**Design and Build an Optical Instrument**

In this unit, you are learning about how light interacts with different materials. In this project, you will demonstrate your knowledge of these principles by building an optical instrument, such as a telescope, microscope, periscope, projector, etc. You will draw a design plan with a detailed diagram before building your chosen instrument. Once you have completed your instrument, you will prepare a presentation that explains how light interacts with the materials in your instrument to create an image, using the vocabulary you have learned in this unit. To complete this project, you will present your instrument to the class, explain how it creates an image, and demonstrate how it is used.

**Project Rules:**

* Have your teacher approve your design plan before you begin building your optical instrument. Your instrument needs to use lenses, mirrors, or both. If you have an idea that does not use these, get it approved by the teacher before beginning anything.
* You may not use any pre-assembled parts—only those items listed in the materials section are allowed. If you wish to use a material that is not listed, you must obtain your teacheer’s permission.
* You must record any tests or modifications that you make to your original plan on the original design plan and hand it in again with the final project. (It is ok if you change things on your instrument that were not on the original plan, just write about what you changed!)
* During a class presentation, you will demonstrate how your instrument functions, describe how light interacts with all the materials in your instrument as it passes through, and how it creates an image. Use lots of the vocabulary from this unit in your explanations in a manner that demonstrates your understanding of the vocabulary.

**Suggested Materials:**

Some miscellaneous items you might need include tape, glue, clay, filters (such as colored cellophane or wax paper), cardboard or plastic tubes and boxes, flashlights, protractors, rulers, and meter sticks or measuring tape.

Some optical components you might need include concave lenses, convex lenses, flat mirrors, concave mirrors, and/or convex mirrors (many of these can be found at dollar stores, in old cosmetic compacts, toy magnifying lenses, etc.)

**Project Hints:**

* Brainstorm a list of optical instruments that you could build. Think about how these instruments work. Do they contain mirrors? Do they contain lenses? If so, what type? Think about the path that light takes as it travels through these instruments. Do research about different ways to build your chosen instrument.
* When making your design plans for your optical instruments, include measurements such as sizes/dimensions of materials, distances between lenses and the degree of the angle that light is being reflected. Is light being refracted by any part? If so, explain what causes the refraction and why it is needed.
* On your design plans, use arrows to draw the path that light will take as it travels through your instrument. Think about the angles of the light rays as they reflect off mirrors or are bent by lenses.
* Try to incorporate moving parts into your design so that you will be able to focus your lenses or adjust mirrors. One suggestion would be to use two cardboard tubes, one of which fits inside the other. Attach your mirrors or lenses to opposite ends of the tubes. You can adjust the distance between the lenses or mirrors by sliding the tubes back and forth. 
* Make sure that you test your instrument several times and fix any problems it has **before** your class demonstration. Record any modifications that you make to the original design.

**Project Timeline and Due Dates\***

1. Type of optical instrument selected \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Design plans completed and approved \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Optical instrument constructed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Tests and modifications of instrument completed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Presentation is prepared (Explanation of light path & how image is created) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Class presentation & instrument due\* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\*also due: original design plan with any tests and modifications written on it

# **Project Grading**

Design Plan - shows d detailed diagram of the instrument, has all parts labeled with specific name/type of material, distances between parts/size of materials are labeled, path of light is drawn through diagram using arrows. 10pts/T

Testing and modifications - Multiple tests performed and modifications recorded on original design plan 6pts/T

Presentation- student verbally described how light interacts with parts of the instrument and explained how their instrument functions to produce an image, accurately used many key terms from this unit clearly demonstrated an understanding of instrument does to the path of light (it is ok to use your written explanation during your presentation) 10pts K / 10Pts C

Instrument – well put together, shows substantial time and effort involved in building, functions properly produced image 30pts/A

This is a fun project that you will help you learn a lot about how light behaves but if you procrastinate it will not be as fun and your presentation, instrument, and grade will suffer.

Be Smart! Start Today! Pay attention to the timeline! If you need help, don't wait until the last day to ask!

I can't wait to hear you tell me about what you built! Blow me away with your science amazingness!