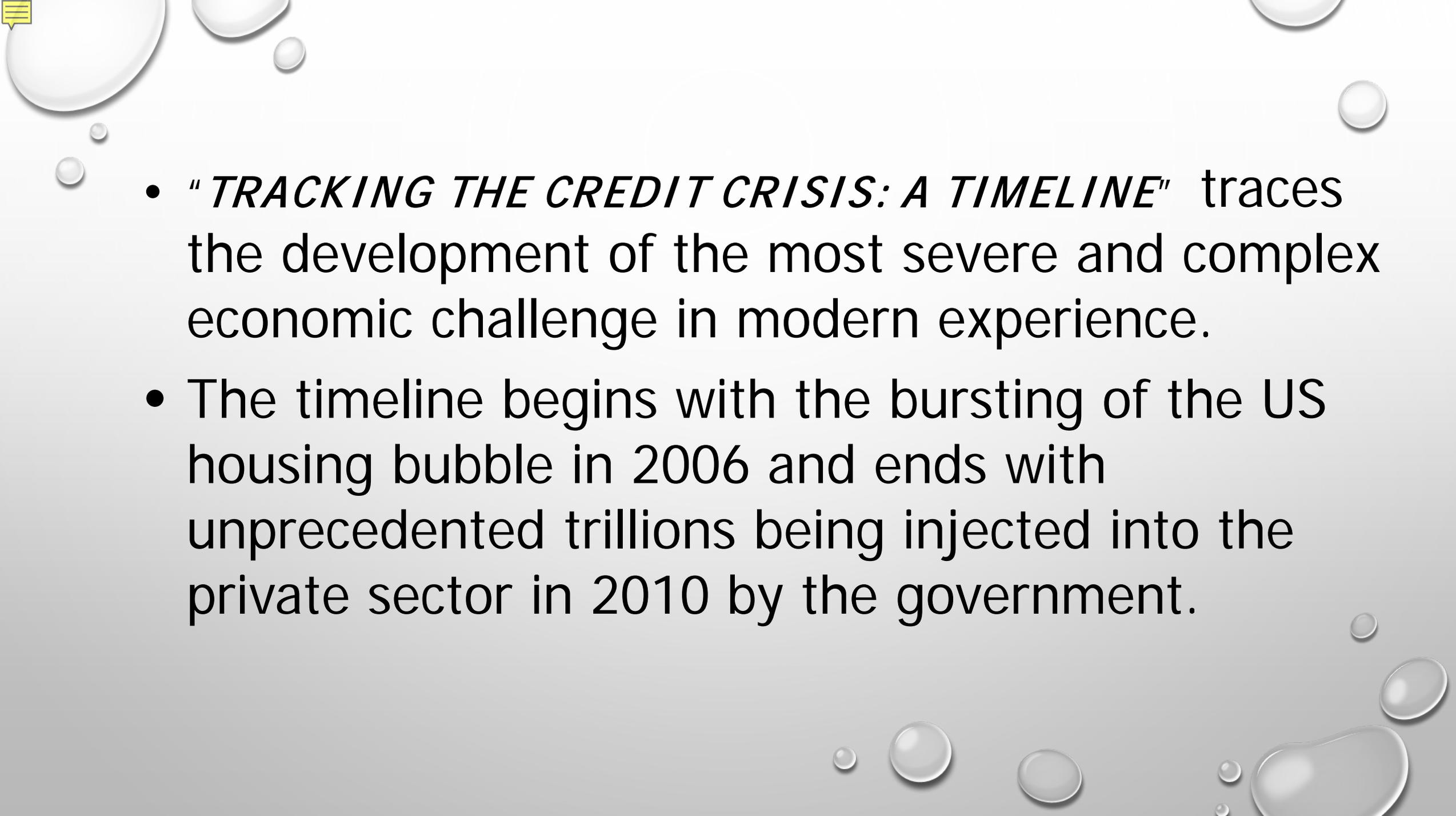
# Finding the height of a tree



A *golden rectangle* is one with *Divine Proportions* where the ratio of the length divided by the width is approximately 1.618. These rectangles appear in advertising, architecture, art, etc. Find a rectangular object that fits this description, then give the name of the object, its length and width (state the unit of measurement), and show by division that the ratio is between 1.613 and 1.623. You may not use any object already quoted by a classmate, so please check their responses first. Use an actual physical object that you can measure (not something found on the internet or in a book) and attach a picture of the object.



- **The Museum of American Finance**, an affiliate of the Smithsonian Institute, has a mission to preserve, exhibit and teach America's financial history.
- The museum is a **non-profit 501(c)(3)** that is a guardian of America's collective financial memory, presenting current financial issues in order to connect the past with the present while guiding the future.

- 
- "*TRACKING THE CREDIT CRISIS: A TIMELINE*" traces the development of the most severe and complex economic challenge in modern experience.
  - The timeline begins with the bursting of the US housing bubble in 2006 and ends with unprecedented trillions being injected into the private sector in 2010 by the government.





On August 10, 2007, \_\_\_\_\_ dollars were injected into the global economy to prevent a liquidity crisis.

Using 7 billion as an approximation for the current world population, find the dollars per person injected into the global economy.



**JUL 28** Merrill Lynch with \$50 billion worth of mortgage-backed securities for \$7 billion, at around 22¢ on the dollar, leaving Wall Street.

holds secret... to 50% of its shares to Korean or Chinese investors. Talks reportedly break down because Lehman is asking too high a price for its shares.

from the... actions. As a result of the decision, the markets go into a tailspin.

emergency... global financial crisis in... Leaders of France, Germany, the UK and Italy meet and agree that Europe will not allow any bank to fail.

**JUL 22** IndyMac Bank closes down due to large mortgage-related losses. With \$30 billion in assets, this is the second-largest bank failure in US history. The FDIC, which insures deposits in member banks, estimates that the borrower could approximate \$1 billion.

**JUL 22** Wachovia posts a \$1 billion loss in the second quarter, due largely to mortgage loans.

**JUL 23** President Bush signs into law a housing bill which contains a rescue plan for Freddie Mac and Fannie Mae and gives the government the power to...

**SEP 14** Bank of America drops out of the bidding for Lehman because of the government's lack of support and enters into discussions to buy Merrill Lynch instead.

**SEP 15** Lehman Brothers announces that it will file for bankruptcy — the largest in American history.

**SEP 15** The DJIA responds with a 504-point drop.

**SEP 16** The...

**OCT 7** The DJIA falls below 10,000 for the first time since 2004.

**OCT 10** The DJIA caps its worst week ever with the highest one-day volatility on record in its 112-year history. Over the previous nine days...

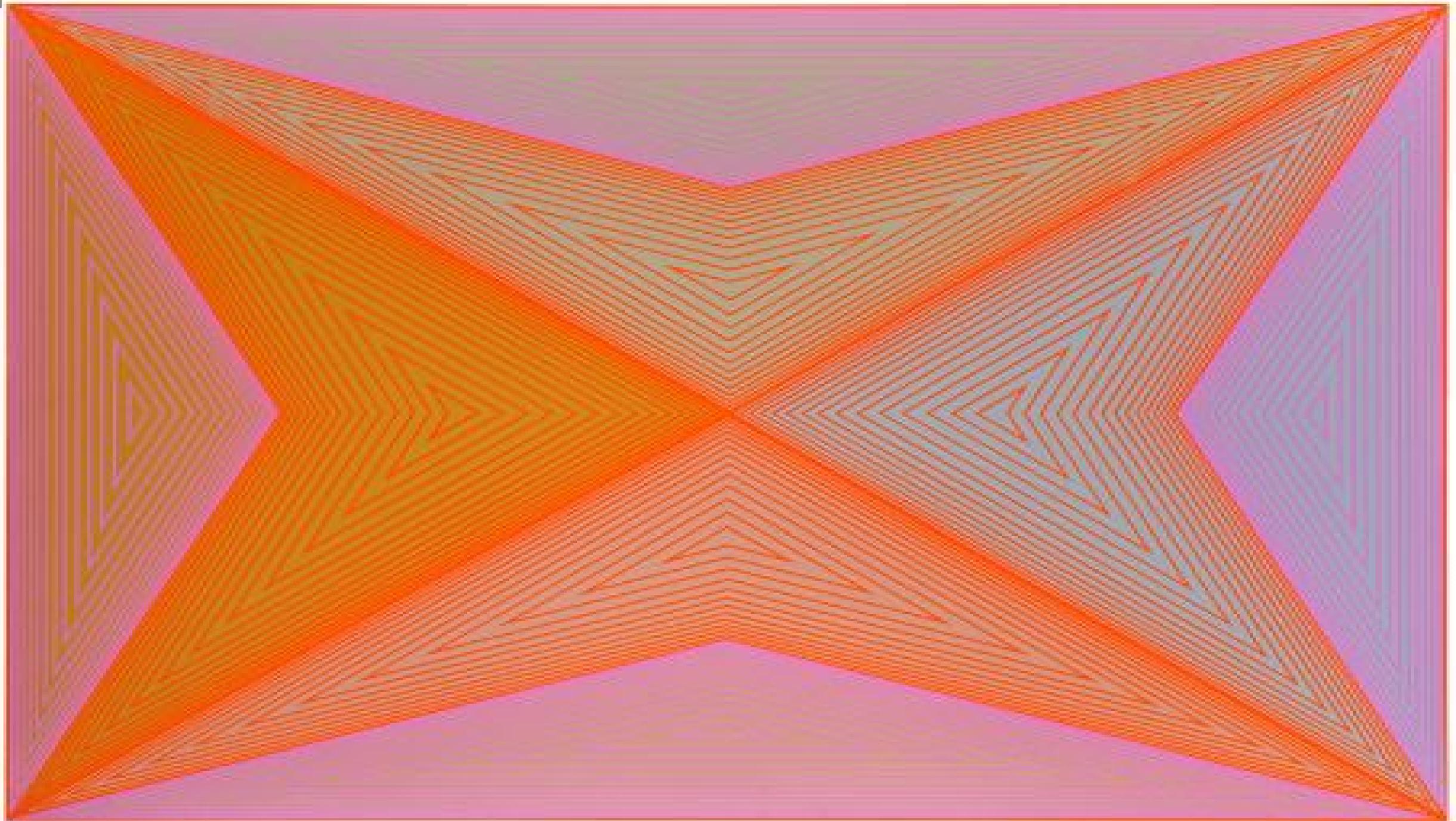
11,000

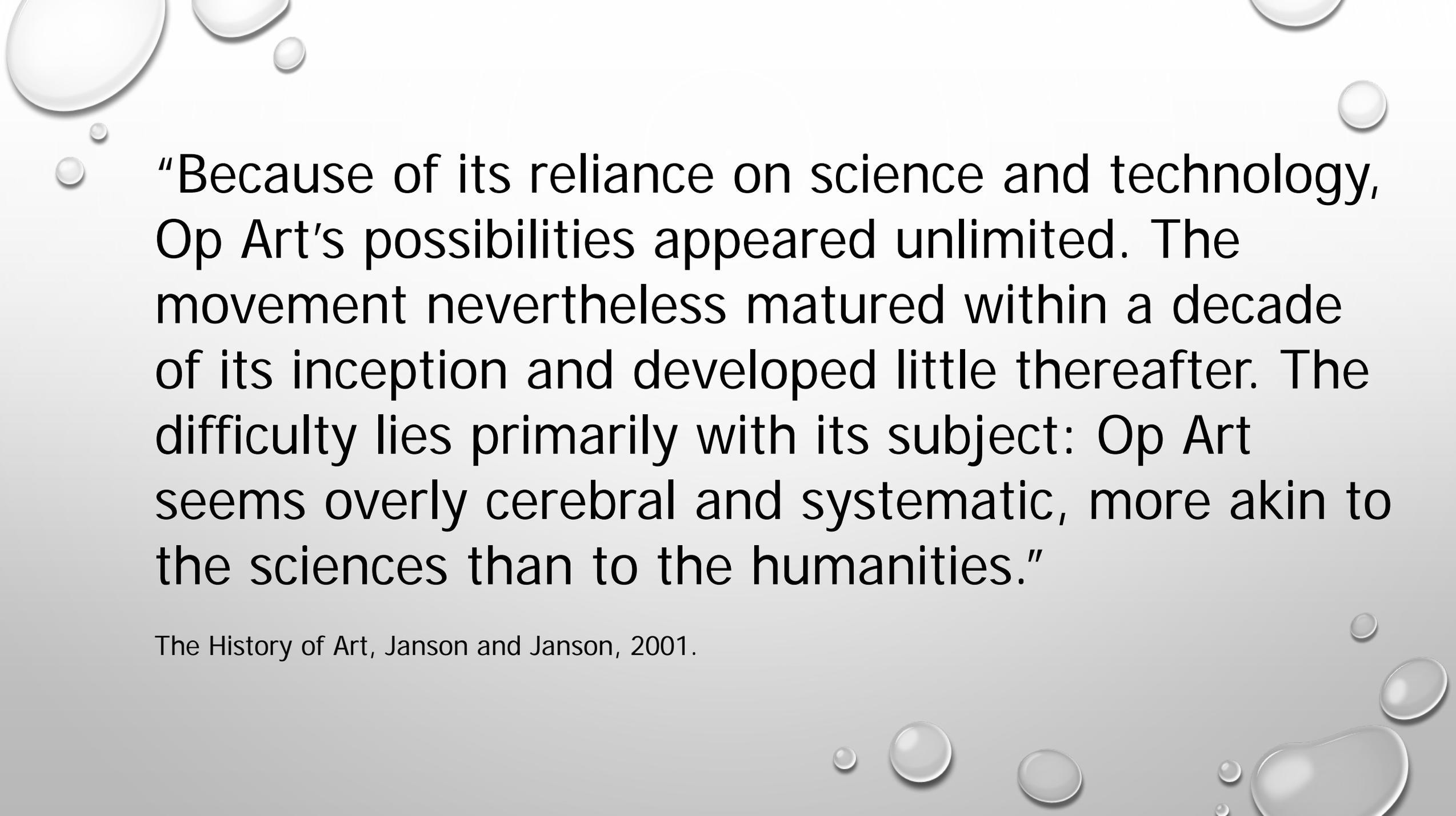
# ANUSZKIEWICZ

- Richard Anuszkiewicz (1930 - ) is well known for his geometric and linear forms that are carefully - almost scientifically - planned and executed.
- "I'm interested in making something romantic out of a very mechanistic geometry. Geometry and color represent to me an idealized, classical place that's clear and pure."

# OP ART (OPTICAL ART)

- This abstract art form relies on certain optical phenomena to cause a work to seem to vibrate, pulsate, or flicker.
- New materials and processes supplied by science allow geometrical precision to control surfaces and edges in order to evoke a retinal response.





“Because of its reliance on science and technology, Op Art’s possibilities appeared unlimited. The movement nevertheless matured within a decade of its inception and developed little thereafter. The difficulty lies primarily with its subject: Op Art seems overly cerebral and systematic, more akin to the sciences than to the humanities.”

The History of Art, Janson and Janson, 2001.

*"I'm interested in making something romantic out of a very, very mechanistic geometry. Geometry and color represent to me an idealized, classical place that's very clear and very pure."*

*Richard Anuszkiewicz*



1964



1964

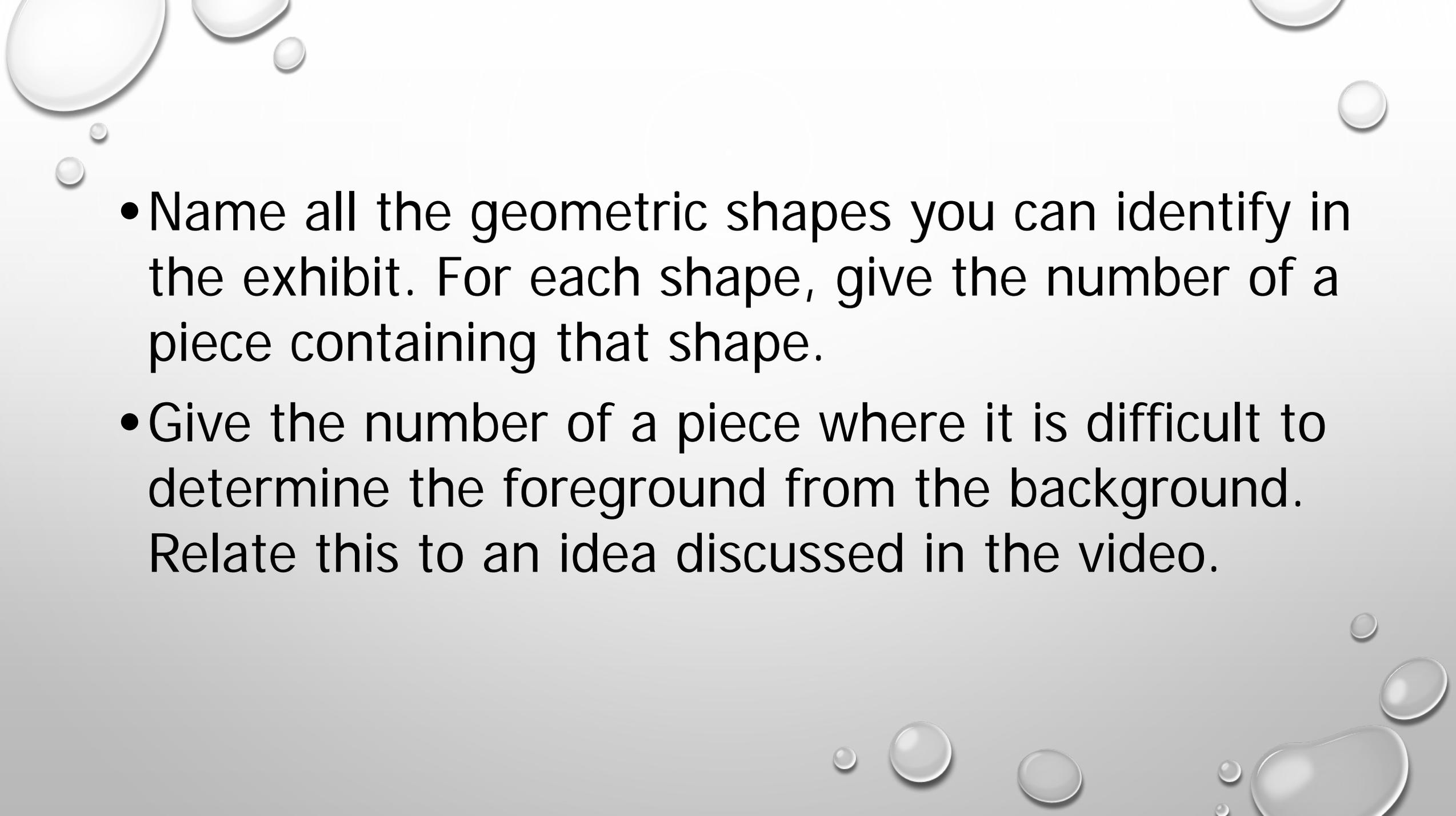


1964



1964



- 
- Name all the geometric shapes you can identify in the exhibit. For each shape, give the number of a piece containing that shape.
  - Give the number of a piece where it is difficult to determine the foreground from the background. Relate this to an idea discussed in the video.

<https://www.youtube.com/watch?v=hnds9-GmwkM&t=1s>





When used together with the warm color red, blue can create high-impact vibrant designs.

