Photonics Outreach Guide

Guidance for scientists, professionals and advanced students who want to share their knowledge, passion and experience with K-12 students.

Created By

LASER CLASSROOM

For

INTERNATIONAL YEAR OF LIGHT 2015

Why K-12 Photonics Outreach?

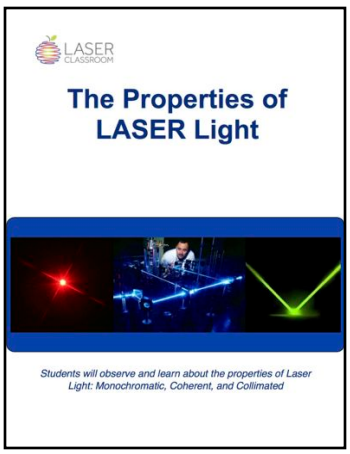
INTERNATIONAL
YEAR OF LIGHT
2015

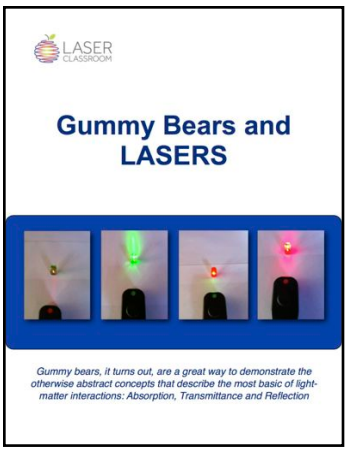
A unique, once in a lifetime opportunity to share your passion for the power of Photonics!

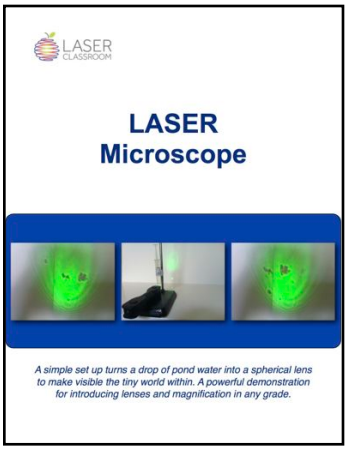
- Increase awareness and appreciation of photonics in your community - make photonics a household word!
- Contribute to building a STEM pipe line towards a strong photonics community
- Inspire and engage students in the exciting field of photonics
- Contribute skills, knowledge and resources that schools are lacking
- Enhance and develop your professional speaking and communication skills

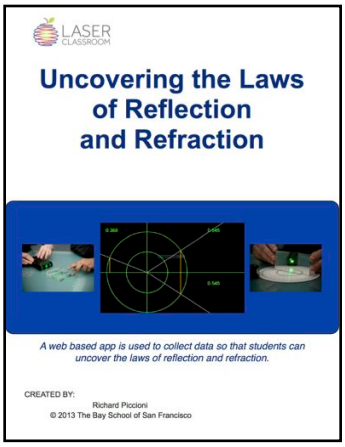
FREE Lessons and Demonstrations

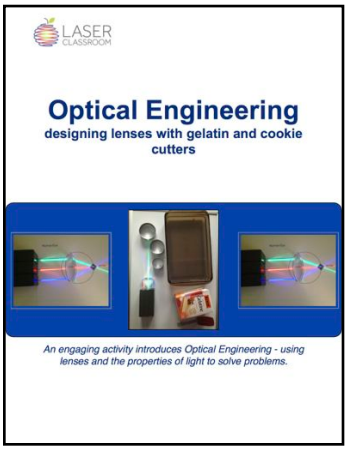
Not sure where to start? LASER Classroom publishes many FREE downloadable lessons, activities and demonstrations that are easy, educational and fun!

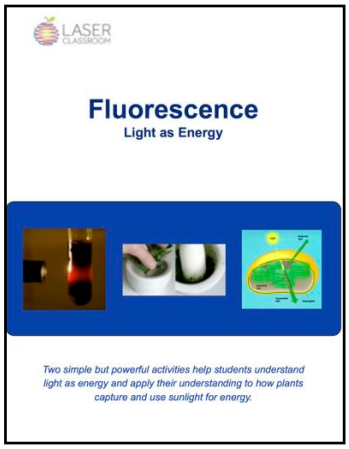












These and more available now in our FREE Lesson Library

http://store.laserclassroom.com/lessons-library/

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BRINGING STEM TO LIGHT

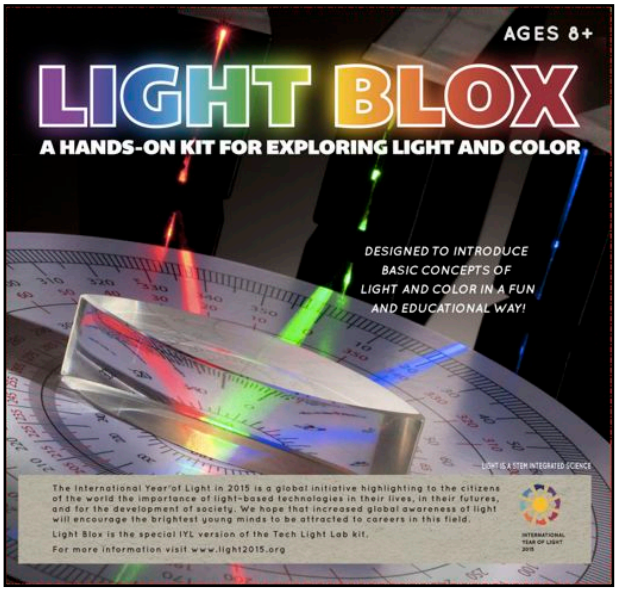
Kits and Equipment

You can do a lot of teaching and demonstrating with just the light in the room and a pair of diffraction glasses. But if you're looking for more, here are some tips.

- Safety first! Especially if you use lasers, make sure you know the power output and purchase from a reputable dealer who is compliant with FDA regulations.

- Hands on is best! Sure, do an impressive demo - the kids will love it! But when it comes to real learning, they need to get their hands on something, which can be tricky with light.

- What can you do with your investment? Is it flexible and affordable? Will you get a lot of use out of it? Are there parts that you'll have to replace often? Can you do more than one lesson or demonstration with it? Is it easily portable and easy to set up and use? All good questions to ask when evaluating what and whether to purchase equipment for your outreach effort.



IYL 2015
Featured Kit
www.laserclassroom.com

LASER Blox
Safe, Versatile, Visible
www.laserclassroom.com

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BRINGING STEM TO LIGHT

IYL2015 Resources

INTERNATIONAL YEAR OF LIGHT 2015

www.light2015.org

Listing of Events

See what's happening near you to celebrate the International Year of Light 2015 and raise awareness of light and light based technologies! Or, are you starting or creating something for IYL 2015? Share it!!

Why Light Matters

Here, you'll find tips for talking with people outside of the photonics industry about why light and light based technologies matter to them! Answers the question "Why should light matter to ME?"

Learn About Light

Quick and easy to understand and communicate information about LASERs, light sources, light in nature and light in art in culture.

FREE Stuff!

Download free posters and prepared presentations; navigate to lots of websites with even more cool stuff to share about light, lasers and optics.

Outreach Logistics

Communicating with the teacher prior to your visit is key to a great experience for you, the kids and the teacher! Things to cover in your pre-visit conversation:

- Date, time, location and school visitor policy or check in procedure
- How much time will you have?
- Ask about outlets and power supply to support any equipment you bring with you.
- How many students are in the class?
- How is the room arranged?
- If you have any specific needs - from audio visual equipment to a sink, now is the time to check and make a request if necessary
- Ask if there are any special situations or needs that you will need to consider (for example, are any of the children physically handicapped?)

Date: _____ Time:_____ Grade or Age:_____

Location: _____

Contact: _____

Educational Goal:_____

Presentation Topic:_____

Equipment/Materials to Bring Along

Other Notes or Considerations

Collaborating with the Teacher

Beyond logistics, there are lots of ways you can collaborate with the teacher to ensure that everyone is getting the most out of your visit.

Discuss what the students are currently learning about and how you might be able to support and expand on it given your area of expertise and the activities and lessons provided in this guide.

Explore the skill level of the students - what are they familiar with already? what misconceptions might they have that you can address?

Discuss the teacher's goals - what would the teacher like the students to get out of your visit? This can range from wanting the kids to be inspired to wanting them to have a new skill or a deeper understanding of some concept.

Share your expectations regarding classroom management. In general, it remains the teacher's responsibility to support the visit and make sure that it goes smoothly. The teacher will remain in the classroom and manage students who are disruptive.

Engaging Students

Having an impact and making a difference is what it's all about, and you can only do that when students are engaged. It's not hard with Lights and LASERs!

Don't Lecture (too much)

Hands on activities that get students talking with each other and using real equipment is a powerful way to keep them interested and engaged. When you do speak to them, consider your language, and construct a narrative.

Consider your language

Use words students will understand and take time to explain and use new vocabulary. Choose simple, precise expressions rather than complex scientific terms and symbols. Give brief, concrete, and whenever possible - amusing, explanations that create teh desire to understand rather than long accounts that are overwhelming and intimidating and boring.

Construct a narrative

The scientific process is a natural and compelling story. It is filled with mystery and climactic struggles - mastering the art of telling a story as a means of teaching is a great way to connect with students. Some ways to construct narratives are:

- **Journey** - A story that travels through space, and or time is a journey. For example, take them to Egypt in 280 BC to discuss the worlds first light house.

- **Quest** - A story that follows the ups and downs, the successes and failures of looking for, and finding a big answer. For example, the competitive drama that lead up to the invention of the first LASER.

- **Mystery** - A story that collects and makes sense of clues to find the answer to a great question can be very compelling. What were the clues that led to the stunning conclusion that light is both a particle and a wave?

Connecting to the *REAL* world

Connecting a lesson or activity to something students care about and can relate to, hooks them in to the science and helps them remember what they learned.

Connect to:

- How your work or research uses or applies the concept or skill you are demonstrating or teaching about.
- A recent discovery or scientific advance that relies on the skill or concept you are demonstrating or teaching about.
- A technology or application that students can relate to or care about.
- Other disciplines - usually photonics is covered in physics, but it is applied in Biology, Chemistry, Earth Science and Nano Technology.

Ways to Connect

- Be inquiry-based - ask LOTS of questions, more on questions on the next page
- Be student-centered - create talks and activities around what the students are interested in, or what they are already studying in class
- Present students with a challenge - involve students in figuring something out
- Require students to grapple with the content - you may end up giving them the answer, but give them time to struggle with the questions first.

Asking Questions

An old adage says "tell me and I forget; show me and I remember; involve me and I understand" . We all want students to understand - questions can help.

Questions involve students in learning by

- **Attracting attention -** What happens when? What do you notice?
- **Inspiring observations** - How much? What size? Where?
- **Predicting outcomes -** What do you think will happen next?
- **Stimulating conclusions** - What happened? What might that mean?
- **Encouraging critical thinking** - What's your opinion? Do you agree?

Questions inform your teaching by

- **Identifying what makes the information difficult**
- **Helping you to choose the most appropriate activity or demonstration**
- **Guiding the amount or level of content in real time**
- **Stimulating feedback from students**

What students get when you ask questions

- **The ability to tackle real world issues and controversies**
- **A chance to develop research and communication skills**
- **The experience of colloaboration**
- **A deeper understanding of the content**
- **A sense of involvement and impact on their own learning**

LASER Safety

If you use Lasers for your outreach, we advise the use of class II, <1mW or class IIIA, <5mW lasers for classroom settings. This class of lasers does not have enough output power to injure a person accidentally, but is capable of causing eye injury if stared at for a long period of time OR if the beam is intentionally pointed directly into the eye. The bottom line is, lasers need to be handled cautiously and under adult supervision at all times.

What is a safe LASER?

Kids want to know WHY? WHY can't I look directly into the aperture of a LASER? Taking a moment to satisfy curiosity and honer a question can make the rule following a whole lot easier. So, we recommend a brief explanation of the science behind LASER Safety.

The FDA puts lasers in to safety classifications. Most classroom lasers are class IIIA, which means that it's power output is less than 5mW, and it is considered safe for the general public to use as long as basic safety practices are observed.

Class II and Class IIIA lasers are considered safe because the eye's reflexive look-away response time is approximately 0.25s. At <5mW, a laser beam's energy density (W/cm2 or J/cm2) isn't sufficient to cause biological damage, and the eye is protected. Once you exceed the 5mW limit, however, the blink reflex no longer offers protection.

At less than 5mW of power, your natural look away reflex protects you from ACCIDENTAL damage. If you purposefully stare into even the weakest laser, you risk serious injury

It is important to buy your classroom lasers from a reputable retailer who offers a guarantee that it is compliant with the rules and regulations that govern all laser products. LASER Classroom is such a retailer.

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LASER Safety, Continued

Basic Laser Safety Rules

1. Never look directly at the beam source, or aperture
2. Never point the beam at another person
3. Always be mindful of where a “bouncing beam” will land due to reflection

LASER Hazard Classifications

The most important criterion you will use in applying laser safety control measures is the hazard classification designated by manufacturers on the equipment labels.

Class 1: cannot, under normal operating conditions, emit a hazardous level of optical radiation. Included in this category is laboratory equipment using lasers with all beam paths and reflections enclosed.

Class 2: or low-power visible laser device of 1 milliwatt, does not have enough output power to injure a person accidentally, but may injure the eye when stared at for a long period. These lasers are used for alignment procedures and in the optical experiments in this kit.

Class 3a: rated in power from 1 milliwatt to 5 milliwatts—cannot injure a normal person when viewed with the unaided eye but may cause injury when the energy is collected and put into the eye as with binoculars.

Class 3b: lasers from 5 milliwatts to 500 milliwatts can produce eye injury when viewed without eye protection. Eye protection is required.

Class 4: lasers above 500 milliwatts in power can injure you if viewed directly or by viewing both the specular and diffuse reflections of the beam. These lasers can also present a fire hazard. Eye and skin protection is required.

LASER Classroom™ is the home of LASER Blox™ and of all the tools and resources you need to teach and learn about Light, Lasers and Optics.

LASER Classroom™

- manufactures, kits and distributes products for teaching, learning and research
- creates and distributes lessons, activities, labs and curriculum

For schools, outreach organizations, government entities and corporate entities

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