Module Plan

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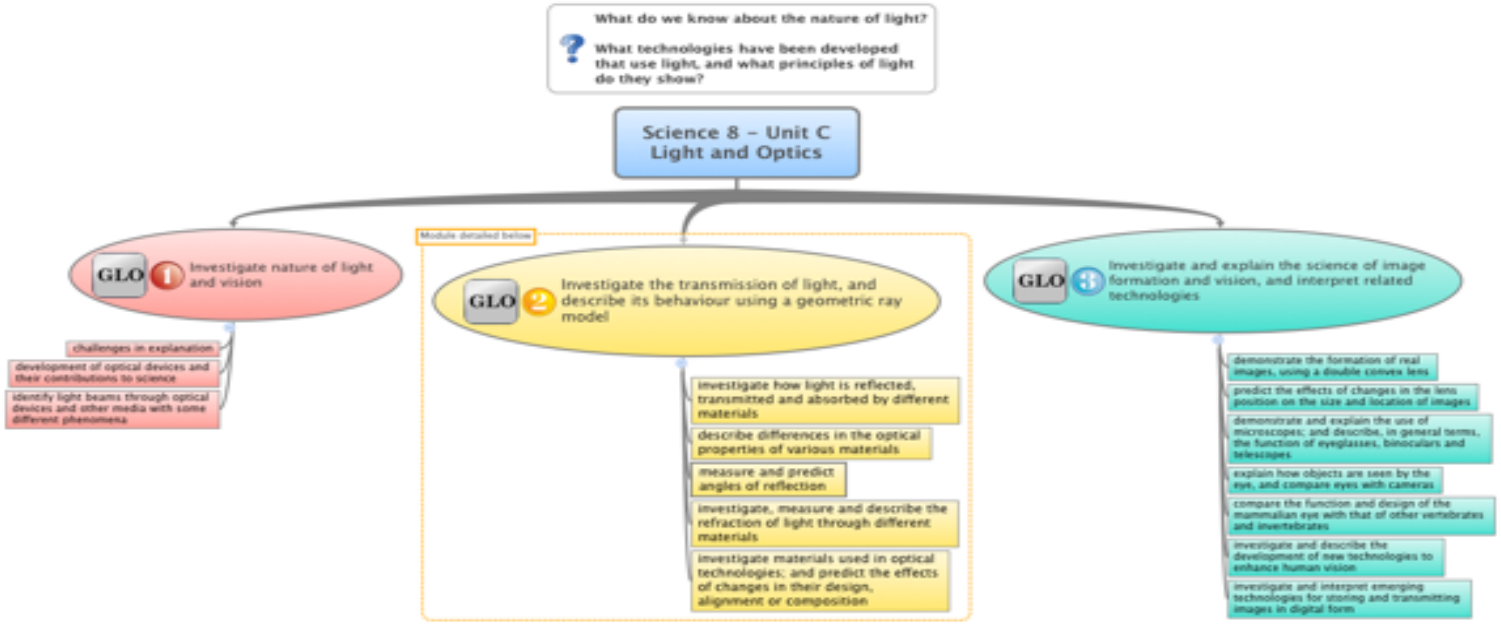
Module info: Grade 8 Science, Unit C (Light and Optics) (Alberta Education), STS Knowledge GLO 2 (Investigate the transmission of light, and describe its behaviour using a geometric ray model)

Table of Contents

Unit at a Glance



Graphic Organizer of Outcomes for the entire unit, with this module highlighted in yellow.

Description

This unit is one of the several science units which really lends itself to a high level of hands-on learning and experimentation by the students. The technology which students could use, but are not limited to include flashlights, laser pointers, various lenses, various shapes of mirrors, computer simulation, other computer software such as website authoring, concept mapping software, video camera and editing software.

A significant amount of learning in this module will be self-directed, with guidance from the teacher.

The initial learning for this module will be a relatively short direct-instruction lesson introducing the ray nature of light, and how it could interact with various optical elements. This lesson will include some brief examples.

The primary learning will be through hands-on exploration, guided to the end result which is a video, concept map, and website created to show results of learning. These may be done in small groups of 2-3, or individually.

A culminating discussion with the class about their findings and results will help reinforce or add to their individual learning.

This outcome module will need about 1 ½ weeks. Lessons will be presented as follows:

The intro/setup lesson, several work periods including a Q&A class, a final presentation class, and a culminating discussion. Some of the work will be expected to be completed at home or outside of class time. The work periods will allow students to use lenses and curved mirrors available in the school.

The main performance task for this module includes three main components: (1) video(s) showing either a

simulation of light ray interactions or real light ray (laser and flashlight) interaction with lenses; (2) a concept map showing the relationships and connections between higher order concepts of light down at least three levels for three different categories to specific details; and (3) a website setup on a free service which is a placeholder for the video(s) and concept map, but includes a description of learning and understanding about light, its interactions, and how it behaves in different conditions. They won't be graded on the quality of the videos or website produced, but rather on the content. Students will be given a loose rubric to follow.

Rationale

The reason I've chosen these technologies and performance task is that they help guide the student into the "nuts & bolts" of light and how it interacts. Chances are not many things will be new compared to experiences they have already had - but it will constructively add to their understanding of the world around them, and how they are affected by light and optics every day.

As they explore with real mirrors, lenses such as magnifying glasses, and opaque materials, they will literally see first hand how light interacts with these objects. They will be able to recognize similar properties, angles or reflection/refraction, and scattering. Guiding them to play games with mirrors and lasers, trying to hit targets, will help them to predict angles of reflection.

The reason I've chosen for the students to use a website as a final delivery method helps them to reflect on the accuracy of the results they post, knowing that the pages will be publicly accessible.

The actual performance task is not very challenging, rather it will serve as a foundational step for deeper learning throughout the year and into high school.

Many of the of the skills, analyzing & interpreting, and teamwork outcomes will also be covered by using these technologies in a small group.

Module Outcomes

2. Investigate the transmission of light, and describe its behaviour using a geometric ray model

    - investigate how light is reflected, transmitted and absorbed by different materials; and describe differences in the optical properties of various materials *(e.g., compare light absorption of different materials; identify materials that transmit light; distinguish between clear and translucent materials; identify materials that will reflect a beam of light as a coherent beam)*
    - measure and predict angles of reflection
    - investigate, measure and describe the refraction of light through different materials *(e.g., measure differences in light refraction through pure water, salt water and different oils)*
    - investigate materials used in optical technologies; and predict the effects of changes in their design, alignment or composition

Assessment

Students will know:

- how light interacts with different materials, including transparent and opaque. (reflection, transmission, absorption)

- how to measure and predict reflection & refraction
- how the changes of optical materials affect the interaction of a light ray

Students will be able to do:

- ask questions about variables of an experiment
- plan investigations
- state a prediction and hypothesis
- use technology safely

Evidence of Learning

Summative Performance task

(group project, individual marks based on participation and understanding)

The performance project will be a group assignment, with groups of 2-3 students. It will be broken into three main components:

1. **Video** - students will create a video either entirely of them demonstrating the way that light interacts with various transparent and opaque materials, lenses, and mirrors. They are to demonstrate these interactions with point light (incandescent flashlights) as well as lasers (dollar store LED lasers), and will explain the differences in the interactions. They can include screencast videos of software or website simulations of light interacting with different shaped lenses and mirrors (convex/concave, convergent and divergent) if they cannot get real-world examples. They will also demonstrate and explain how light interacts with different medium interfaces - such as air/glass, air/water, and water/oil.

2. A **concept map**, using one of the free software solutions available online as a webapp, or free download. The map's central topic will be light, with at least three sub topics, and at least three more points under each of those sub-topics. The map will show relationships between the interaction, methods of determining angles of reflection and refraction, as well as the formation of images through lenses and mirrors. This map will be saved as an image.

3. A **website**. Students will then create a website using a free online service such as Weebly. The website will have an introduction/home page discussing the reason for the site (beyond phrases such as "because it's an assignment"), a disclaimer that findings and information presented are those of students and may contain errors, and an introduction to the members of the group. The site will have a basic navigation menu directing visitors to a page of their findings including their video (shared via youtube or vimeo), their concept map, and anything else they might have discovered along the way. A third page will be for additional resources and interesting websites or videos about light and optics, with the fourth and final page containing references to all sources they used. Once the website it setup, they will share the URL with family, other friends outside of this class, and ask for feedback. The website will be presented to the class.

A checklist is included after this section.

Formative discussion

After all groups have completed and presented their websites, the teacher will guide a class discussion about

the similarities and differences between all of the groups' findings/results, and what they learned about light and optics. There will likely be quiet observers during this discussion - do the best to engage all of them through provocative questioning, throwing a light object for the "speaker of the moment", etc.

Formative Exit slip

Two to three exit slips should be given during the working period days, asking students about their learning of light and optics, participation of group members, other questions that come up, real-world examples about light, and others.

Lessons

Two formal lessons are needed for this module, with the remaining classes being led by exit slip feedback, answering questions, and guiding students. All lessons need proper opening, guiding questions, setup of centers and materials, and closure.

Introduction to Project Lesson Plan

Date:	Teacher: Dwayne	Length of Class: 60 min (start: 9:00)
Subject: Science		Unit: Light and Optics
Outcome(s)(GLO/SLO): 2 - Investigate the transmission of light, and describe its behaviour using a geometric ray model		Grade: 8
Learning Objectives: (Students Will:) Understand the nature of the light project, expectations, and how to get started.		
Materials: mirrors (convex/concave/flat), lenses (convergent, divergent), small point light (flashlight), laser, aerosol spray, something to make dust or a water mister		
KSAs: 3, 5, 6, 10		
Background Information: Students should know about the basic nature of light from GLO1, and likely will have already experienced reflection and refraction in their personal lives.		
Differentiation – When making groups, make sure to pair up weaker students with stronger students; give oral and visual instructions		
Assessment – brief discussion at the end of the class to check for understanding of the project		

Introduction: (3 mins)

Purpose: To show a simple example of how light interacts with some optical devices, to give them ideas on how to implement their project.

"*This week we want to learn how to represent what happens with light on paper, using something called geometric ray tracing. First we need to see and experiment as much as possible with light, so that when we see it on paper, we know what's happening. Remember – light always travels in what kind of line?"*

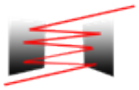
Have a couple of flat mirrors set up facing each other, point a laser at one of the mirrors – **ask** the students what they see. Then turn down the lights, and spray aerosol or make dust to make the laser beam visible.

Body: (Activities/Sponge): 9:03 - (51 mins)

Discuss how the beam interacted with the mirrors, what the students saw, and whether it was predictable.

Show the effect of a convergent lens on a point light source (flash light), and **ask** someone to describe what has happened to the light?

"if we were to draw this on paper, it would look like this" (on board).



"When we use a magnifying glass on a leaf, we are creating an image of the sun with a converging lens, and on paper, it looks like this."

Display project checklist and expecations on the board, and explain that there will be a project that they will be working on in small groups. Go through the expectations, options, and flexibility. Make sure to **explain** that the students are encouraged to come up with their own unique experiments and explanations, and that they will be giving a brief presentation showing off ther results in a week.

Ask if there are any confusing items on the list. (list includes making a video (or two), a concept map, and using a website as a delivery method).

Explain that there will be some working periods to use classroom equipment, but they are expected to work outside of class as much as possible, using class time for questions and discussion if needed.

** School equipment is to stay at school, but the dollar store can often provide them with many of the items they might need.

Create groups of 2-3 ahead of time, and display the groups on board, explaining that if there are irreconcilable group problems, to talk with teacher.

Closure: (Review/Preview) 9:54 (6 mins)

Ask students to recap what the project is about, what their expecations are, and when it is due.

The next three classes will be work periods to use some of the classroom equipment, and to ask questions. Two days after the presentations, there will be a quiz.

Up Next? – work periods	End time: 10:00
Art of Teaching – engagement, management of the class during group making time	

Light and Optics Project Checklist

- ❑ Video (15 marks)
    - o Demonstrate the interaction of both laser and incandescent bulb with lenses – flat, divergent, convergent; and mirros – flat, concave, convex. The video might be real-world interaction, or an online simulation screencast
    - o Explain what is happening with the the light rays in each case, and a possible explanation as to why laser is diferent from bulb. (warning… lasers are dangerous in the eyes – keep the beam away from faces, including pets)
    - o The video is hosted publicly on a site like Vimeo or Youtube (make sure it is accurate and correct)
- ❑ Concept Map "Light Interaction with Optics" (10 marks)
    - o Create at least three main topics around the central topic (ie. reflection, refraction, absorption)
    - o At least three more ideas or subtopics for each of the above topics – the more detail the better
    - o Save the concept map as an image file
- ❑ Website (15 marks)
    - o Create a site on a free hosting service like weebly with four pages
    - o The pages should be linked from a navigation menu on each page
    - o Pages might include – Intro, Findings (video(s), concept map, ray drawings for the different experiments you tried), other helpful links, References
- ❑ Presentation (10 marks)
    - o In front of the class, present your website and your results (~6 minutes per group)
- ❑ Group Member feedback (give this to me individually)
    - o give a quick feedback of what score you would give yourself, and what score your group members should receive (this will be used to weight the final scores of each individual, coupled with what the teacher observes)

Total marks for this project: **50**

Closing the Project Lesson Plan

Date:	Teacher: Dwayne	Length of Class: 60 min (start: 9:00)
Subject: Science		Unit: Light and Optics
Outcome(s)(GLO/SLO): 2 - Investigate the transmission of light, and describe its behaviour using a geometric ray model		Grade: 8
Learning Objectives: (Students Will:) show demonstration of understanding of raycasting from their projects.		
Materials:		
KSAs: 3, 5, 6, 10		
Background Information: Students should have a good hands-on background with light and how it interacts with different optics		
Differentiation – give time for those to speak as needed, without pressuring		
Assessment – discussion about the findings and similarities/differences from each project		

Introduction: (3 mins)

Purpose: This class is to let each of the students build on each other's knowledge and understanding.

"We had some great presentations in the last class – now lets talk about your results about ray casting, and how we can predict what happens with light as it interacts with different mirrors, lenses and objects."

Body: (Activities/Sponge): 9:03 - (51 mins)

Ask the class "what did you notice about all of the presentations yesterday"? Why were most of the results and findings the same?

Ask if there were any differences, and why?

Ask what the difference is between a laser and a bulb light source? (laser is coherent, and is like a single beam of light, unable to spread or focus. bulb point sources are incoherent, meaning there are infinite amounts of beams of light being sent away from the filament, and we can then focus them or spread them further).

(8 – 10 min) Show an online simulator like http://physics.bu.edu/~duffy/java/Opticsa1.html to demonstrate the different optics and light sources/images.

State that these simulators are possible because they are based on laws of physics, and that they are predictable, with math equations to determine what happens in each case.

Closure: (Review/Preview) 9:54 (6 mins)

Ask students if they have more questions about how light interacts with different optics, and how to represent the interactions with ray diagrams. Introduce that there will be a quiz about this topic tomorrow.

Up Next? – quiz	End time: 10:00
Art of Teaching – lots of discussion: keep the class on track with minimal digression	