Biosensor NSF GK12 Project

Interdisciplinary STEM focus

Collaboration and Two-Way Growth

Flexible to the Needs and Desires of your GK12 classroom

as experienced by Jeramy and Matt

Goals of the NSF GK12 Project

1. Bring university level scientific research INTO the high school class and curriculum
2. Build a connection between high school students and a "resident scientist" to reduce any perceived barriers to entry into the STEM fields and bring relevance to the scientific process
3. Add content knowledge and research exposure to the high school teacher while also building on communication skills of the fellow (oral, written, and interpersonal)

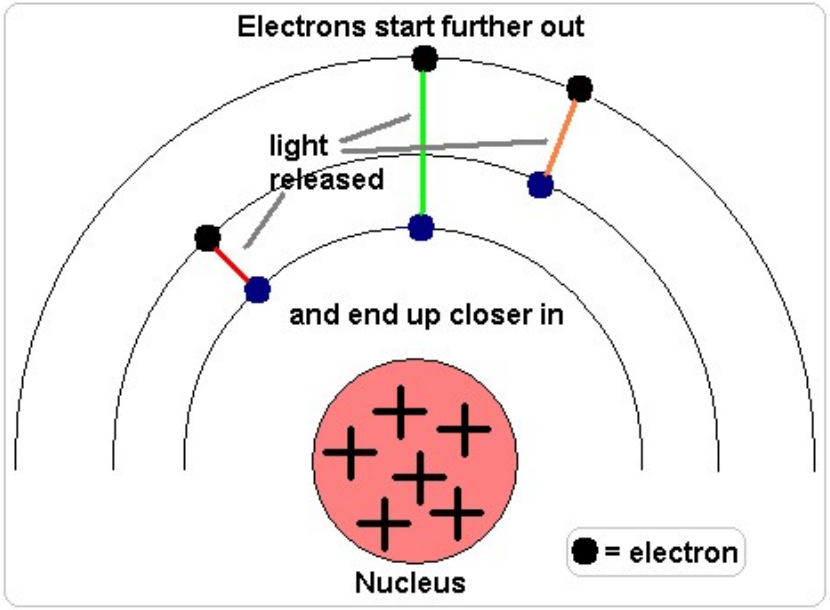
Teacher-Fellow Collaboration

CO Physical Science Standard 2: Matter has definite structure that determines characteristic physical and chemical properties.

a. Develop, communicate, and justify an evidence-based scientific explanation supporting the current model of an atom

b. Gather, analyze and interpret data on chemical and physical properties of elements such as density, melting point, boiling point, and conductivity

c. Use characteristic physical and chemical properties to develop predictions and supporting claims about elements' positions on the periodic table



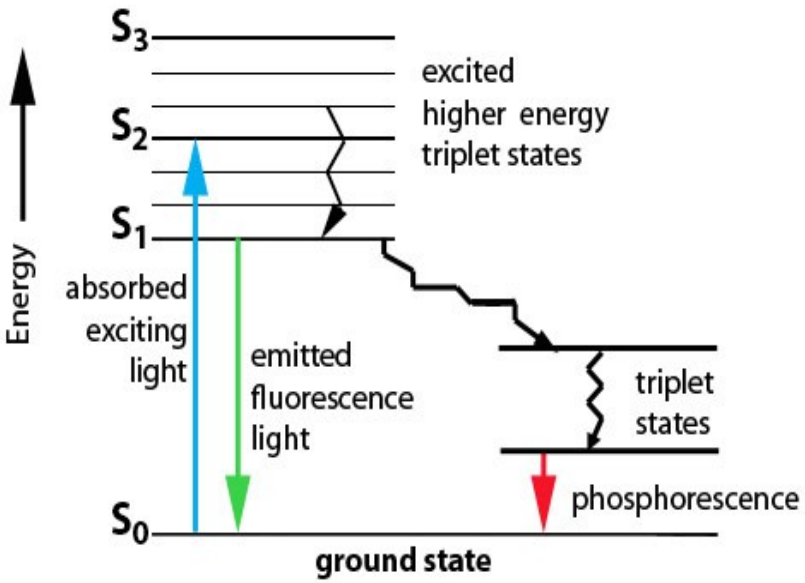
Bohr Model and Quantum Model of an atom (Ch. 5)

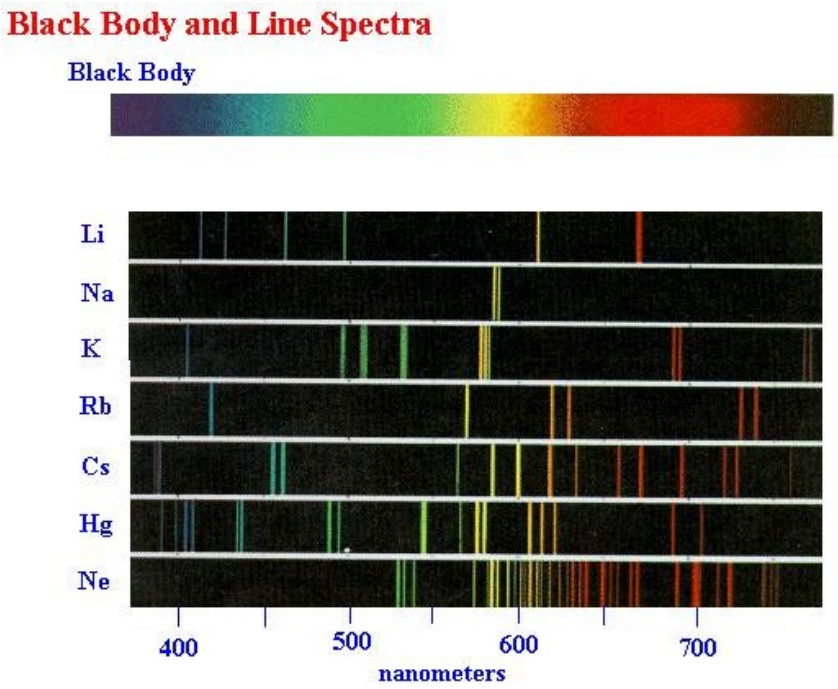
evidenced by unique atomic emission spectrums of different elements

Teacher-Fellow Collaboration

The concept: By exciting atoms (energizing them), you can cause electrons to jump to higher energy states (no visible observation).

And then when the electrons naturally return to the lower energy state, they release this excess energy at light (often in the visible spectrum).





Teacher-Fellow Collaboration

Previously:

Only discussed two ways to "excite" atoms

- Heat with flame test lab
- Electricity using gas spectrum tubes

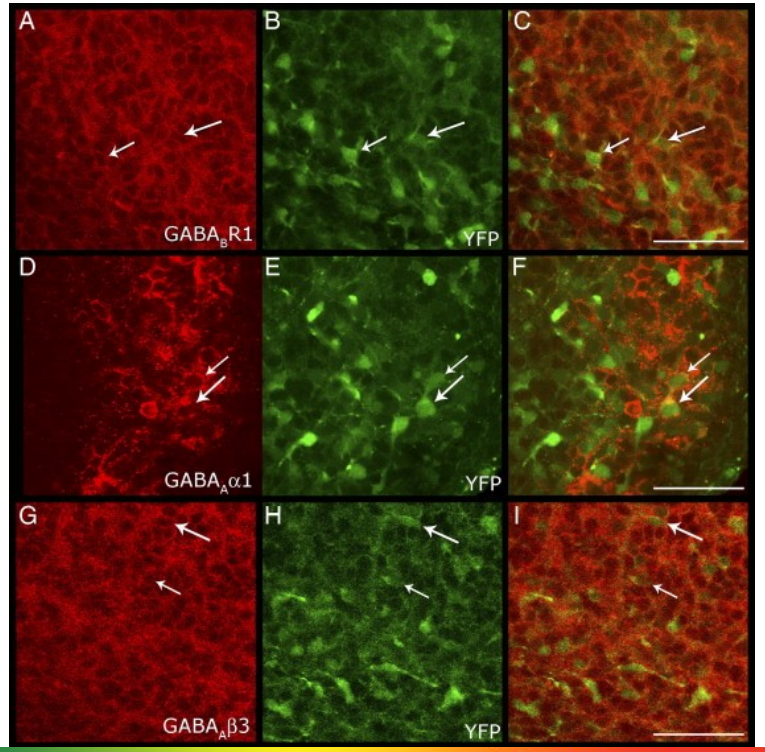
Now I've added a third way:

➢Photons using fluorescence microscopes

•New Spectra Lab Developed

•New Application Questions related to Biosensor Neuron Research

•LEEDS Precision Instruments representative Jeff Bright able to give hands on experience with high-powered fluorescence microscopes (see diagram to the right)



Teacher-Fellow Collaboration

New Concept:

Fluorescence in Relation to the Biosensor Project

In order to detect the neural migration in embryonic mouse brains, certain neurons express fluorescent proteins.

Fluorescence is a specific transition that occurs when an electron is excited by light photons (from the microscope) into a higher energy state. When electrons drops back down to its original state new photons of a specific color are emitted.

Only the neurons that are tagged fluoresce, allowing the research team to monitor the movement of these neurons in the brain.

Teacher-Fellow Collaboration

Another New Concept Example:

"Doping" of silicon wafers to alter the conductive properties

Use of electrochemistry to track presence and movement of certain particles in the biosensor

This enhanced my Period Trends Unit and my Aqueous Solutions Unit:

- Introduced standard curves used in scientific research
- Introduced conductivity probes being used for stream conductivity as a way to monitor total dissolved solids (TDS)
- Had student create and interpret their own standard curve of conductivity (**µS/cm**) and total dissolved solids (**mg/L**) relationship
- Used probeware to test samples of Spring Creek and Glenwood Springs water, graph their results and predict causes of the trends observed
- Students asked to design an experiment to test their predicted caused for variances in Spring Creek TDS over the course of a year

Teacher-Fellow Collaboration

Connecting dots/Seeing patterns/Understanding relationships

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GK-12 Challenges

- Time Management

  - two busy work schedules, an inconsistent school schedule and and constraints on "extra" time in the day

  - can be difficult to weave in new content without losing too much time
- Finding natural (non-artificial) overlap of Colorado Content Standards and what exactly is going on with Biosensor Research
- Authentic connection with between fellow and students

GK-12 Insights

- Plan early and cooperatively because during the school year is tough
- Utilize the fellow as a resource of knowledge, new lab equipment or chemicals, and source of new relevant applications
- Feel free to explore anything innovative and exciting that you've wanted to do for a while but lacked adequate time or resources to prepare and conquer this as a team