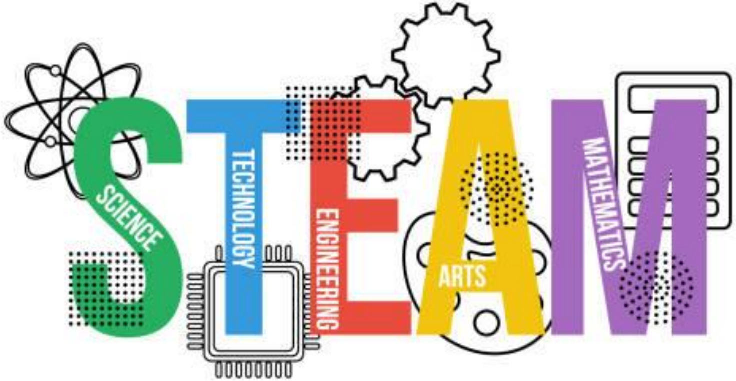
Art and Science

Patterns, Origami, Color Science, and Structural Design

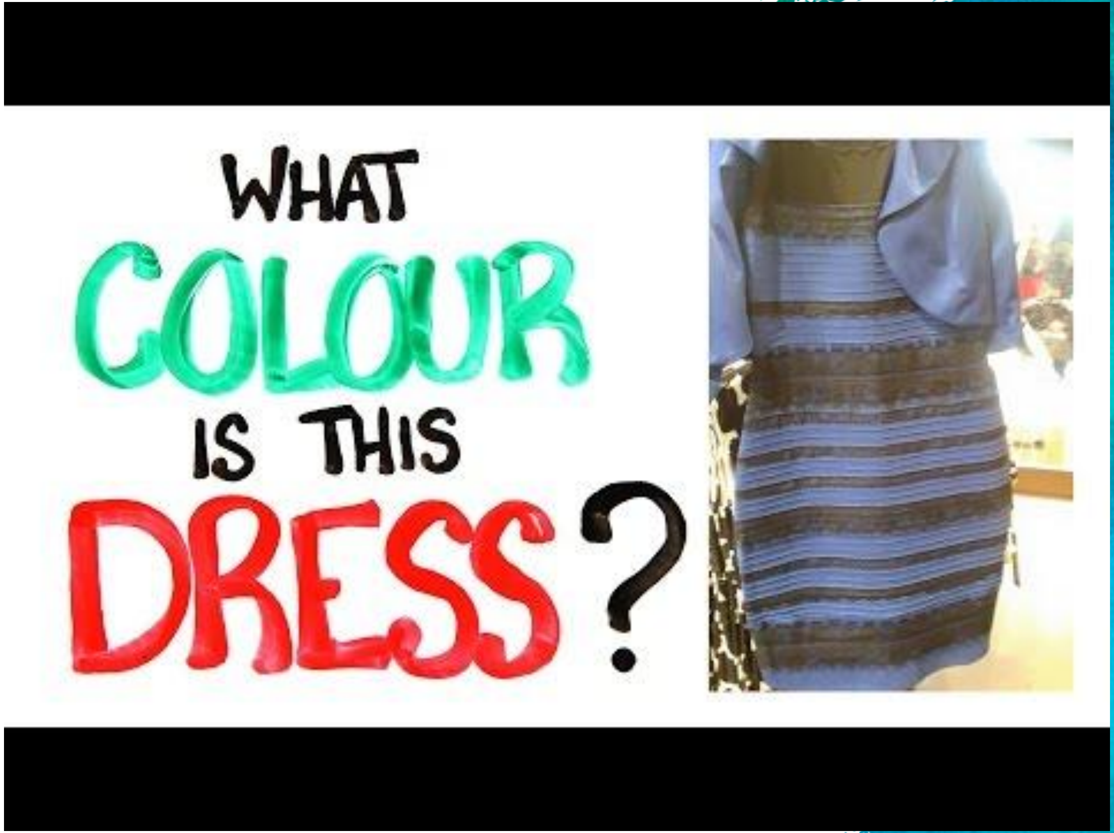
5549 GRYPHON ROBOTICS

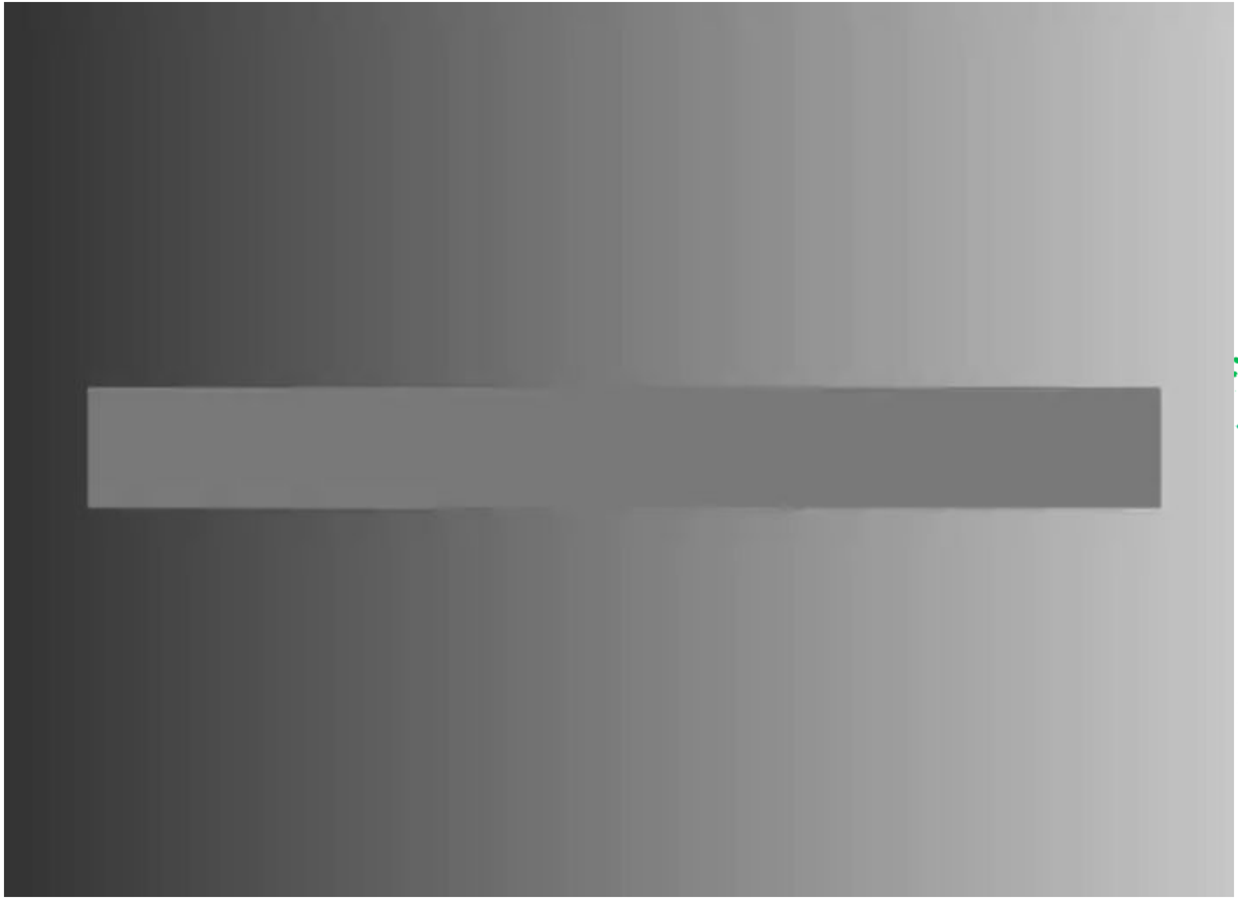


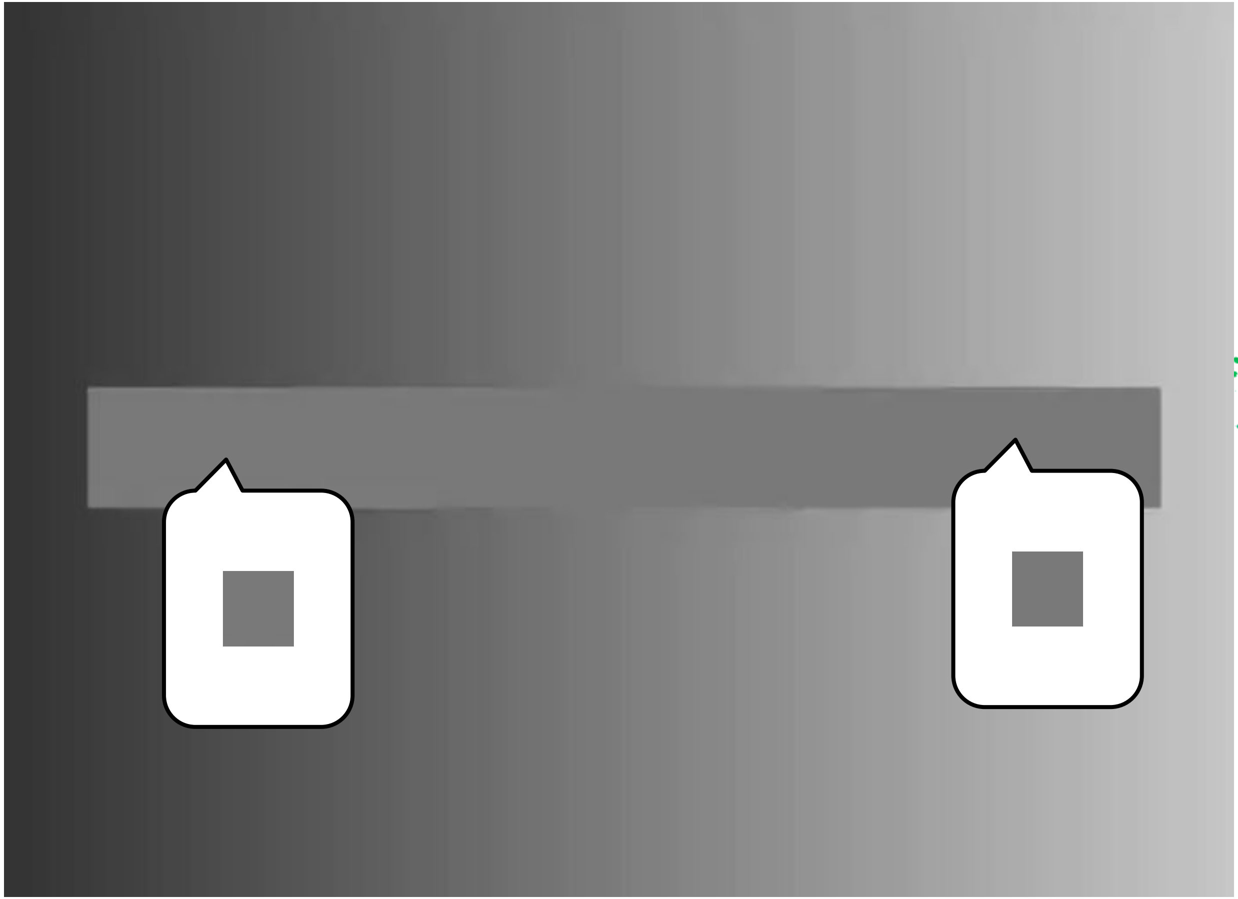
Focus on the “Art” in STEAM

Creative and critical thinking → Modern approach to science!

What Do You See?







Why Study Color and Optical Illusions?

Pilots may encounter visual illusions while flying

→ false horizon

→ Narrow runway

Safety control while driving. Use illusions to control driver speedon hazardous covers

→ Painting stripes on the road closer together as driver approach the sharpest part of curve

→ Makes drivers think they are speeding up

Lightbulbs can flicker on and off and specific intervals

→ Save about 20% of energy

→ Brain doesn't register the flicker

Camouflage

→ Used on drones, ships, airplanes, and even humans! Using the right combination of battens and colors to blend in and trick the mind.

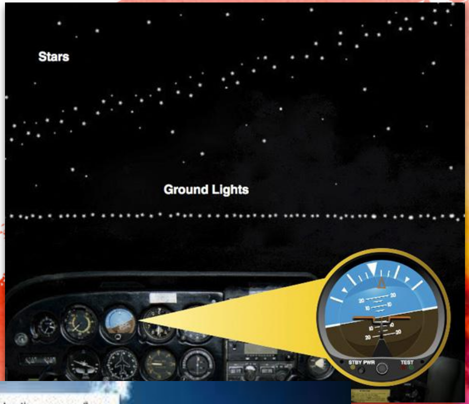
New insight on how vision and the brain work

Fashion

→ Use of colors and cut of material can help to give the illusion of different shapes and sizes

Entertainment purpo

→ Use of props and perspective of humans/objects

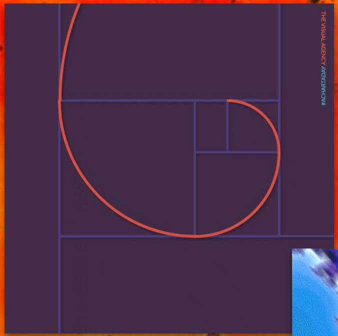


Patterns

Patterns

Materials:

- Computer
- Scavenger Hunt Document (provided)



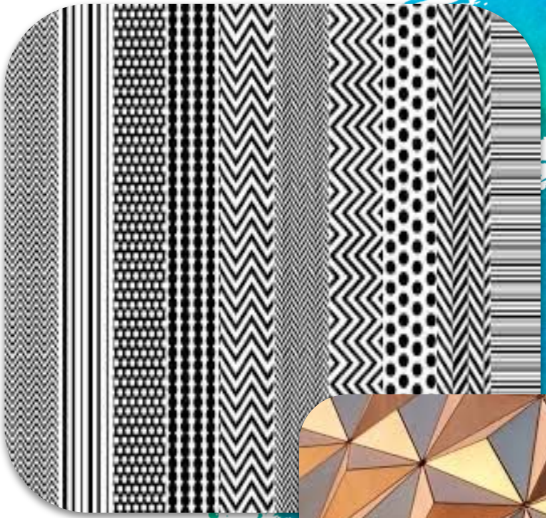
Have you ever wondered why patterns happen? What patterns are used for?

Patterns

Patterns are defined as a repeated form of design.

Patterns can occur both naturally or be man made.

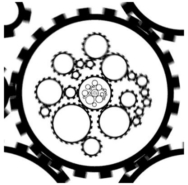
Patterns can be used to describe trends in data, further understand a concept, or simpl be used for admiration.

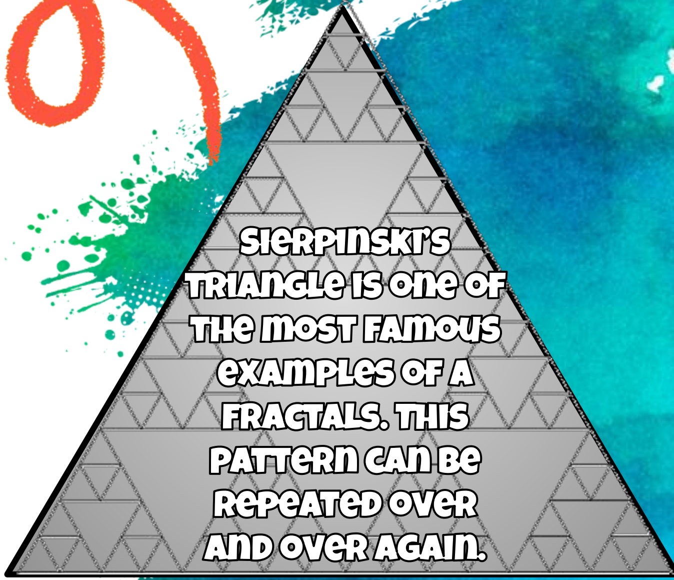


Fractals

Fractals are a mathematical pattern that happens all around us, they are essentially never ending patterns. Fractals appear all around us and are used to help explain complex theories, like the chaos theory.

In other terms, fractals is an **infinite pattern**, if you zoom into the object, the pattern will loop and loop forever. You can think of Fractals as like a hydra from greek mythology, when one head is removed, two more appear in an infinite loop.





How Fractals Help You Understand the UNIVERSE

Optical Illusions

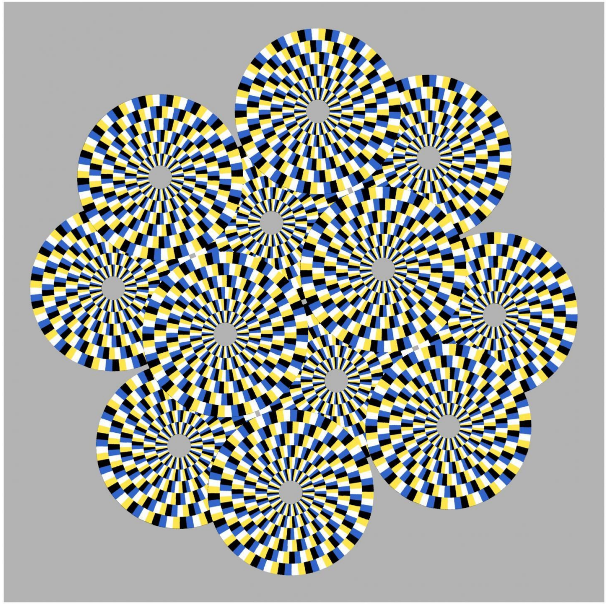
Optical illusions use color, light, and patterns to create an image that appears to be something it's not.

Optical illusions cause our eyes to deceive us and than our brain process the image wrong.

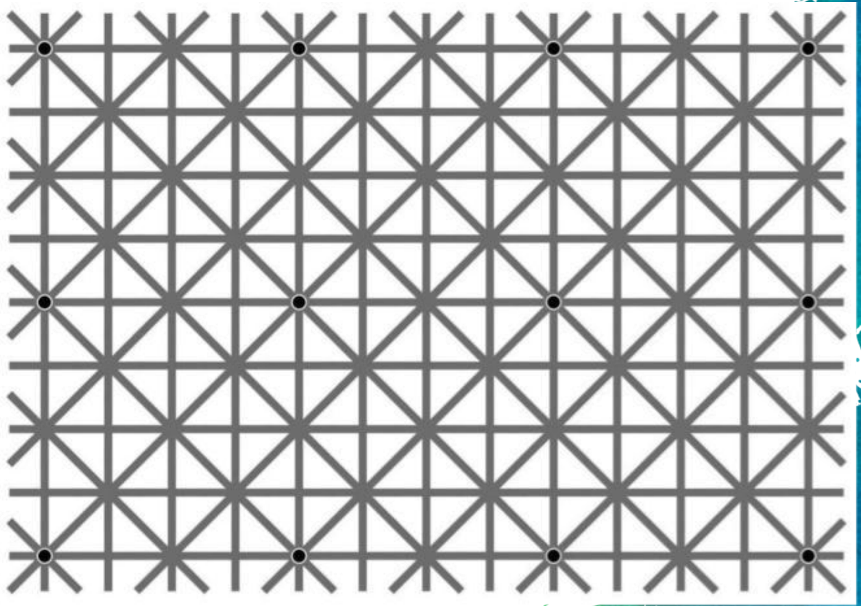
There can optical illusions that affect the shape of an object, movement of an object, color shades, size of an object, and more.

There's actually two woman in this photo, can you see them both?

More Optical Illusions

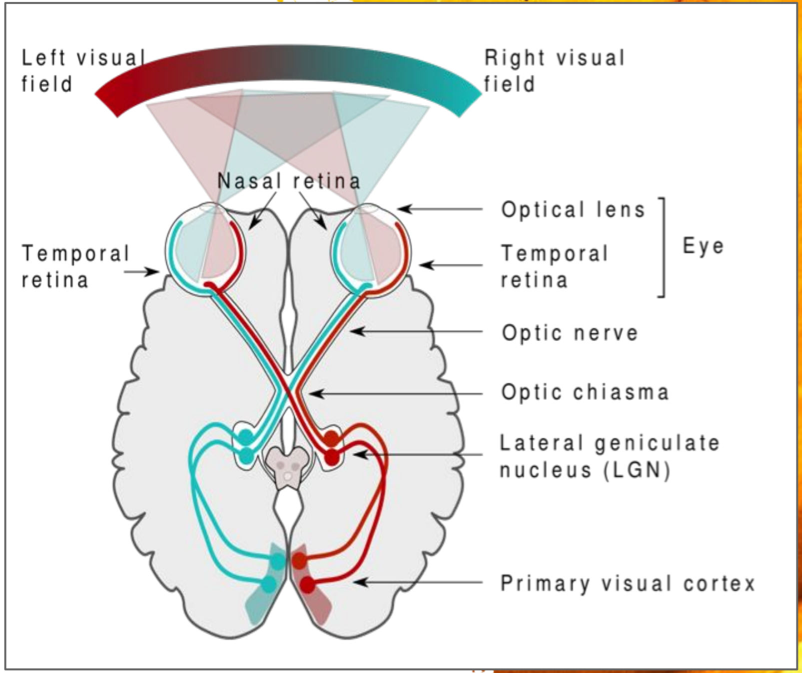


Stare at this picture. Move your eyes around slowly/head slowly and look at the center dots. What do you notice?

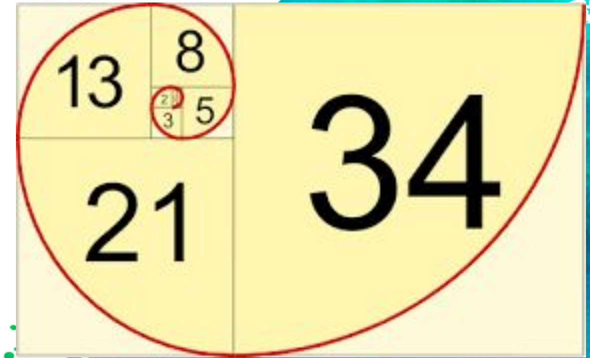


There are twelve black spots in scientist Jacques Ninio's Extinction Illusion. Can you see them all at once?

How Optical Illusions Trick Your Brain

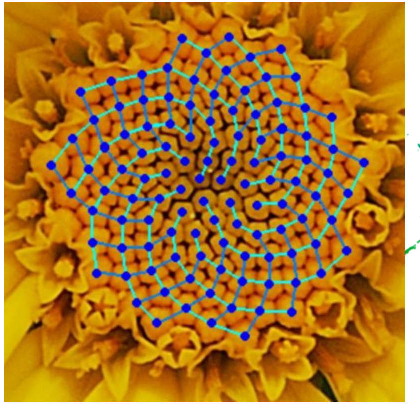


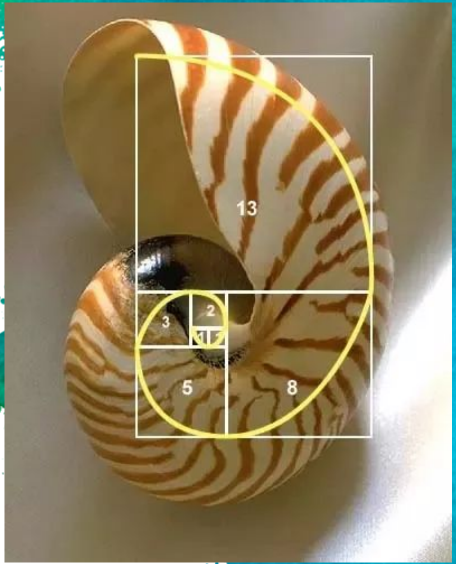
Patterns in Nature



The most common pattern that happens in nature is called **Fibonacci.**

It's number series that continues forever because you get it by adding the next number with the previous number. So it goes: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55…





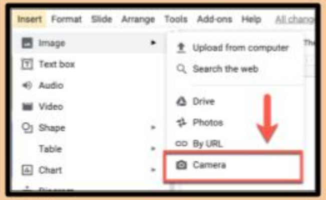
This an appear as a spiral which can be found in nature in things like pineapples, flowers, plants, shells, almost anything. Read more here!

Pattern Scavenger Hunt HERE

Try to find as many patterns as you can. Look in your house, outside, all around you! Upload what you find onto the scavenger hunt board.

NAME

Goal: Can you find these patterns? Complete 3 boxes in a row! Take a picture of the item(s) that you find to mark your space!



Want More?
Fill in ALL of the boxes

Leaf Pattern	Spiral Pattern	Zigzag Pattern
Circle Pattern	Star Pattern	Flower Pattern
Coil Pattern	Square Pattern	Stripe Pattern

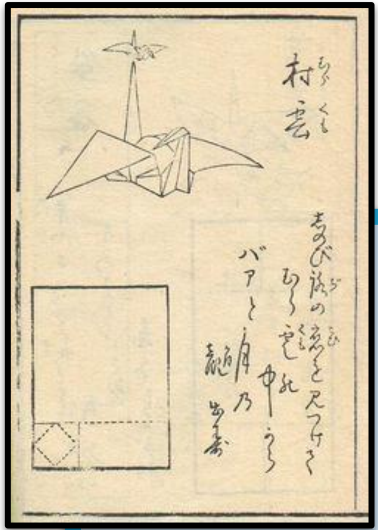
Origami

Origami

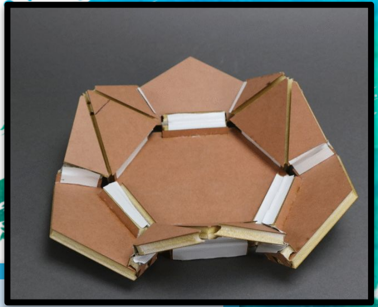
Materials:

- Printed copy of this PDF
- Scissors

Have you ever wondered about Origami? Or what origami is used for?

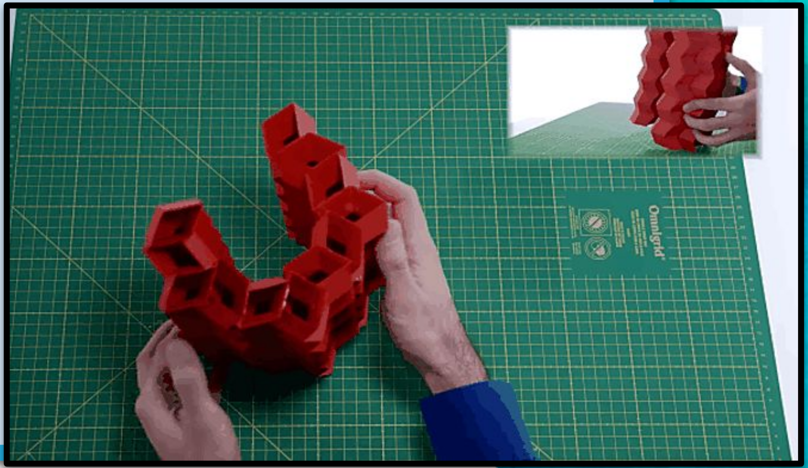


What is Origami?



History: Paper was first invented in China around 105 A.D., and was brought to Japan by monks in the sixth century. Handmade paper was a luxury item only available to a few, and paper folding in ancient Japan was strictly for ceremonial purposes, often religious in nature. By the Edo period (1603–1868), paper folding in Japan had become recreational as well as ceremonial, often featuring multiple cuts and folds.

Today: Origami has expanded to incorporate advanced mathematical theories. Mathematical origami pioneers like Jun Maekawa and Peter Engel designed complex and mathematically based crease patterns prior to folding, which emphasized the puzzle aspect of origami, with the parameters of using one piece of uncut paper. Artistic origami has also enjoyed a recent resurgence, with abstract paper folders such as Paul Jackson and Jean-Claude Correia.



The Math and Magic of Origami

Real World Application

- **Mirrors and Solar Panels**
  - Must be compact for lift-off and then quickly assemble once in outer space
- **Air Bag Design**
  - Needs to open quickly, become ridgid
  - Software with mathematical algorithm developed with origami concepts to help improve designs
- **Heart Stents**
  - Needs to be compact to fit in catheter and then expand in arteries
- **Self-Assembling Robots**
  - Watch this video HERE
- **Architecture**
  - Adjusting screens and walls to let specific light to come through
  - Shading and cladding to keep out sun and fold when not needed
- **Retinal Implants**
  - Building flat reduces cost
  - Increases amount of dense electrodes near retina due to fold

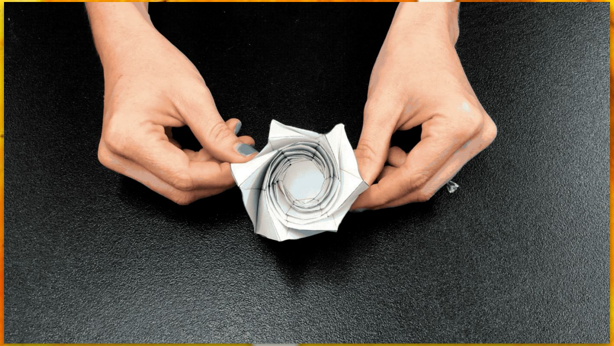
Make Your Own Starshade

In the same way as we shield our eyes from the glare of the Sun by placing our hand at arm's length in front of our face, this new device, called Starshade, could shield a telescope's camera from the light of a distant star. Starshade's precise design would block light from a star so the telescope might be able to capture an image of the planets around the star. Scientists could then study these exoplanets to learn more about them and even search for signs of life.

Origami Instructions

1. Print starshade template HERE
2. Cut out the design - follow the exterior black line
3. Crease the darker fold lines
4. Crease the secondary lighter fold lines
5. Fold major lines
6. Unfurl it

FULL INSTRUCTIONS HERE



LEARN WHAT A STARSHADE IS HERE

Color Science

Color Science

Materials:

- 6 glasses / jars
- Paper Towels
- Food Dye or Liquid Watercolor
  - Red
  - Yellow
  - Blue

Have you ever wondered why colors can mix? The difference between colors?

Color
Science vs. Art

While it may not seem like it, there a couple of differences in color when applied to art or science. This is because science and art use two different color systems!

Science

From a science point the primary colors are: **red, green, and blue**.

This is called the **Additive Color** system.

This is based off of light, so white is all the colors combined and black is the absence of color.

This is used in rainbows, prisms, and on your TV.

ART

From an art point the primary colors are: **red, yellow, and blue.**

This is called the **Subtractive Color** system.

This is based off of mixing colors and the chemical makeup of colors. White would be no colors mixed and black would be all the colors combined.

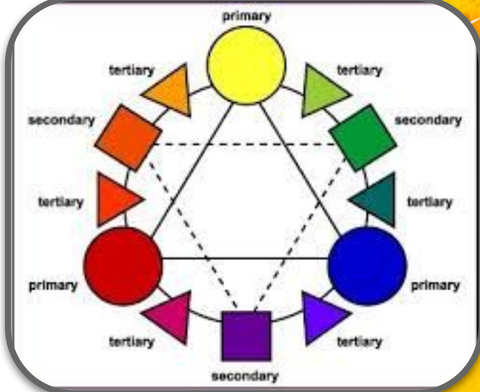
This is used when painting things or in a material world.

What's The BEST??

All colors can actually be formed by a small combination of Additive and Subtractive colors.

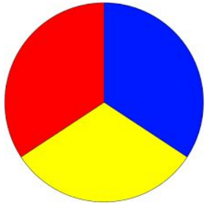
Cyan, **magenta**, **and yellow** are the three "best" primary colors. They are different than blue, red, and yellow. This is used in printers, painting, and from a science perspective!

Primary Colors and Color Wheel



<u>The Three Primary Colors:</u>

These colors can make most colors
Red, Yellow, Blue

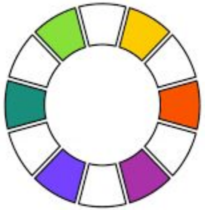


<u>Three Secondary Colors:</u>

These are the most common made by the primary colors
Orange, Green, Violet

<u>Six Tertiary Colors:</u>

Formed by mixing the primary and secondary colors
Red-Orange, Yellow-Orange,
Yellow-Green, Blue-Green,
Blue-Violet, Red-Violet



<u>Warm Colors:</u>

These are the more vibrant colors - Red, Orange, and Yellow

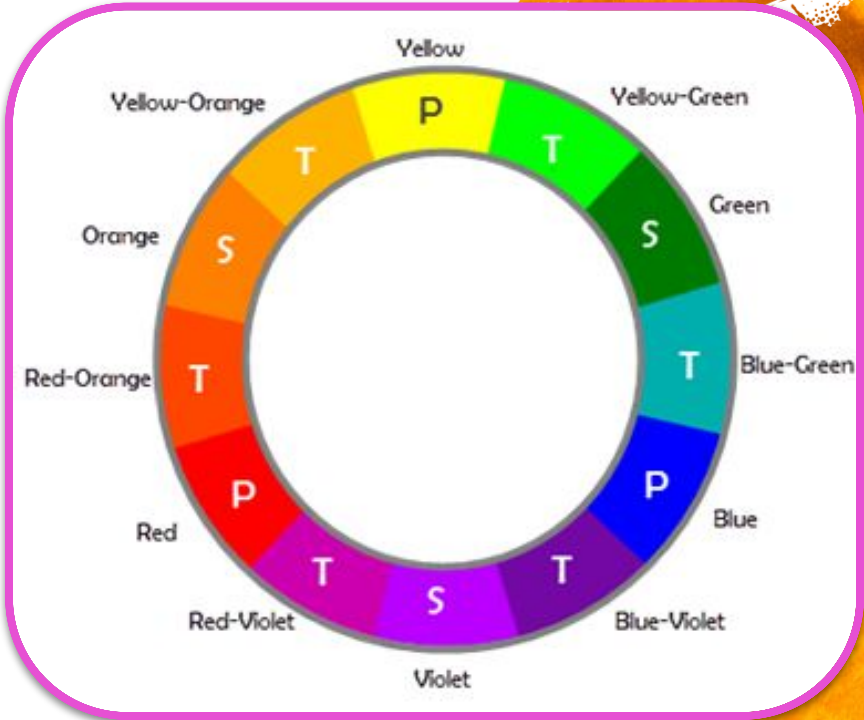
<u>Cool Colors:</u>

They are more subdued than warm colors - Green, Blue, and Purple

<u>Neutral Colors</u>

Colors that can counterbalance warm or cool colors - Black, White, Gray, Tans, and Browns

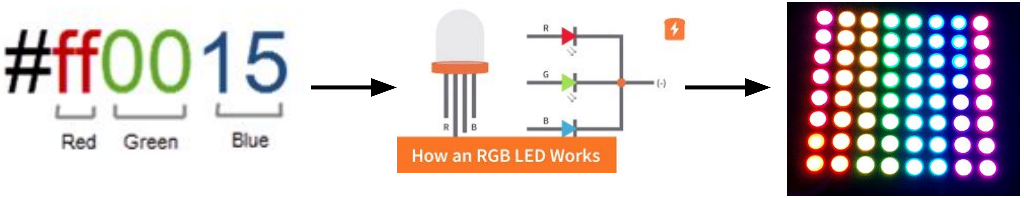
Primary Colors and Color Wheel



Color Wheel:
The color wheel is used to show the relationship between the three categories of color.

Most color wheels showcase on 12 colors but most intermediate colors, or colors formed by the Six Tertiary Colors, can be added.

Hex Codes: Commonly used in coding and design, HEX codes are shorthand for RGB values.



The Northern Lights

Rainbows

Walking Rainbow Experiment

1. Fill 3 jars with water almost to the brim.

2. Put 3 or more drops of a different primary color in each jar.

3. Place all 6 jars in a circle. Alternate the jars that have water and food dye with the empty jars.

4. Fold 6 paper towels in half, vertically. Cut about 2 inches from the bottom of your paper towel.

5. Place one end of your paper towel in the bottom of your first jar and place the other end in the bottom of the jar next to it. Submerge the paper towels as much as possible to reduce the length of loose paper towel between the jars.

6. Repeat step 5 until each jar has 2 paper towels going in different directions.

7. Watch for a few minutes as the colored water walks to the empty cups.

Materials:

- 6 glasses / jars
- Paper Towels
- Food Dye or Liquid Watercolor
  - Red
  - Yellow
  - Blue

Extensions!

- Vary the water levels you start with to see how long it takes the water to reach an empty glass
- Change the type of paper towel
- Change the amount of paper towel used
- Vary the height of filled glasses by raising them up or down on books or a set of stairs

The Science Behind

Walking Rainbow Experiment

Capillary Action, Adhesion, and Cohesion

Capillary action is the ability of a liquid to flow upward, against gravity, in narrow spaces. This is the same thing that helps water climb from a plant's roots to the leaves in the treetops. Paper towels, and all paper products, are made from fibers found in plants called cellulose. In this demonstration, the water flowed upwards through the tiny gaps between the cellulose fibers. The gaps in the towel acted like capillary tubes, pulling the water upwards.

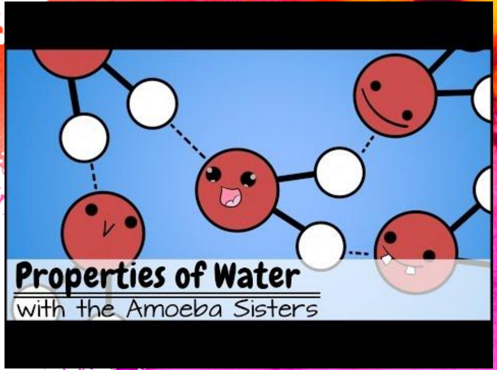
The water is able to defy gravity as it travels upward due to the attractive forces between the water and the cellulose fibers. The water molecules tend to cling to the cellulose fibers in the paper towel. This is called **adhesion**.

The water molecules are also attracted to each other and stick close together, a process called **cohesion**. So, as the water slowly moves up the tiny gaps in the paper towel fibers, the cohesive forces help to draw more water upwards.

At some point, the adhesive forces between the water and cellulose and the cohesive forces between the water molecules will be overcome by the gravitational forces on the weight of the water in the paper towel. When that happens, the water will not travel up the paper towel anymore. That is why it helps to shorten the length that colored water has to travel by making sure your paper towel isn't too tall and making sure you fill your colored liquid to the top of the glass.

Materials:

- 6 glasses / jars
- Paper Towels
- Food Dye or Liquid Watercolor
  - Red
  - Yellow
  - Blue



Color Significance History and Art

Different colors can signify different things, and those meanings have changed over time. For example, **purple** used to be the color of **royalty**. Now it's just a normal color. There are multiple different interpretations for each color and they can be specific from culture to culture. For example, in America brides wear **white** on their **wedding** day as a symbol of **purity** but in China, **white** is worn at **funeral** as the color of **mourning**.

Companies can use specific colors as a marketing tool and to brand products. Like when you see **red** you think of **Coca-Cola**, **Facebook** is **blue**.

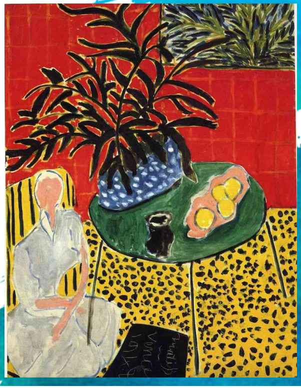
Color Significance History and Art

Color’s can be significant in art too. By using **warm** or **cool** colors artist can shape the emotions of the viewer and change the way an observer perceives the painting.

Colors like **red** can draw the viewer into the painting more and capture their attention.

A dull **blue** can be used to create a more somber tone in paintings.

CLICK on THE ART TO ReAD more!



The red background in “Interior with Black Fern,” by Henri Matisse captures the reader's attention.

In the iconic “The Starry Night” by Vincent Van Gogh, blue is used to reflect his own sadness.

Structural Design

Structural Design

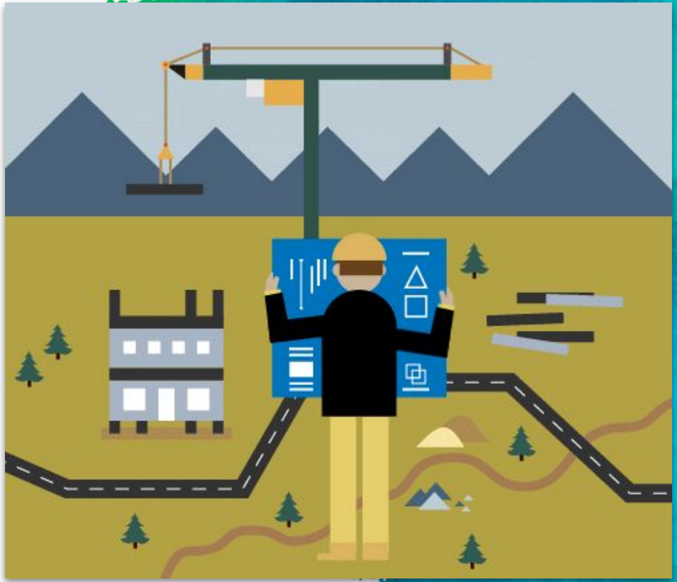
Materials:

- Popsicle Sticks (lots of them)
- Hot glue or Wood Glue
- Mini clamps (optional)

Have you ever wondered how bridges work? Who builds bridges?

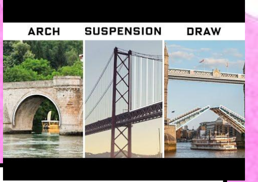
Civil and Structural Engineers

Civil and structural engineers are in charge of designing, building, and supervising major transportation projects and other major structures, like bridges and water supply systems in both the public and private sectors.



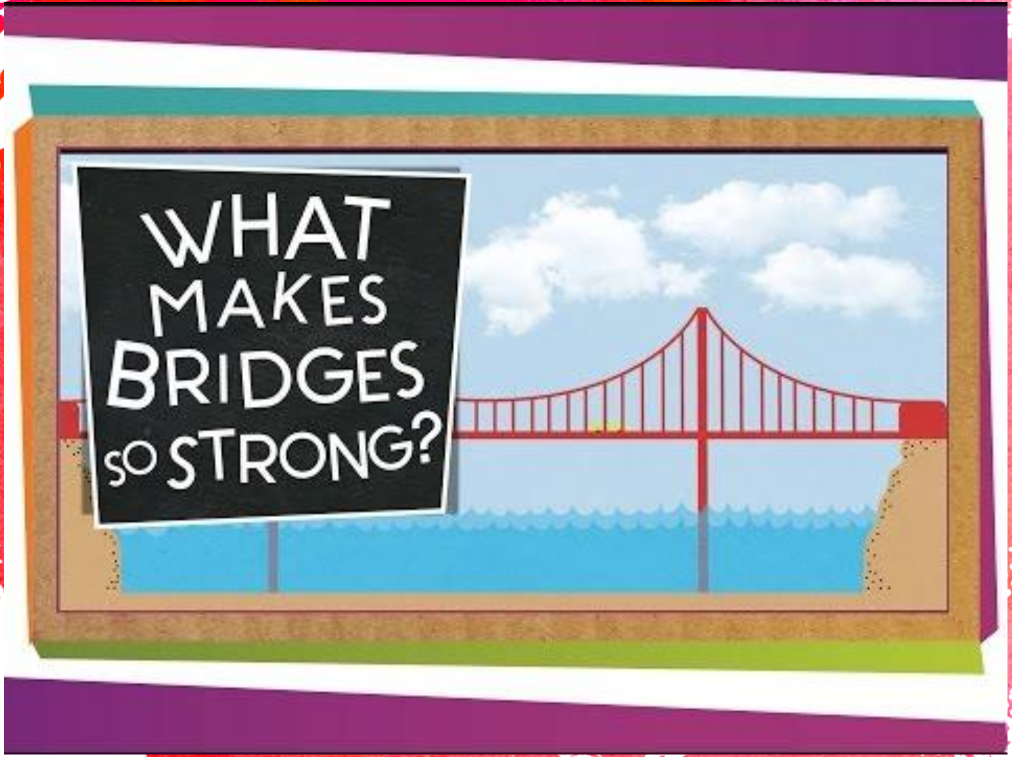
Most engineers have at least a bachelor's degrees and have experience with using mathematical process to problem solve and communicate with a team.

TYPE OF BRIDGES

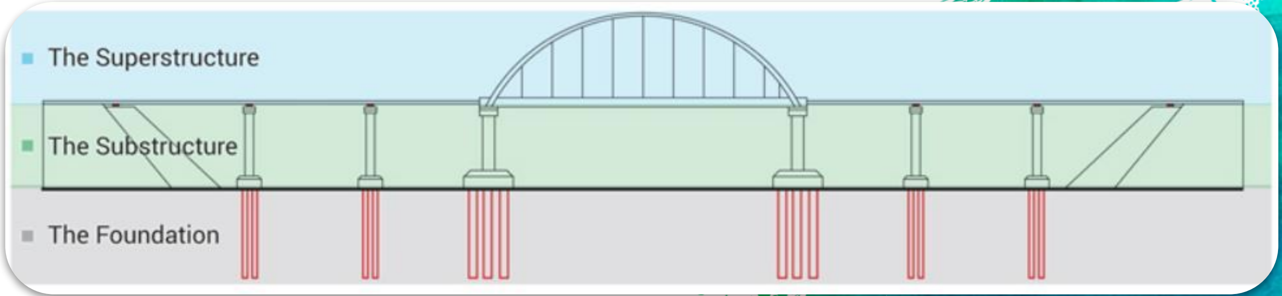


Arch Bridges	Short Span Bridges	Beam Bridges	Cantilever Bridges	Suspension Bridges
Most common types of bridges, supported by forces of compression and the arch of the bridge carries the tension	These bridges are supported by joist framing and abutments	Most of the support on these bridges comes from the edges of the bridge, most cost effective bridge	Similar to Arch Bridges but the support comes from other parts of the bridge and then connects to a supporting pier	The support of these bridges comes from the suspension of cables holding the bridge up
				

Bridge Strength



Key Aspects of Bridges



The three primary aspects of bridges are…

Foundation: holds the bridge up and is what the bridge is built upon

Substructure: components that hold the bottom of the bridge up

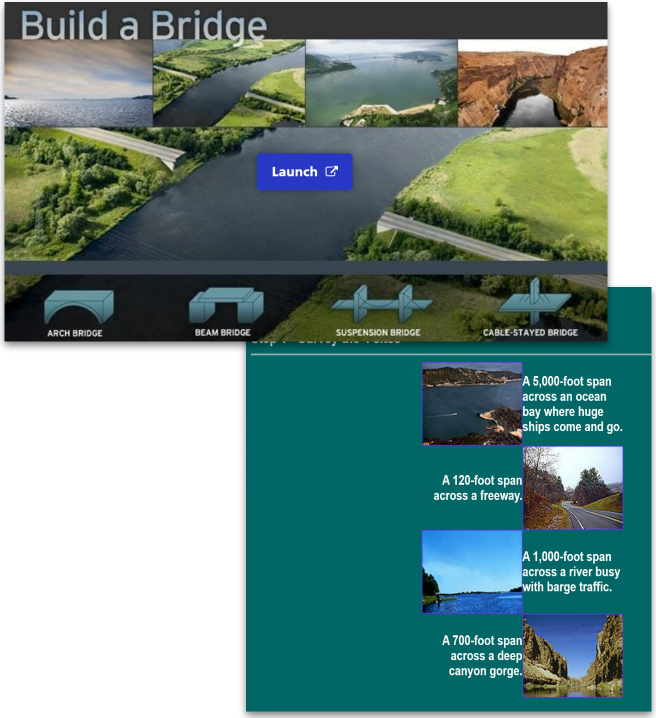
Superstructure: parts of the bridge that are built on top of the bridge

Key Aspects of Bridges

Different bridges use different components to fit the need of the bridge. These components are on a majority of bridges.

Substructure	Superstructure	Foundation
Abutment- the endpoint of the bridge	Girder- connects all the piles together, main component of a bridge	Piles- reinforced concrete posts that sits in the ground and serves as main point support for the bridge
Cap- sits on piles to provide extra support	Truss Network- framework of the bridge, in charge of distributing workload	

Test Your Knowledge



Click HERE to get started!

Step 1: Launch the interactive.

Step 2: Survey the land

Step 3: Learn about bridges

Step 4: Play the Game! (Select the non-shockwave version)

Popsicle Stick Challenge

Challenge yourself to make a bridge out of **popsicle sticks** that can hold weight. There is no wrong or right way to do this, just have fun and push yourself!

Step 1 → Design Bridge
Sketch your design out, it's recommended that you use triangles in your design. Than estimate the number of popsicle sticks that you'll need. If you need inspiration, check out the next slide. You can also use this page to help!

Step 2 → Start Glueing
Start glueing small sections of your bridge together, and then piece them all together

Step 3 → Add More Support
Add support to the bottom of the bridge using more popsicle sticks

Step 4 → Try to Break it!
Test out how much weight your bridge can hold, start small and than use more weight as needed.

Popsicle Stick Challenge

Challenge yourself to make a bridge out of **popsicle sticks** that can hold weight. There is no wrong or right way to do this, just have fun and push yourself!