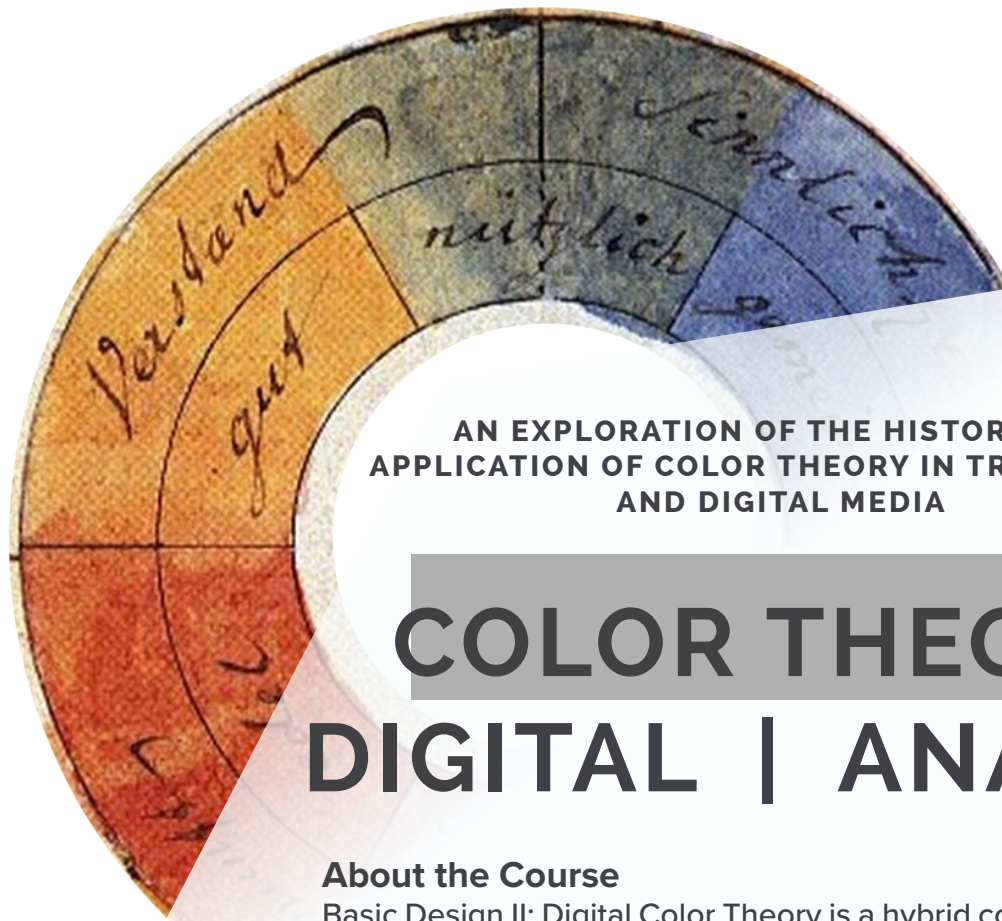


Basic Design II: Digital Color Theory



AN EXPLORATION OF THE HISTORY AND
APPLICATION OF COLOR THEORY IN TRADITIONAL
AND DIGITAL MEDIA

COLOR THEORY DIGITAL | ANALOG

About the Course

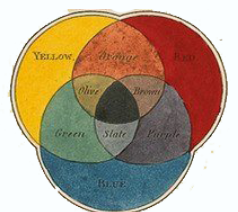
Basic Design II: Digital Color Theory is a hybrid course with studio sessions alternating between the design studio and the digital lab. Student artwork is scanned on the library's large-format scanner and becomes the basis for digital projects.

Digital | Analog Project

The Digital | Analog Project is a major milestone for the course as a whole, it structures students into teams which explore the history and application of color theory from different viewpoints. Students create group presentations, paintings, and digital artwork during the course of this project. The team-based rivalry results in an energized atmosphere, with teams scoring points on a leaderboard over the course of the semester.

Tools | Media

The analog portion of this lesson requires a standard color theory supplies set consisting of drawing pencils, pen and ink, and gouache or liquid watercolor paints. The digital portion of this assignment requires the Adobe suite of programs and uses Photoshop and Illustrator.



PROCESS OVERVIEW

*Sections in black are ones we can cover during the teaching presentation.

1. STUDENTS DIVIDE INTO TEAMS

2. READING AND RESEARCH

3. CONCEPTUAL FRAMING

4. BATTLE / DISCUSSION

5. IN-CLASS NEWTON EXPERIMENT

6. PAINT NEWTON COLOR WHEELS

7. DIGITAL NEWTON COLOR WHEELS

8. IN-CLASS GOETHE EXPERIMENT

9. PAINT GOETHE COLOR WHEELS

10. DIGITAL GOETHE COLOR WHEELS

11. CREATIVE COMPOSITION

12. CONCLUSION

TEAM NEWTON

Students who join #TEAMNEWTON are scientists interested only in greater truth. For #TEAMNEWTON color is a best thought of as pure physical phenomena. We can discover new things about color through observation and experimentation. Newton proved that white light contains all colors. Color theory is an extension of physics and there is always more to be learned. When there is no light, there is no color. Color is phenomena that can be explained by a contained mathematical solution.

TEAM GOETHE

#TEAMGOETHE have other ideas. Color is best understood as a sensation within the individual perceiving it. All human sensation and emotion can be connected to color. Color takes place inside the mind of the viewer and so is best understood as a reflection of the architecture of consciousness. All color is not contained in light, darkness also contributes to color and should be thought of as a separate substance which interacts with light and changes its properties. Color is best explained by psychological association.

Choose your team

Write your name below to choose your team allegiance. Team members should assign captains to lead and organize their team. The teams can receive bonus points for using the hashtags on the Newton V. Goethe facebook page, as long as it is relevant to the spirit of the project.

#TEAMNEWTON FTW!

GO! GO! #TEAMGOETHE

Reading

This assignment is based on Newton's *Opticks* and Goethe's *Theory of Colours*. Both works are public domain and readily accessible. They are somewhat difficult to read but easy to understand if you go slowly. Teams meet separately and organize themselves so that each team member has to read one chapter and summarize it in class. The teams can receive bonus points for using the hashtags on the Newton V. Goethe facebook page, as long as it is relevant to the spirit of the project.

[Newton's
Opticks
\(1730\)](#)



[Goethe's
Theory of Colours
\(1840\)](#)



NEWTONIAN CONCEPTS

Digital

Signals or information that can be expressed numerically. Digital information can be reduced to numbers and quantified. For something to be true, it should have a simple mathematical expression

Epiphany

The human mind is an instrument for the discovery of truth. Inspiration and insight lead us ever closer to truth. Our senses prepare us for epiphany, but we must use mathematics to express the truth we feel. When I saw the apple fall I knew the truth of my gravitational equations.

[Borges](#)

[Funes the Memorious](#)
[1942](#)



GOETHIAN CONCEPTS

Analog

Sources of information can have infinite variation and therefore can't be expressed numerically. Human experience itself is analog. Think of our sense of touch, an infinitely variable source of information that could never be codified. The language of mathematics is too simplistic to address human experience.

Apophany

The human mind is not a mathematical structure, it is instead the center of a sensorium. Truth can't be discovered through sudden ecstatic revelation. Ecstatic revelation is a truth unto itself. When I fell in love, I felt that everything I saw overflowed with infinite meaning and ever-increasing connection.

Analog Mathematics

Imagine a system of analog mathematics. Numbers are not based on pattern or repetition, but each number is seen as a distinct experience. Such a system would be non-functional, the only way to experience it would be to spend your life counting. Borges explores these ideas in his short story, Funes the Memorious. Students will read this story as part of our discussion.

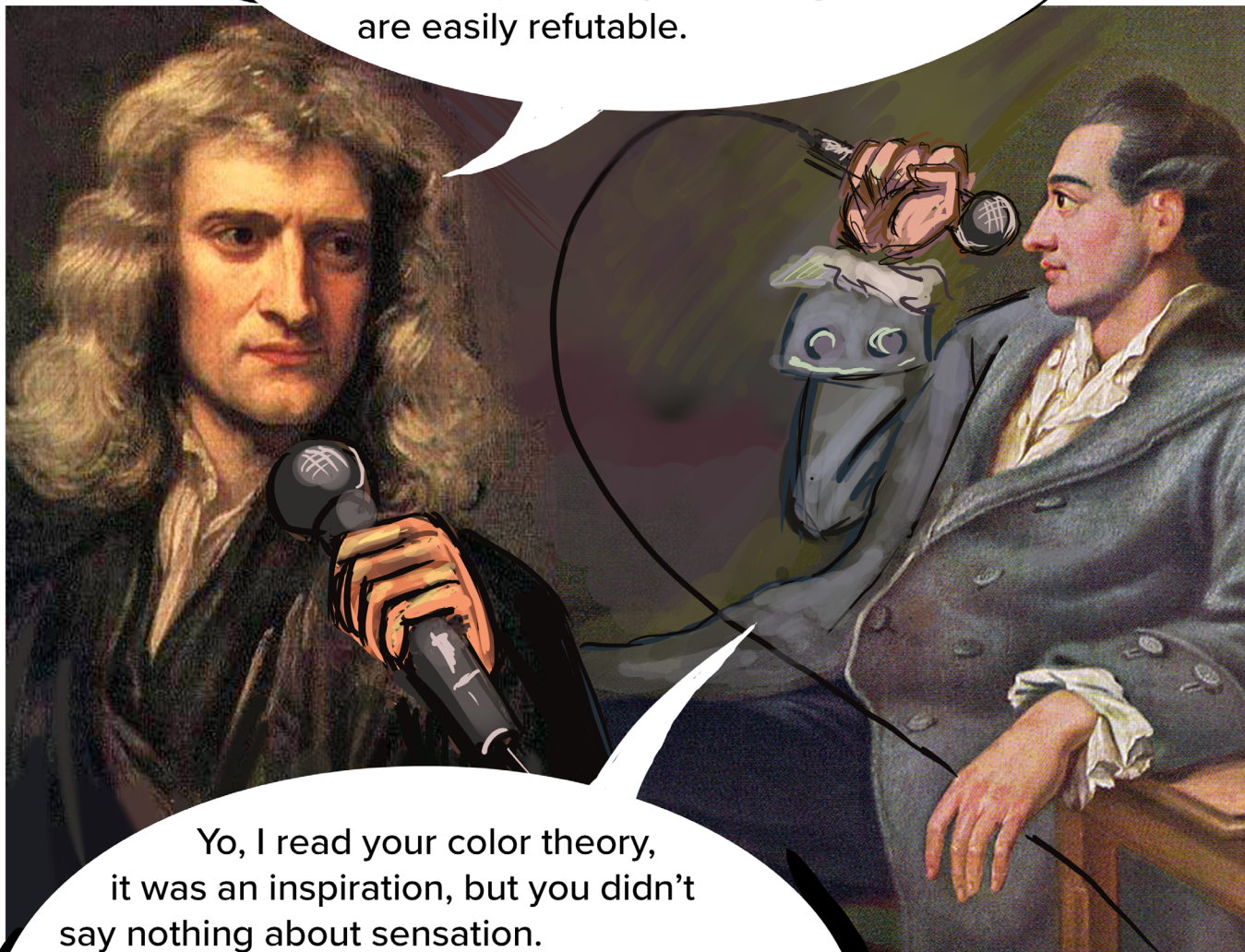
Synthesis

Students have finished the reading and specialized in either Newton or Goethe on their teams. Next they prepare to communicate their knowledge to the whole class in the form of a discussion.

In-class discussion or rap battle

The discussion consists of rounds, each led by one team. After each round the other team has a chance to respond. During the response students should attempt to challenge the ideas presented by the other team by referring to their area of expertise. Extra credit for creativity.

Yo, Name's Newton. Ever heard of me? I'm guessing probably. I'm the greatest scientist in history. By the way I invented gravity. Without me you'd be floating free above the trees. Oh wait, you want to battle me? I put an end to medieval fiction. I shattered white light with my prism. I followed my intuition. The truth is indisputable, your retrograde ideas are easily refutable.



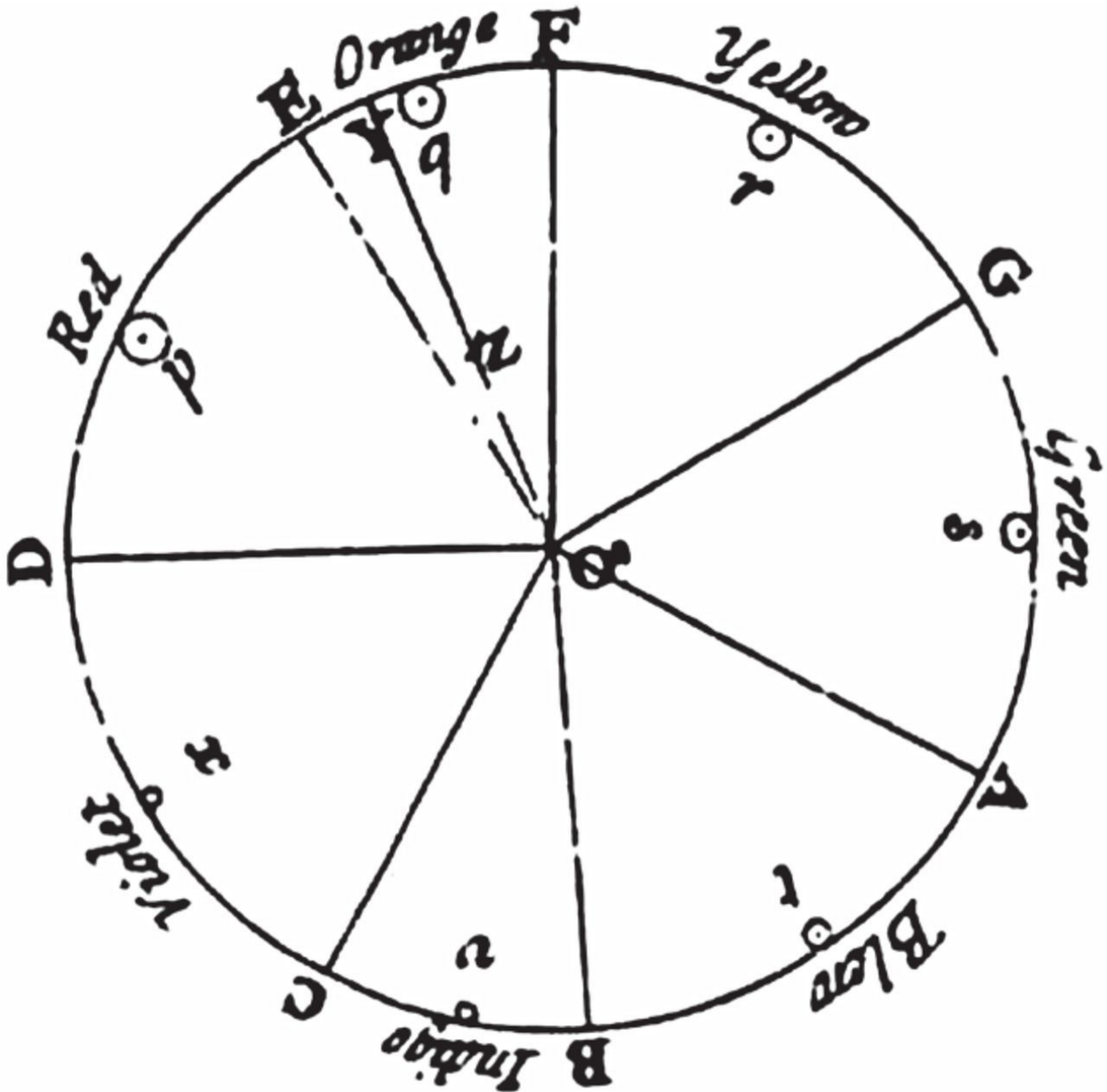
Yo, I read your color theory, it was an inspiration, but you didn't say nothing about sensation. What about perception, poetry and emotion? Who needs a heart if a heart can be broken? I'm not trying to say your process was flawed (yes I am) but it's been more than a century since you wrote your laws. I looked into the darkness and this is what I saw...

TEAM NEWTON

This page is printed on cardstock and handed out in the studio portion of the class. Everyone does the assignment but the members of #TEAMNEWTON lead the assignment, demonstration and discussion.

Painting from light

Mix your colors to match your observations from the prism as closely as possible. Fill in Newton's color wheel.



Measuring the spectrum

Use the prisms we have in class to break white light into a spectrum. You can try to use natural light or you can turn on the projector and hold a prism in front of it. Line up this edge of the assignment with the prism you've created. Draw the bands of color as you observe them, and measure the distance between them. Use paint to accurately represent what you observed.

Analysis

Music

Newton was inspired by music, though not a musician himself. He felt that the observable spectrum fit a musical scale in the Dorian Mode, which starts and ends with the note D and has no sharps or flats. The letters you see around the outside of the color wheel show colors and their corresponding notes on the scale. In *Opticks*, Newton describes playing a note and seeing a resonance in the corresponding color. We can repeat the experiment by playing the chords on guitar while observing the spectrum. Do the chords played feel like the colors they correspond to? Do you see any change in the spectrum when the chord is played?

Circle of Tones

John Coltrane's drawing of musical structure has a lot in common with Newton's color wheel. What can we discover by comparing the two images? Coltrane's image includes flats and sharps, accounting for five notes. If those are removed you will have a circle with 7 points, just like Newton's drawing.

Epiphany or Apophany?

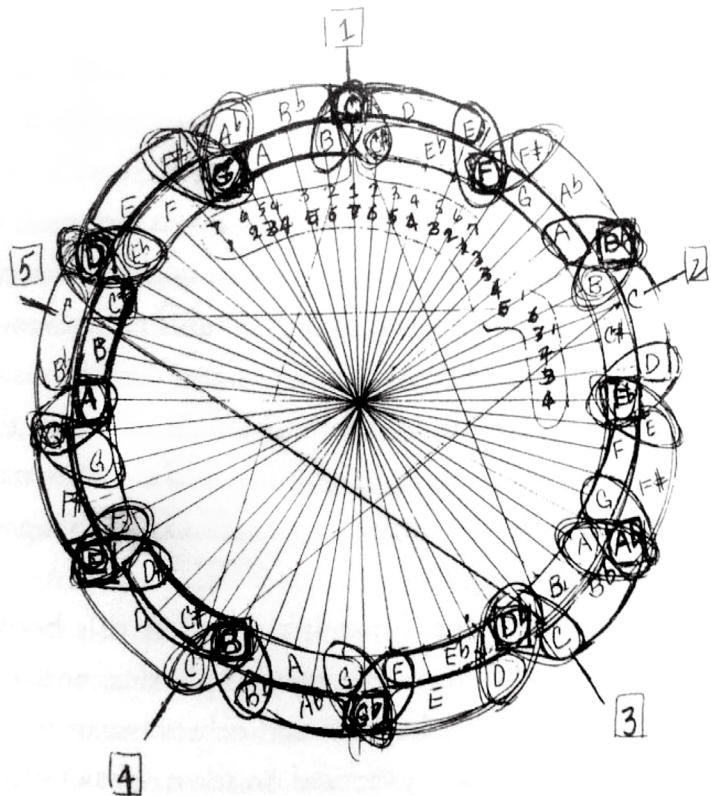
Newton works from scrupulous observation in *Opticks*, but he began the work convinced that music and light were related. He needed seven colors to create a full Dorian scale, so he added orange and indigo even though he couldn't see them in the spectra. Even now, physicists who study light have been unable to observe orange or indigo in the spectrum. Does *Opticks* represent a revelation of truth or imagination?

Digital Component

A computer monitor is essentially a light mixer for color. We can easily study light mixing and the Newtonian scale in Adobe Illustrator and Photoshop.

Digital Process

Open a new document in Illustrator and set the color space to RGB (the primary colors of light). Create 3 circles with full values for Red, Green and Blue and all other colors set to 0. This means that colors will mix in an additive fashion, they will get brighter when they interact. Move the circles so they overlap and explore the primary and secondary colors of light your monitor shows. How do they compare to what you painted? Copy the circles and rasterize the group. Make another set of circles and sample the secondary colors from the array you just made. Set the new group of circles to multiply. This means that their interaction will be additive. You should be able to recover the primary colors from where the secondary colors overlap. Rasterize and sample the color to check.

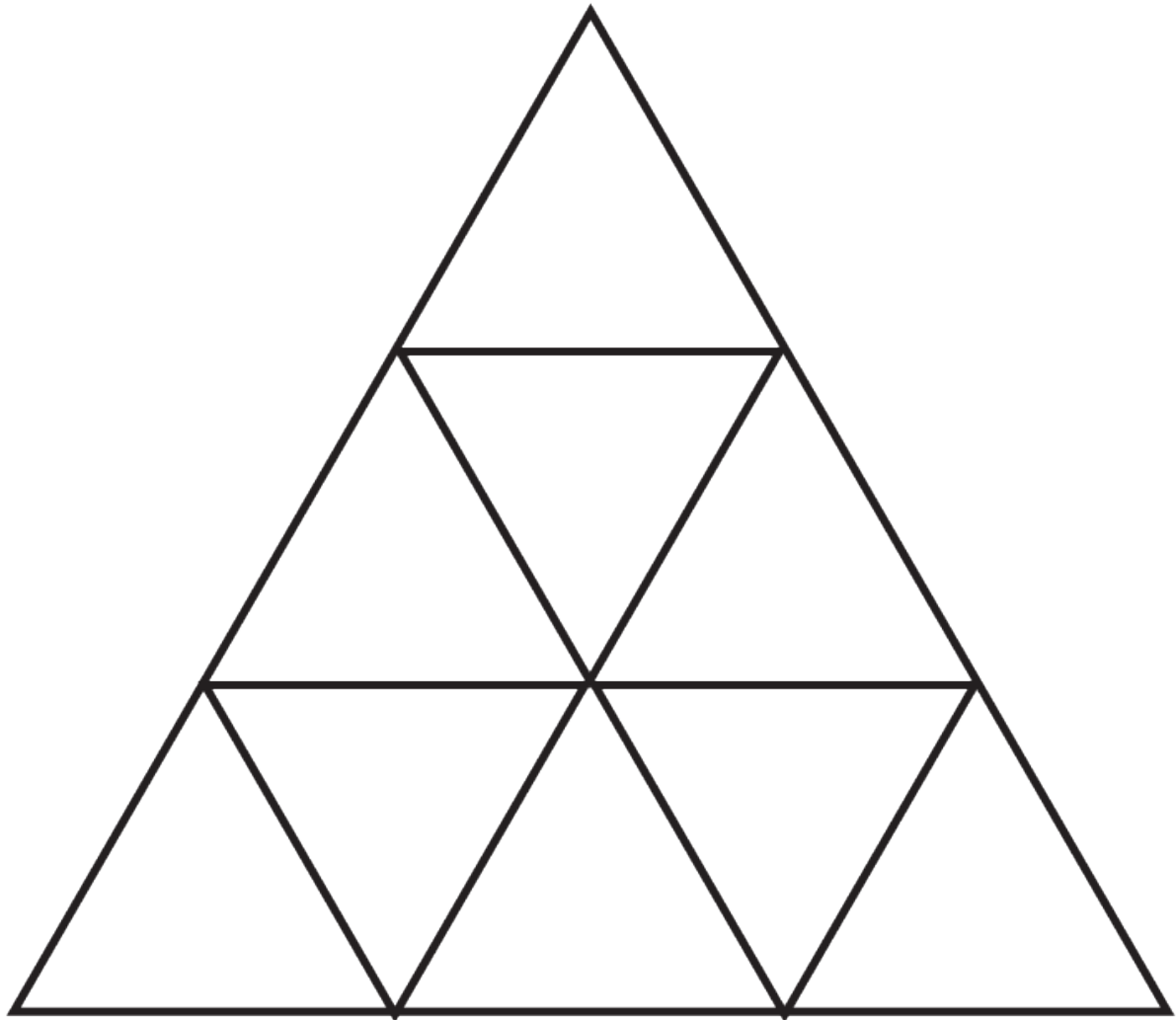


TEAM GOETHE

This page is printed on cardstock and structures a painting exercise in the studio. Everyone participates but the assignment is directed by members of #TEAMGOETHE. Team members also facilitate discussion and demonstrate some of the topics.

Goethe's triangle

Refer to the information and pictures on the back of this page to complete Goethe's triangle. Try to compose the triangle using the shadow colors you discovered.



Painting from shadow

Goethe believed that shadow was more than the absence of light. He felt it was a physical phenomena with observable qualities. In his theory of colors, he even claims that shadow has sentience in a limited fashion: that it responds to the thoughts and emotions of the observer. In class, we brought in three focused lights with colored gels, darkened the room and set out to create colorful shadows. Look around the room and paint some of the colors you observe in the strip below.

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printed on cardstock.

TEAM GOETHE

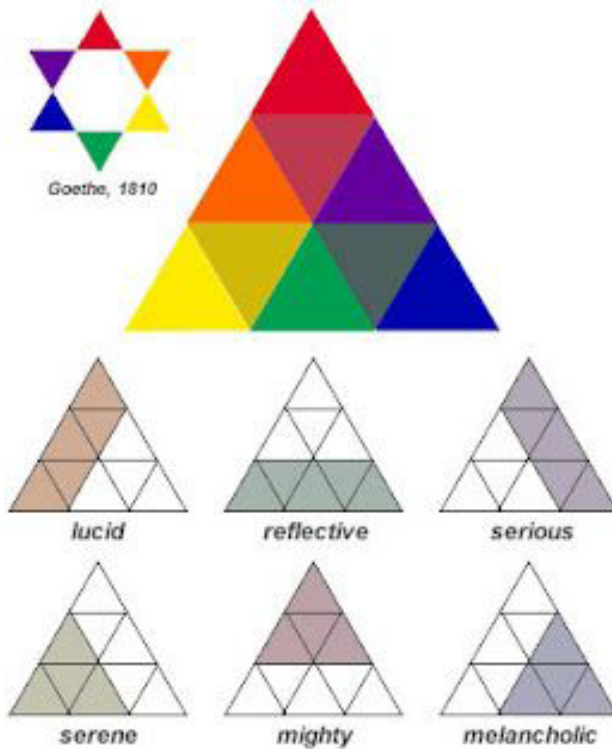
Power, Melancholy and Joy

Goethe developed an additive system, and places the primary colors (red, yellow and blue) at the furthest corners of an equilateral triangle. Red, in Goethe's view the most powerful color, goes at the top. Blue represents melancholy and is placed on the right, while yellow is joy and is placed on the left. Secondary colors, green, purple and orange are midway between the primaries. The remaining colors are mixtures of the three others that enclose them.

Emotional Assymetry

Goethe's color theory is built around emotion and psychology. The perfect state is feeling all emotions at once, and different moods only occur through assymetrical states. Goethe identified color systems which represent emotional states. How true do you find Goethe's system? See if you can identify Goethe's systems in some of the fine art examples we study in class, such as Picasso's *Old Guitarist*.

In the space below, think of an emotion not mentioned in the diagram and try to represent it as a color system using Goethe's ideas.



What emotion did you represent?

Digital Component

We will spend some time studying Goethian color in Adobe Illustrator.

Digital Process

Goethe closely observed "after images," the colors that can be seen after looking away from an intense source of color. Find a copy of the Superman logo online and place it in your illustrator document. Edit the color and invert it. Stare at the image for 1 minute and then look away at a blank wall. Do you see the normal colors of the Superman logo?

Build the Goethian Triangle in Illustrator by creating equilateral triangles with the polygon tool. Note that this is a pigment system so we're not using light. Each color should be darker in value than the parent colors. Use edit > convert to grayscale to check this. There is no RGB numerical formula for the primary colors of paint, so you should just choose them instinctually. You can set the transparency mode to color to allow the colors to darken as they mix. This works well for creating the tertiary colors. Keep checking the black and white version to make sure children are of darker value than parent colors.

DIGITAL | ANALOG

Creative Composition

On one large sheet of bristol board, create a black and white composition that communicates the themes you've been working with on your team. The subject of this drawing is up to you. The subject can be anything that inspired you in your reading or discussion. Try to be true to the subjects you studied on your team. What is Newtonian artwork? Would it be linear and rational? Would it be clear and bright? What is a good example of Newtonian artwork in art history?

What is Goethian artwork? Would it be emotional and dreamlike, full of arcane symbolism like the work of William Blake?

You could create a portrait, tell a story, work with text or whatever images you like. You could work with pure geometry and abstract forms. Work through your concepts by creating at least 3 thumbnails. Meet in your teams and discuss the thumbnails with team members and ask for feedback.

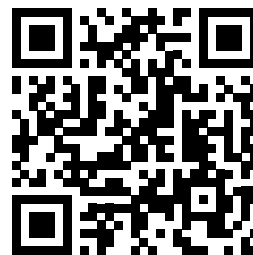
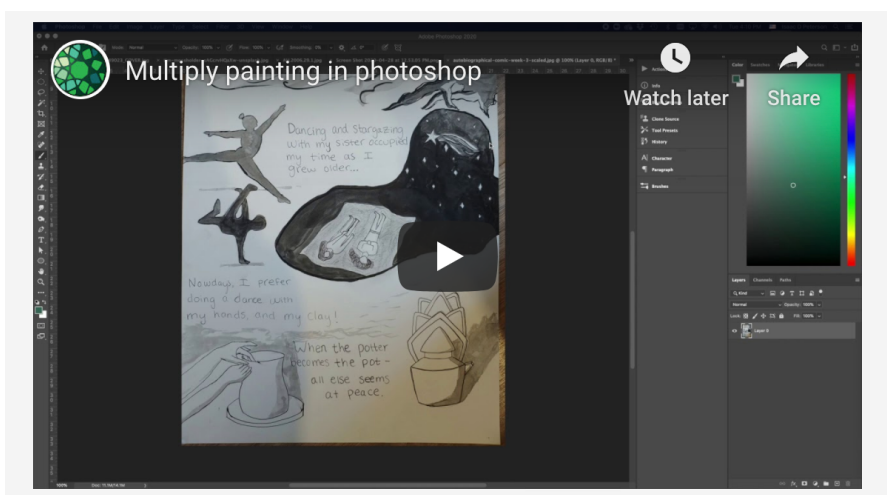
Once you have decided on your approach work on a large sheet (11 x 17) of bristol board. Fully render it in black ink and ink wash but don't use color. We'll finish the artwork on the computer.

Go to the library and use the large-format scanner to scan your work. Save it and bring it to class for the digital session.

Bring your drawing into Photoshop and correct it and crop it if needed. Set the ink to multiply and place it at the top layer. Bring up the color charts we made earlier in Illustrator. Carefully plan your color structure and write a paragraph about its meaning before you start. Bring the color structure into photoshop and sample it to create a set of swatches. Use multiply painting to color your work.

[This video gives a complete walkthrough of the multiply painting process](https://youtu.be/ifbJT1_s5tk)

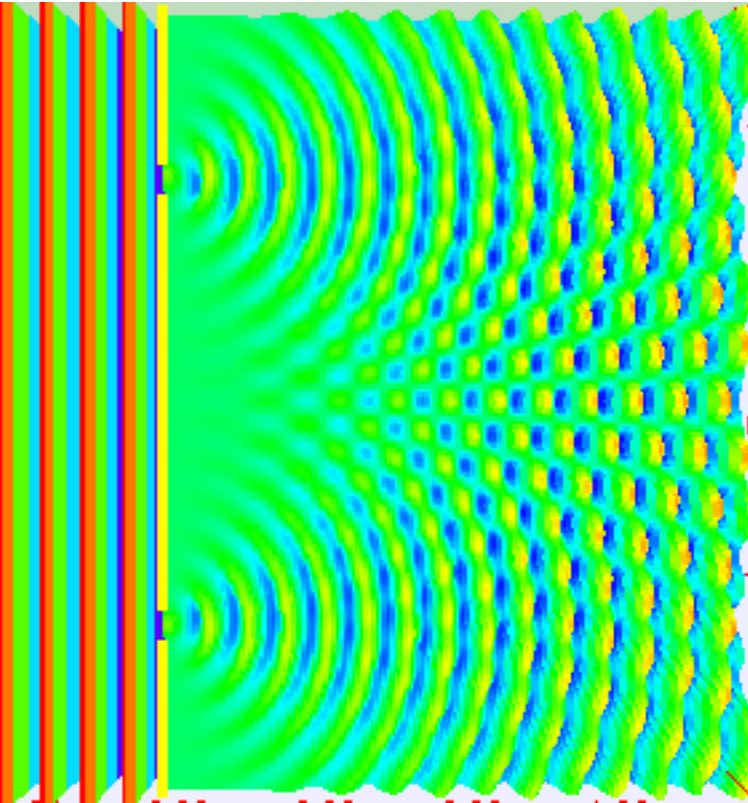
https://youtu.be/ifbJT1_s5tk



Turn in your work

Export your work as a JPEG. Upload both your color structure and your final artwork to the appropriate assignments in Blackboard.

DIGITAL | ANALOG



The Double Slit Experiment

Focused light passes through two slits. A wave is capable of passing through both slits at the same time, creating a pattern of interference. A wave and the resulting interference pattern are the perfect example of analog information.

Photons have an electrical charge and can be tracked individually with special detectors. If such a device is introduced into the experiment we can perceive photons as digital information. They can only pass through one slit or the other. The physicist Richard Feynman has said that if detectors could be perfectly isolated for each slit the interference pattern would disappear. The reality of light changes depending on the expectation of the viewer.

The Ocean of Paradox

Your physics textbook might describe this as 'wave / particle duality.' Duality is not possible. A particle and a wave represent two very different states of reality. Imagine you are standing on a beach looking out at the ocean. A long wave rolls in, stretching for miles in each direction. The wave is energy moving through a medium, the ocean. That medium could very well be composed of particles, such as water molecules. The wave is a gigantic analog signal acting on trillions of particles. Now imagine a tennis ball floating out on the water. It has a finite position that can be precisely mapped and expressed as coordinates. The tennis ball can be located digitally. Nothing can be both a particle and a wave; duality is fundamentally impossible.

Quantum Apophany

Light exists in a state of unreality, though it illuminates the real. Goethe appears to be the villain in this story, drawn to magic and unreason more than a century after Newton set the modern age in motion, but the double slit experiment shows us that at some essential level Goethe was right. At the quantum level, consciousness shapes reality; our eyes detect light as waves and so light becomes that. If a detector could be made that perceives sentient shadows and reflected emotion, in alignment with Goethe's ideas, light might just take that form too.

Conclusions

Is light digital or analog? Is color phenomena or perception? Is truth revealed by epiphany or apophany? Are we living in Newton's world or Goethe's? Or some synthesis of the two? Give your thoughts in a 1-page response. You don't have to make an argument that supports your team affiliation. Turn in your writing on Blackboard. Discuss these issues in class and see if you can decide which team wins.