Ocean Education
From Light to Inspiration

Education Workshop

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Just Add Light
Why Education?

- Roughly $1.3 trillion market (mostly K-12 and Higher Education)
- Second only to healthcare

When I ask DuPont or Exxon how they know us, they said well I used your stuff in my Chem 101....
Education Products: Integrated System Kits

FLAME-CHEM Systems
FLAME-CHEM-VIS-NIR $4,200
Absorbance: Beer’s Law
Transmission: Color

EDU-PCPACK
EDU-PCPACK - $1,500
Absorbance: Beer’s Law
Transmission: Color
Emission: Atomic Emission

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What Are We Selling?

In the Last 5 Years

• 2,500 systems/kits/spectrometers
• $2,000,000 USD Total Revenue
• More than 80% USB-650 systems
• 70% visible wavelength range
Sample Experiments and Teaching Aids

- 12 experiments covering a wide range of topics
- General Chemistry, Biology and Physics labs
Sample Experiments

More Complete Curricula:

- Detailed instructors notes
- Presentation materials
- Pre and post lab questions with answer key
- Sample spectra
- Sample tests
- Materials/Samples
- How-To videos
- ...
Sample Experiments: Topics and Concepts

• Making absorbance measurements
• Beer’s Law
• Diluting samples
• Molarity
• Using standard curves to determine unknown concentrations
• Chlorophyll
• Chemical kinetics
• Rate law calculations

• Determining reaction order
• Atomic and molecular structure
• Atomic emission
• LEDs
• Fluorescent lighting
• Determining the composition of lighting materials
• Relationship between absorbance and transmission

But wait. There’s more....
Sample Experiments: Topics and Concepts

- Active pharmaceutical ingredients (API's)
- Weighing chemicals and preparing samples and standard solutions
- Using absorbance features to identify an unknown
- Measuring reflected color
- Delta E
- Fluorescence
- Determining excitation wavelength
- Instrument response function
- Making relative irradiance measurements
- Configuring absorbance and fluorescence systems
- Radiometric calibration of a system
- Measuring absolute irradiance with an integrating sphere
- Determining peak metrics for LEDs
What Are the Other Options?

• ThorLabs – Build Your Own Spectrometer Kit ($1227 - $1608)
• ThorLabs – CCD Spectrometers ($1950 - $2750)
• Thermo Scientific – Integrated systems (Spec200, NanoDrop, etc.)
• Pasco – Wireless Spectrometer ($399)
• Vernier – SpectroVis ($399)
Voice of the Customer

• Include packaging to facilitate storage and transport
• Pricing for lower educational levels and STEM outreach
• More sample experiments
• Simplified software
• Educational Raman system

• Easy to use, swappable, direct-attach sampling accessories
• Curricula to demonstrate principles of spectroscopy
• Simple handheld battery powered spectrometer for use in environmental and atmospherics

To be continued....

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Education Products: New Modular Kits

- Flexible, innovative spectroscopy kits designed to inspire today’s tech savvy students
- Contain all the components and software needed to teach a wide range of topics across multiple disciplines
- Priced for smaller budgets and STEM outreach
- Create a community of users who share experiments, curricula and other information

**Measurements Enabled**
- Absorbance: Beer’s Law
- Transmission: Color
- Fluorescence: Chlorophyll
- Emission: Atomic Emission
- pH: Henderson Hasselbach

**Retail Cost**
- EDU-STS-VIS-PACK: $1499 USD
- EDU-SPARK-PACK: $999 USD

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Education Kit Status

- Featured in the booth at Photonics West, Pittcon and ACS National Meeting
- First order for 6 EDU-STS-VIS-KITS kits from Central Carolina Community College
- First outreach program - Tech Like a Girl Workshop on April 22nd
- 25 kits shipped since April - First ecommerce sale

Work in Progress

- Finalize packaging
- Create additional sample experiments and teaching material
Education Products Roadmap

• More sample experiments and teaching materials
• Update existing EDU-PACK kits with accessories similar to the new STS and Spark kits
• Educational Raman under $10K USD
• Eco-VIS redesign: better cuvette holder, power switch, filter holder...
• More repeatable Spark accessories
• Low cost UV light source
• ...
Simple spectroscopy Apps for phones and tablets

Packaging to Store and Mount Setups

SpectroscopyPi
PocketSpectroscopyLab
Tech Like a Girl Workshop

sponsored by LASER-TEC and the CCCC Laser Club SPIE/OSA Student Chapter
STEM Outreach with EDU-STS-VIS-PACK

- April 22, 2017 all-girls STEM workshop to introduce young girls to careers in science and engineering
- “Tech like a Girl” theme originates out of LASER-TEC, a National Science Foundation (NSF) grant
- 9 girls aged 10 through 14
- EDU-STS-VIS-PACK used to help teach students about spectroscopy
Experiment #1: Measuring Emission Spectra for Different Light sources
Emission Spectra for Light Sources

- The emission spectrum is how bright certain wavelengths/colors are when energy is added to the atoms or molecules in the light source.
- Each atom's emission spectrum is unique and can be used to determine the type of material the light is coming from.
How Do Light Bulbs Make Light?

- **Incandescent and Halogen bulbs**: Electricity heats up a filament/thin piece of metal inside the bulb until it glows.

- **Fluorescent and Compact Fluorescent (CFLs) bulbs**: Electricity flows through a glass tube and light up a combination gas and chemicals called argon, mercury and phosphor.

- **Light Emitting Diodes (LEDs)**: A small semiconductor crystal is energized with electricity causing the crystal to emit light.
Emission Setup
Experiment #2: Identifying an Unknown Sample Using Absorbance Spectroscopy
What Is Absorbance Spectroscopy?

• As the light passes through a sample, some of the wavelengths of light are absorbed so the light that passed through the sample is missing those wavelengths.

• Absorbance spectra are like fingerprints - Each compound has its own unique spectrum.

• Absorbance spectra can be used to:
  • Identify a sample
  • Determine the amount of a compound present.
Absorbance Setup

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Now It’s Your Turn

• What can we do to help you sell more education products?
• What is missing from the kits or the educational product offerings?
• What promotions would you like us to run to help you sell more education products?
Thank you