

Quest to Learn School for digital kids

6th Grade – The Ways Things Work (Math/Science)

Unit title: Invisible Pathways

Length: 10 Weeks

Background

Invisible Pathways is a 2nd trimester unit. It follows a 10-week unit on Simple Machines, which centered on the essential question, “What are the qualities and elements of a system?” and introduced students to science and math-based methods of building simple machines. In this second trimester Mission, students build upon knowledge from the simple machine unit and apply these understandings to a study of light and matter. The essential question is, “How do the relationships between elements in a system create a dynamic?”

Unit Summary

The challenge of this Mission casts students in the role of scientists who must develop and test a theory about the behavior of light. They will study the interactions of light and matter (refraction, absorption, scattering, and reflection), using digital cameras to document the results. They will then use a 3D simulation (called Enigmo 2) to model the movement of light through space, applying understandings gained through direct observation in the real world to a virtual representation. They will do data analysis to understand the colors of light, and they will study the eye as an optical device. Throughout the unit students will use the scientific method to propose and test theories, observe and gather evidence of outcomes, and apply this understanding to the development of new theories. The Mission culminates in a scientific challenge requiring students to collaborate in small teams. The challenge: construct a pathway for a beam of light to travel to a target, changing direction a minimum of 5 times. The resulting pathway will require students to apply their understanding of the different ways light interacts with different materials, how it is filtered, strengthened, and changed.

STAGE 1: DESIRED RESULTS

Established Goals:

NYS Learning Standards for Math, Science, and Technology:

- Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.
- Students will access, generate, process, and transfer information using appropriate technologies.
- Students will understand mathematics and become mathematically confident by communicating and reasoning mathematically, by applying mathematics in real-world settings, and by solving problems through the integrated study of number systems, geometry, algebra, data analysis, probability, and trigonometry.
- Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.
- Students will use visualization and spatial reasoning to analyze characteristics and properties of geometric shapes.
- Students will develop strategies for estimating measurements.

Enduring Understandings: Students will understand that ...

1. The interaction of elements (light and matter) creates a set of relationships within a system.
2. The relationships between elements in a system can change.
3. Systems are dynamic.

Essential Questions:

1. How does light interact with matter?
2. How can relationship between light and matter create a system?

SKILLS Students will be able to...

Science

- Collect and use data as evidence
- Observe and describe relationships between light and matter
- Mix and separate colors of light
- Create material models to show how we see an object
- Create concept maps to model relationships in a system
- Make predictions

Mathematics

- Analyze data
- Calculate supplemental and complementary angles
- Measure angles
- Recognize and identify patterns
- Represent problems in multiple ways.
- Translate pictures and diagrams to numeric expressions
- Express equivalent ratios as proportion
- Find a missing angle when given angles of a quadrilateral.

Digital Media

- Use appropriate graphic and electronic tools such as Enigmo 2¹

¹ Enigmo 2 is a 3D puzzle game where you construct mechanisms to direct lasers, plasma, and water to toggle switches, deactivate force-fields, and eventually get them to their final destination. In addition to the 50 levels that come with Enigmo, there is also a built-in level editor which allows you to create your own games that you can share with friends or post on the web for the world to play.

KNOWLEDGE Students will know...

- That there are different kinds of interactions between light and matter (refraction, absorption, scattering, reflection).
- The anatomy of the eye.
- How light moves.
- Light from a primary or secondary source must enter the eye in order for the source to be seen. Human eyes can detect only a limited range of light wavelengths.
- Different wavelengths of light are perceived as different colors. Colors of light can be combined or separated to appear as new colors.
- Colored objects selectively reflect, transmit, and absorb different colors of light.
- Shadows are the result of the absence of light.
- Non-visible light behaves like visible light but cannot be detected by our eyes.
- The difference between supplementary and complementary angles.
- The difference between rate and ratio
- Understand that some ways of representing a problem are more efficient than others

STAGE 2: ASSESSMENT EVIDENCE

Performance Tasks:

Digital Model:

During stage II of the unit students will build complex 3D spaces from simulated light and matter.

Culminating assessment:

In order to demonstrate their understanding of how light and matter can interact to create system, students will construct a pathway for a beam of light to travel to a target, changing direction a minimum of 5 times.

Other Evidence:

Online Lab Notebook (Daily)

Test

Self assessments

Concept maps

Written reflections

STAGE 3: LEARNING ACTIVITIES

I. The Problem of the Oar (1 weeks total)

Students develop an inventory of behaviors for Photon, a beam of light that has lost its way. Using the scientific method students will produce a series of increasingly complex experiments pairing Photon with a range of materials (water, glass, plexiglass, mirrors, etc.) to gather data on its behavior.

Near the end of this stage they must decipher an invisible message using only a light. This “secret message” is printed in red and green letters on a black background inside a box. When illuminated with red or green light only vowels or consonants appear. Only when illuminated with white light is the entire message visible. The message that is revealed will give students instructions for their next quest, called “Enigmo.”

II. Enigmo (2 weeks total)

Having collected an inventory of behaviors describing Photon’s interaction with different forms of matter, students are challenge to apply this knowledge within a 3D simulation tool called Enigmo 2. This tool allows students to build complex 3D spaces from simulated light and matter.

III. Can You Believe What You See? (3 weeks total)

Light allows humans to see. Students will investigate this concept as they work with a digital model of the eye. Using “light-boxes” they establish the conditions for sight: a light source, object, eye, and straight unblocked path.

IV. Invisible Pathways (4 weeks total)

The unit culminates in a scientific challenge requiring students to collaborate in small teams. The challenge: construct a pathway for a beam of light to travel to a target, changing direction a minimum of 5 times. The resulting pathway will require students to apply their understanding of the different ways light interacts with different materials, how it is filtered, strengthened, and changed.