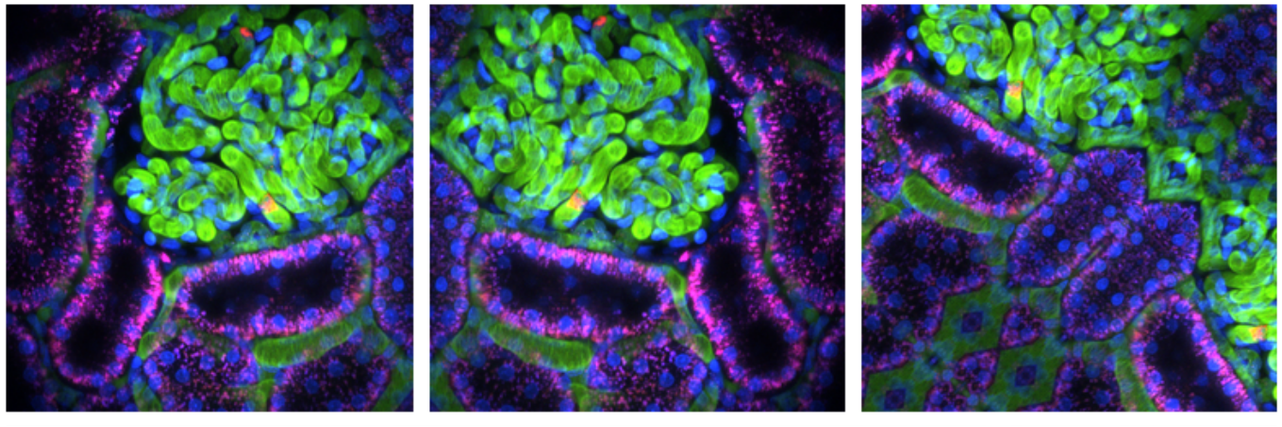
RUBEN SANDOVAL

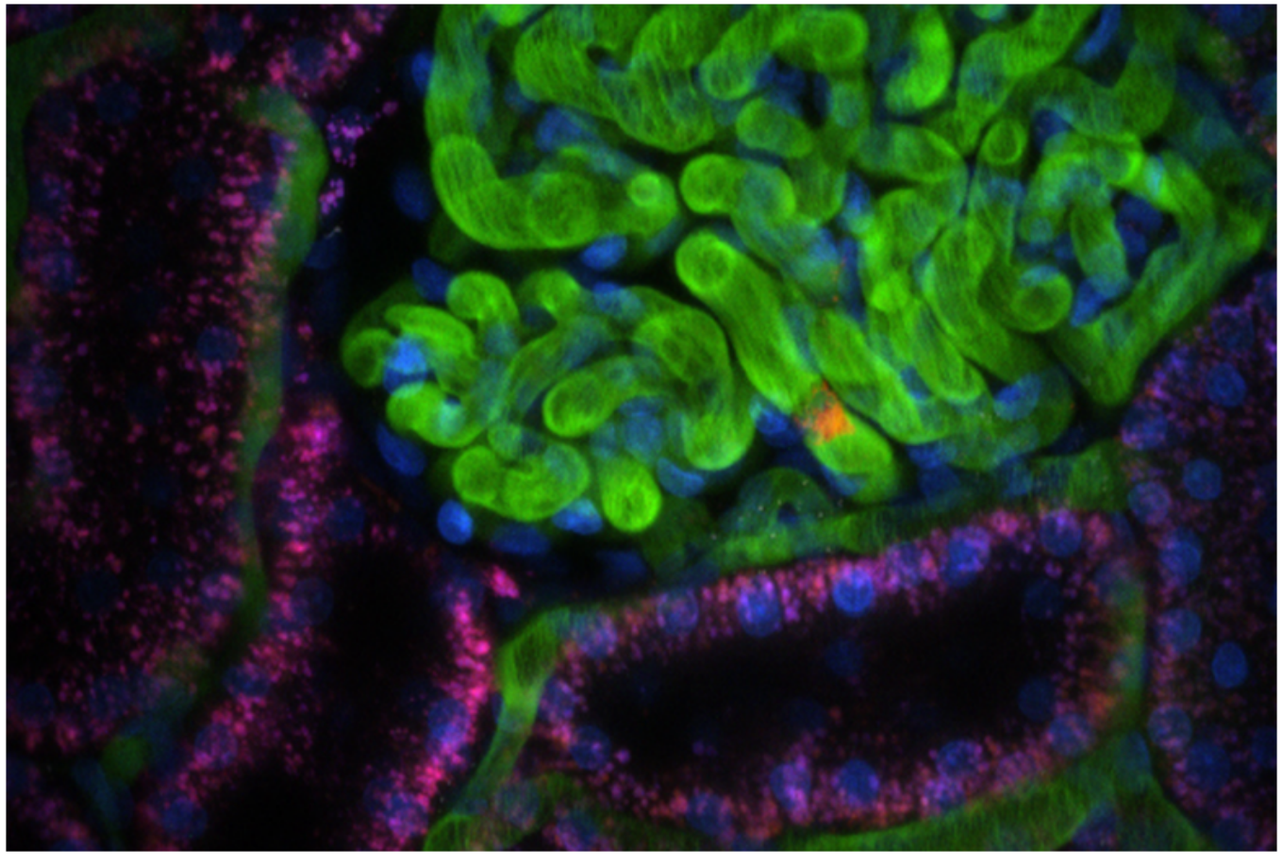
Kidney Cell Kaleidoscope

UNPACKING RUBEN SANDOVAL

Group Talk

- How would you describe Ruben Sandoval's art? Do you like it? Why or why not? You might discuss symmetry and repetition, or color theory.
- Why are his pictures so colorful? Do all of his colors work well together? Do some of them clash? Which piece has your favorite color combination? S's art is so colorful because he uses specialized dyes, which we will talk about later in this lesson!
- What is a tessellation? Where are some other places we see tessellations? In nature, in other artists' works, in architecture and history, etc.
- How do tessellations that make art like Ruben's interesting? Is symmetry always better than asymmetry?





UNPACKING RUBEN SANDOVAL

Group Talk

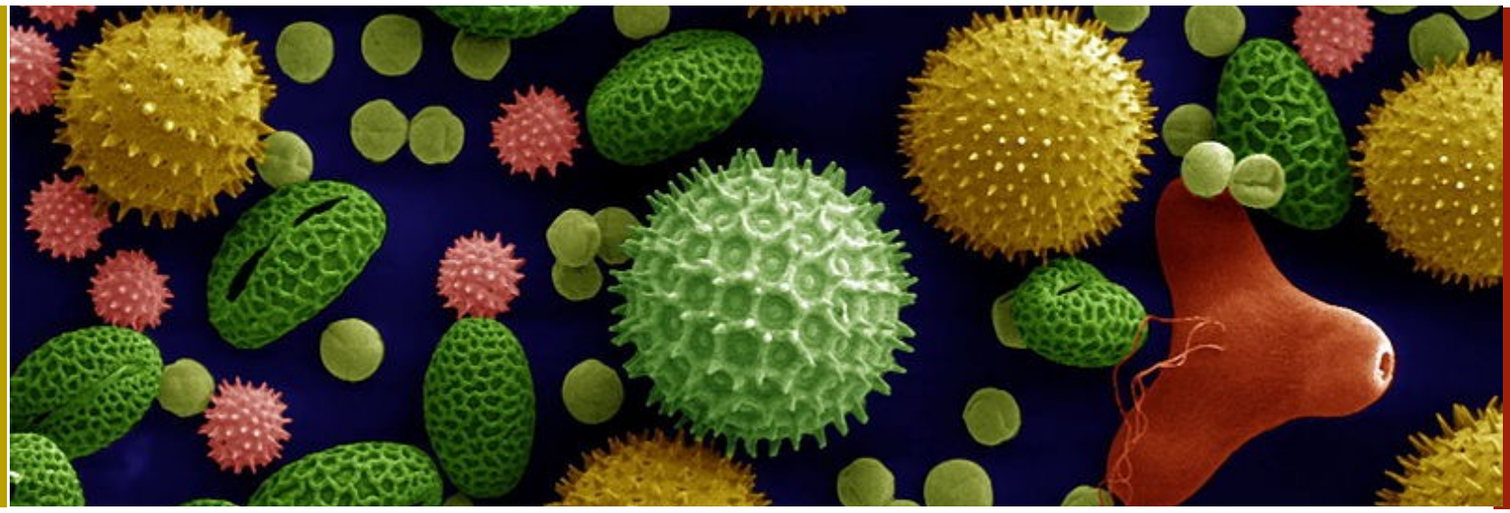
- Ruben Sandoval's work is a combination of art and science—his scientific research is the basis of the artwork he creates. Are these two creative endeavors opposites, or do they have some things in common? What influences you when you make art?
- What can scientists learn from looking at the kinds of pictures Sandoval makes? We can see cellular structures and look for abnormalities in tissues. Why might this be important?

LET'S TALK MICROSCOPY

- If we are going to understand how artists and scientists such as Ruben Sandoval use microscopy, it would be best to know some basic background info about microscopy and imaging. Here are some engaging questions to begin with:

Group Talk

- What experience do you have with microscopes? What have you seen on TV or in other classes?
- Have you ever used a microscope?
- What do we look at with microscopes? Only small things?
- Why might we want to take pictures of what we see through a microscope?



Scanning Electron microgram (color enhanced) of pollen grains, from wikipedia.org

A BIT OF MICROSCOPY HISTORY

So where did the microscope come from?

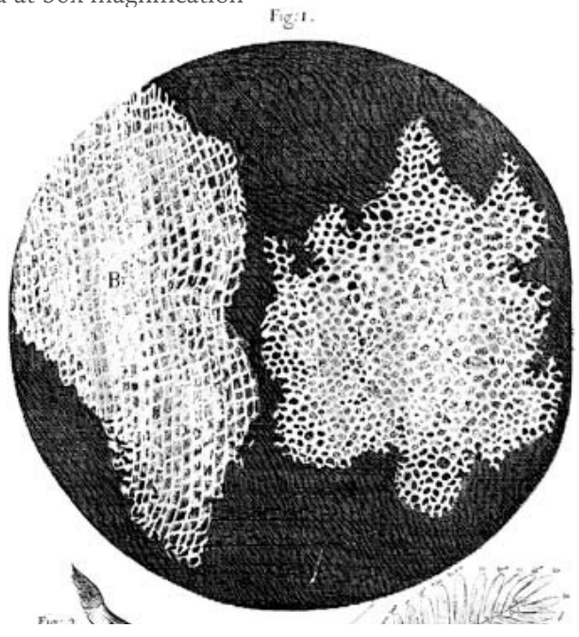
The compound light microscope (the most common and simplest form of microscopes) was invented in the early 1600s in the Netherlands. Although we don't know who invented it first, within a few decades, many scientists had built their own and were discovering the microscopic world for the first time.

The most famous of these scientists is Anton van Leeuwenhoek, who was the first to see blood cells and spermatozoa. By 1676, he had discovered the existence of micro-organisms. Because he was the first to make and use a practical microscope, he is considered the father of microbiology. Meanwhile, Robert Hook was using microscopes to look at skin tissues and plants, and he was the first to coin the term "cell" to describe the building blocks of all living organisms. With the help of microscopes, scientists could now observe and record what cannot be seen by the naked eye. They always carefully drew what they saw so that they could share their discoveries with the scientific community and other curious individuals.

Although light microscopes allow us to see much more than the human eye is capable of seeing by itself, they are limited by how much light can shine through the specimen and by how strong the lenses of the microscope are. We have solved this problem by combining microscopes with computers, so that anything that can be seen through the microscope can also be saved in the computer. Using computer technology, we can blast specimens with lasers to see through them more easily. We can also use special dyes and different UV lights to see specific substances, infections, or parts of the cell. This is how Ruben Sandoval creates his colorful artwork!

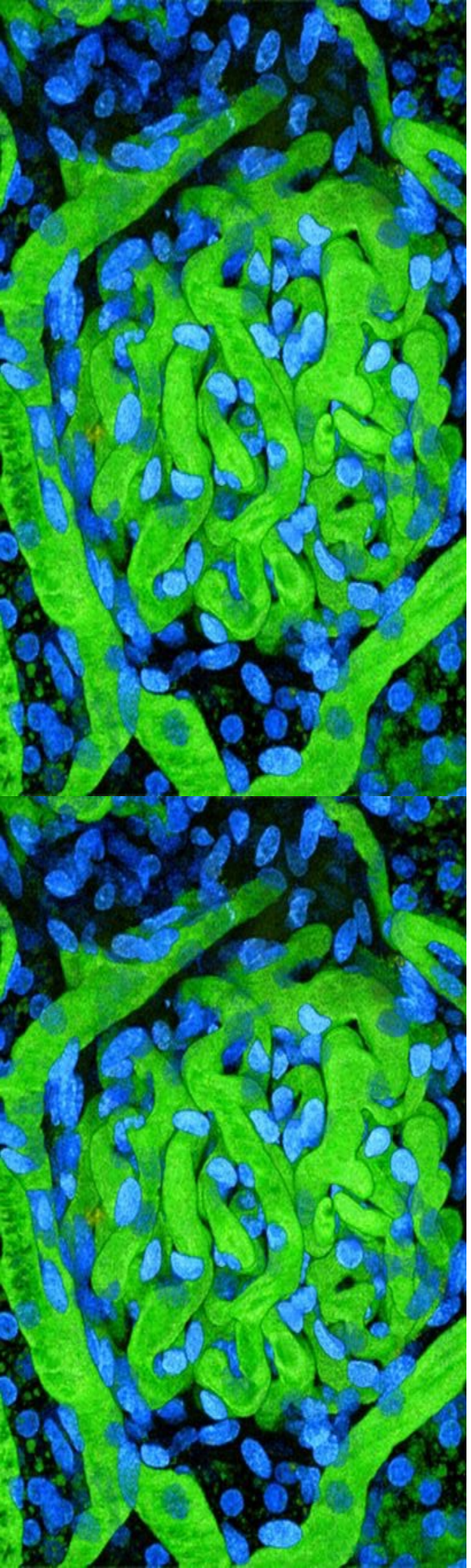
Today, scientists use many types of microscopes. We have electron scanning microscopes to see things as tiny as the inside of a virus (that's over 1 million times magnified!). That doesn't mean, however, that the good ole' fashioned compound light microscope has gone out of style. Scientists, doctors, students, and artists all over the world still use microscopes every day.

Scanning electron color enhanced micrograph (that's what you call a picture of what you see in the microscope) of an aphid at 50x magnification



Drawings of cork cells, observed through the microscope by Robert Hooke.

Microscope. 2016. Encyclopædia Britannica Online. Retrieved 20 March, 2016, from http://www.britannica.com/technology/microscope



Group Talk

- How do microscopes change the way we see and think about the world? They gave us an understanding of cells, germs, DNA, single-celled organisms, and all the countless things we couldn't see before. They helped us understand that the world is bigger (and smaller) than it appears!
- Why did scientists like Robert Hooke and Ruben Sandoval depict what they observed? Why does it matter that they shared their discoveries?
- Can scientific renderings be considered art? Why or why not?
- How do artists and scientists differ? How are they alike?
  Artists and scientists often use very different media, but they both share common goals: observe, explain, expound upon, imitate, or simply share the world they see.

HANDS-ON MICROSCOPY

Ready to try your hand at Sandoval's type of art? Let's give it a shot! Click the graphic below to watch a *Gross Science* episode called See Microbes with the DIY Phone Microscope

This short video will teach you how to make your own microscope, if you don't have one lying around. Gross Science's host, Anna, recommends looking at puddle water, but you can try just about anything! Pluck some hair. Pick a daisy. Dip into your fish tank. Scrape something suspicious off a damp tree trunk. The possibilities are endless… it's your art! Whatever you do, don't forget to record your observations!

Group Talk

- How would you describe what you see? Is it structured? Chaotic? Repetitive? Unique? Is it moving? Is it alive, or dead? Is it beautiful, ugly, or somewhere in between?
- Why would someone want to look at what you're looking at?
- Look at your drawings. Would you consider them art? If you saw these pictures hanging in a gallery, what sort of message or feeling would you think the artist was conveying?

Specimen:_____

Notes:

Specimen:_____

Notes:

Specimen:_____

Notes:

TESSELLATIONS ARE EVERYWHERE

www.freegreatpicture.net/animal-collection/bees-and-honeycomb-21462

https://www.pinterest.com/pin/153192824802533813

TESSELLATIONS IN THE WORLD AROUND US

Tessellations can be found in many areas of life. Art, architecture, and nature hold many examples of tessellations in our everyday surroundings. Some specific examples include oriental carpets, quilts, origami, and Islamic art and architecture.

geoinnature.blogspot.com/2012/04/tessellation-examples.html

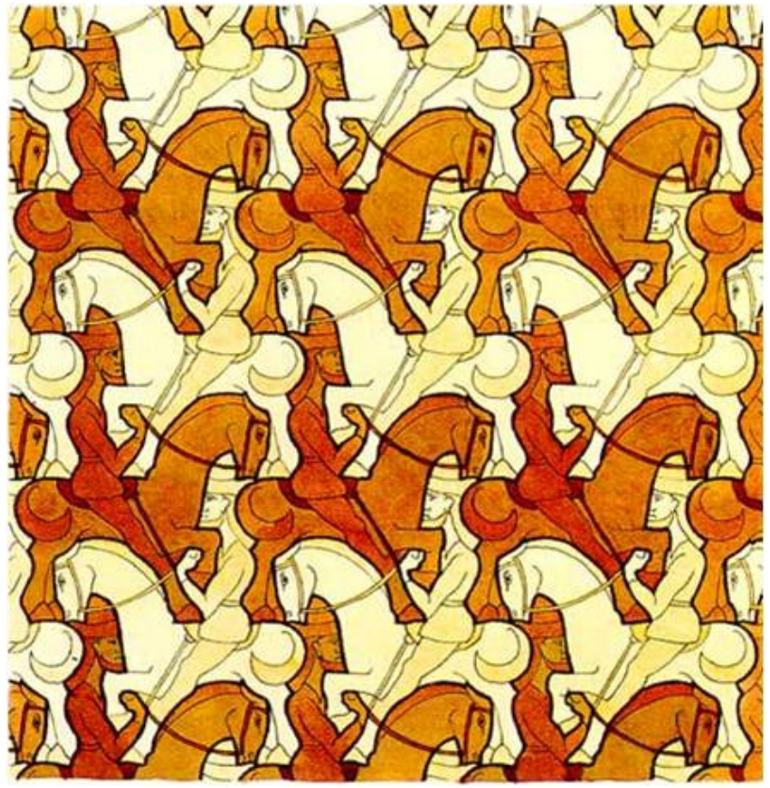
http://www2.gvsu.edu/oxfordj/angie.html

Group Talk

- Where do you see tessellations in your life?
- Why do tessellations matter? How can they be useful and helpful?

What are tessellations?

- Tessellation is another word for tiling. A tessellation is created when you fit individual tiles together to fill a flat space like a floor, wall or ceiling without gaps or overlaps.
- Although we do not know when tiles were first invented, the Tile Association notes that pieces of tiles dating from between 12,000 and 18,000 years ago have been found in sites located along the the Nile River.



mmsart.blogspot.com/2011/11/teasing-tessellations.html

Sandoval and Tessellations

- Notice how the patterns in Sandoval's artwork repeat over and over? The same image gets repeated throughout the piece and could continue forever. That makes it a tessellation!

tdbcons.com/art-by-ruben-m-sandoval

Group Talk

- Why do you think Sandoval tessellated his pictures? Do you think they look better before or after he tessellated them?
- Symmetry plays a major role in tessellations. Do we see more symmetry or asymmetry in our lives?

IS TESSELLATION ART OR MATH?

Maurits Cornelis Escher (M. C. Escher)

www.goodreads.com/book/show/558558.The_Magic_of_M_C_Escher

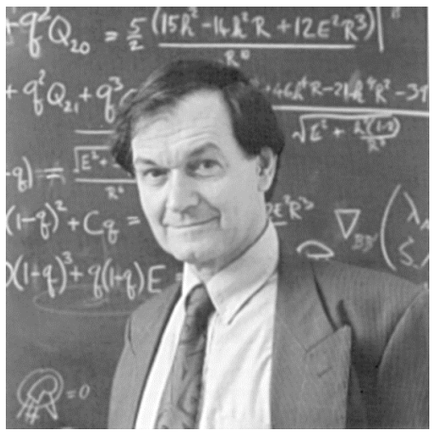
M. C. Escher was an amazing artist who was influential in incorporating tessellations into art. In his early years, Escher sketched landscapes and nature. He also sketched insects such as ants, bees, and grasshoppers, which appeared frequently in his later work.

Escher did not have mathematical training; his understanding of mathematics was largely visual and intuitive.

Check out http://www.mcescher.com/about/biography/ to learn more about M. C. Escher!

https://www.pinterest.com/pin/38280665557450532

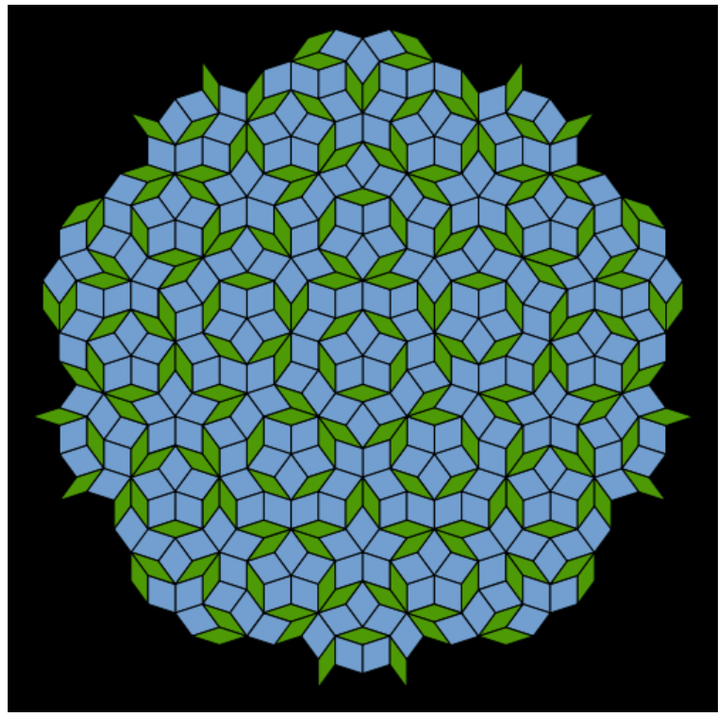
Sir Roger Penrose



www.worldofescher.com/misc/penrose.html

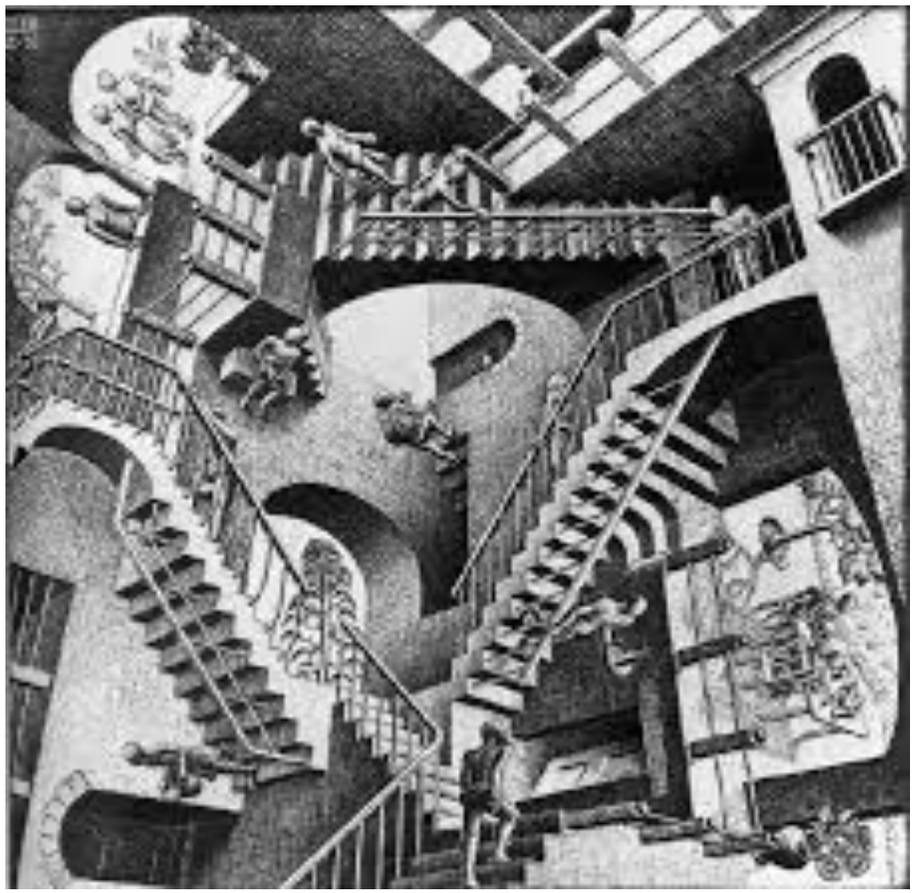
Sir Roger Penrose was born August 8, 1931, in Colchester, Essex, England. He was knighted for his services to science in 1994. Penrose was very involved in mathematics and grand calculations about matter in outer space. He calculated many of the basic features of black holes. In 1969, with Stephen Hawking, Penrose proved that all matter within a black hole collapses. He was also a lover and inventor of mathematical puzzles such as the Penrose Stairway.

There is even a specific tessellation named after Penrose. A Penrose Tiling must be constructed to have both reflection symmetry and fivefold rotational symmetry. Go to http://www.britannica.com/biography/Roger-Penrose to learn more about Sir Roger Penrose!



en.wikipedia.org/wiki/Penrose_tiling

“Only those who attempt the absurd will achieve the impossible. I think it’s

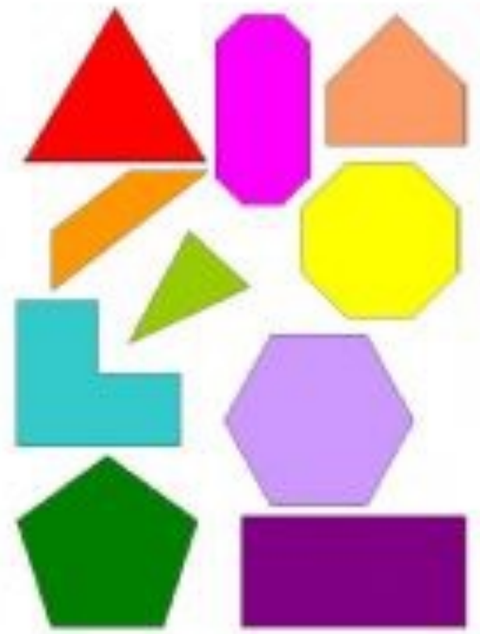


in my basement... let me go upstairs and check.”

-M. C. Escher

ACTIVITY: INTRODUCTION TO TESSELLATIONS

Creating Tessellations



http://www.eslprintables.com/printable.asp?id=52668

➢ Objectives – NCTM Grade 6-8 Standards: Geometry, Reasoning and Proof, Communication and Connections

1. To manipulate triangles, squares, hexagons, trapezoids, and rhombuses to see how they might combine to form patterns in the plane.

2. To consider which of these patterns are tessellations and which are not using the definition that a tessellation is a tiling with shapes that cover the plane without gaps or overlaps.

3. To consider which of these patterns are regular tessellations and which are not using the definition that a regular tessellation is a tiling with shapes that cover the plane in a regularly repeating pattern without gaps or overlaps.

➢ Materials

Activity pattern blocks or paper cutouts of shapes such as squares, circles, hexagons, pentagons, triangles, diamonds, trapezoids, rhombuses, and others or your choice.

➢ *Procedures*

1. Instruct the students to make patterns with the blocks, making certain that they leave no gaps or spaces.

2. After each student or group of students has a pattern, have all of the students rotate around the room to view each others' products.

3. Discuss the patterns.

4. Discuss the relationships between the blocks.

http://mathforum.org/sum95/suzanne/active.html

➢ *Questions*

Which shapes fit together easily?

Which shapes don't seem to fit with the others?

Which patterns could be repeated over and over again in the plane?

What shapes fit together making a pattern using only one type of block?

What shapes fit together making a pattern using two blocks that are different?

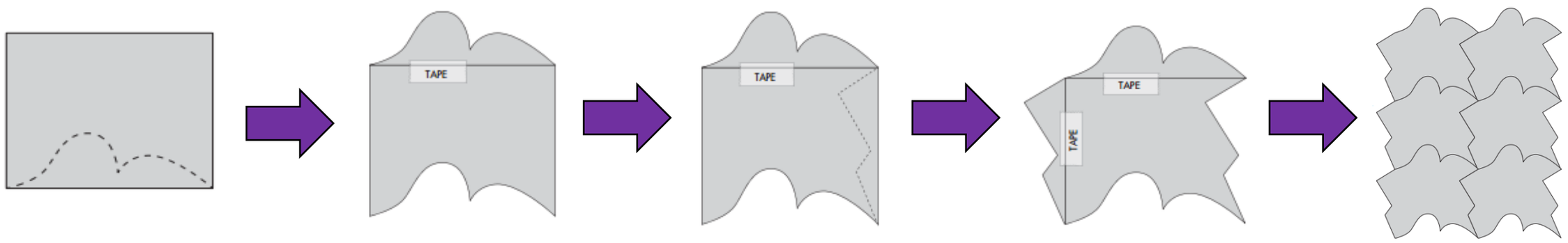
What shapes fit together making a pattern using three blocks that are different?

ANOTHER TESSELLATION ACTIVITY

Sometimes it is hard to see how we can make tessellations with shapes other than regular polygons like squares, circles, triangles, and others.

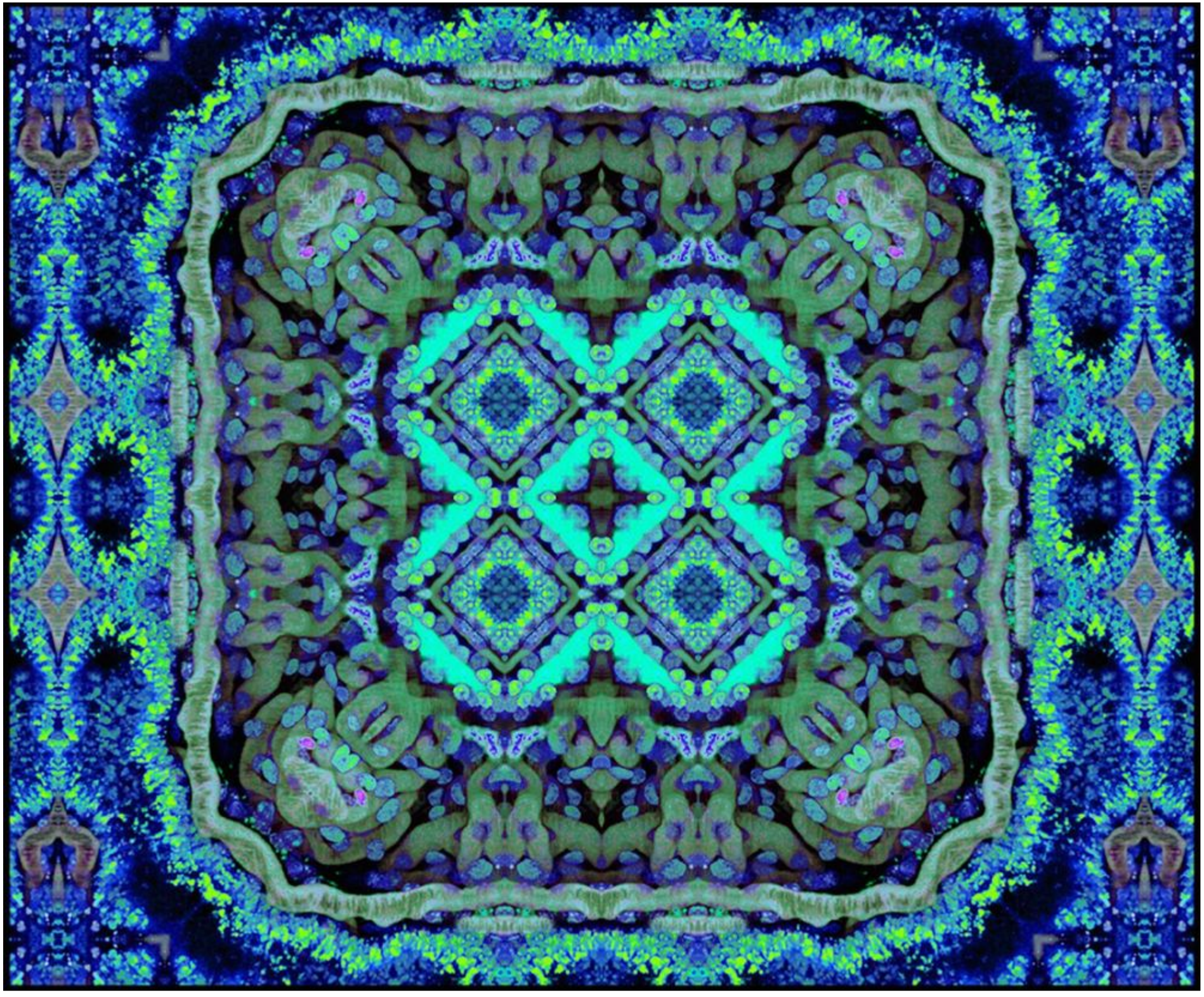
This activity provides instructions for how to create tessellations from ***any*** shape!

Here's a quick look at what the activity asks students to do:

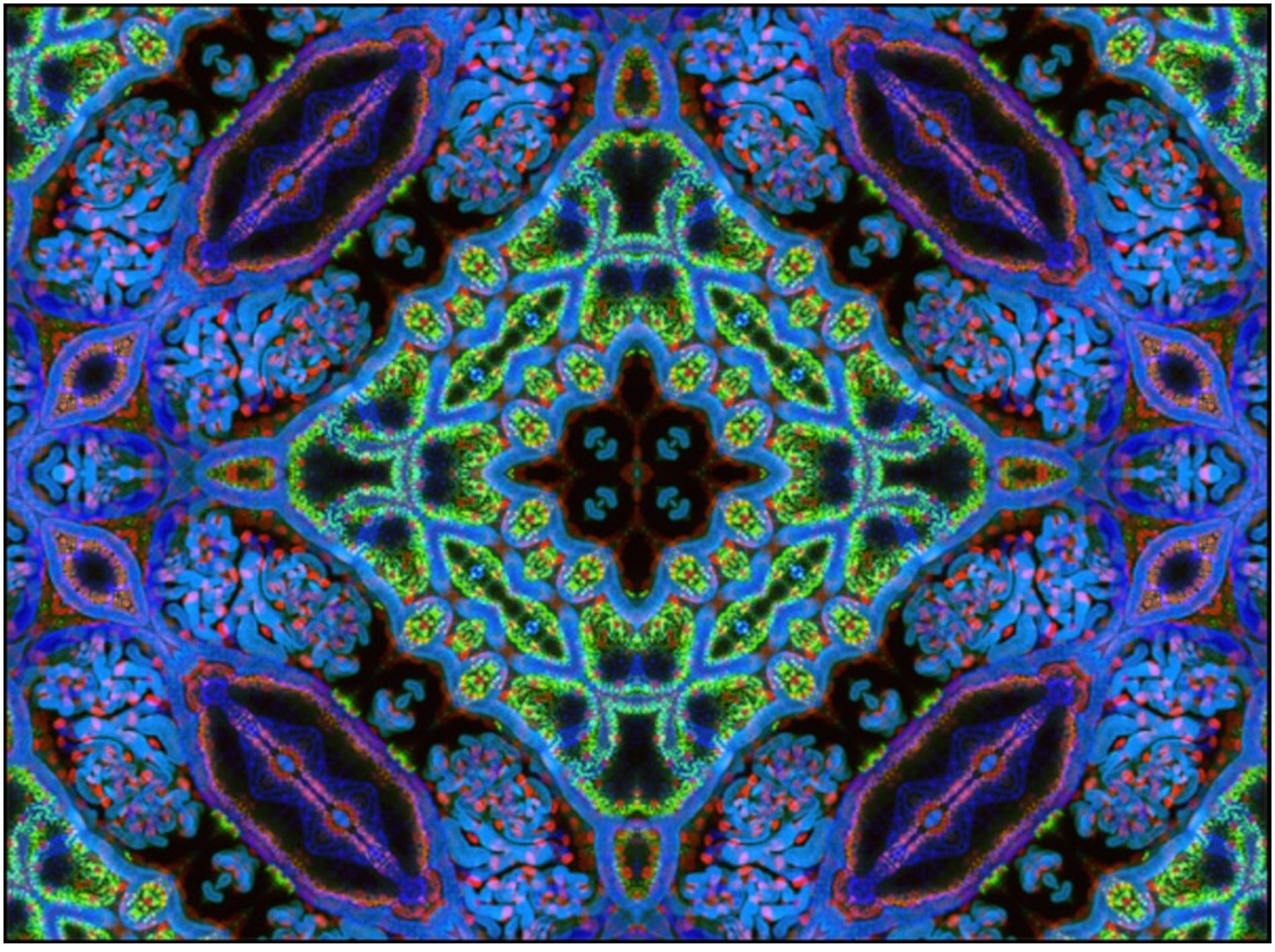


Take a look at this link for the full activity:

http://www.exploratorium.edu/geometryplayground/Activities/GP_Activities_6-8/ExploringTessellations_%206-8_v4.pdf



“Tessellated Kidney I” Ruben Sandoval



"Tessellated Kidney V" Ruben Sandoval

ASSESSMENT

Assessment for Project

	Failed to Complete	Almost Finished	Great Job!	Went above and Beyond expectations
EFFORT LEVEL	***NO EFFORT***	***LITTLE EFFORT***	***GREAT EFFORT!***	***AMAZING EFFORT!***
Followed instructions				
Demonstrated understanding of the process				
Incorporated the concept of tessellation into the artwork				
Used bold color to enhance the artwork				
Demonstrated Originality of work				
Completed work in a timely manner				
Thought through & utilized entire process				
Exhibited Craftsmanship				
Showed respect for others and their work				
POINT VALUE	**0**	**1**	**2**	**3**
TOTALS				

As you probably already know, assessment within the arts is incredibly messy. As an educator, my goal has always been to focus primarily on effort, and very clear, measurable skills. Feel free to adjust this rubric to fit your goals as well as those of your students.

Total Number of points = _____

Extra sketches (10pts. Possible) = _____

Total Points = _____

Consistent Effort demonstrated 22-30

Some Effort demonstrated 15-21

Little Effort demonstrated 0-15