Remotely Accessible Experiments for Use is K-12 Education

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Our education is experiencing a dramatic shift in content students are exposed to in our K-12 system. Thought the focus has been on common core, there is also a push to reevaluate how our science courses are taught in the creation of the Next Generation Science Standards (NGSS). A major shift is being seen where traditional teaching methods, such as lectures, quizzes, exams, etc. are being replaced by new pedagogies based on problem or project based learning, such as inquiry based instruction, flipped classrooms and peer guided learning. This pedagogical shift allows for innovative educators to pioneer the development and seek out new resources to implement in their courses. RAIN has been developing science labs that can be used in conjunction with remote access instruments to expose K-12 classes to modern experimentation that will help fulfill requirements of NGSS.

Currently, RAIN has access to seven experiments that can utilize with remote access available on its website (www.nano4me.org/remoteaccess). These labs include basic chemistry labs that involve determining an unknown mineral using chemical and physical properties **(See Figure 1)** with elemental analysis using energy dispersive spectroscopy (EDS), studying the phytotoxicity of mung beans with various nanoparticle interactions shown in the image to the left that has mung beans grown in a silicon dioxide nanoparticle solution. These SiO_2 infused mung beans were then visualized using a scanning electron microscope (SEM) and finally a lab that quantifies the percent oxygen in a room using steel wool. In this experiment, the oxidation of steel wool in the process can be visualized using SEM and an empirical formula can be determined of the oxidized steel wool with EDS.

Figure 1: Flame test used in Unknown Mineral Lab

A second set of labs are focused on courses in nanotechnology, though they can be used in K-12 or undergraduate science curricula. These include a gold, silver and nickel nanoparticle synthesis and characterization **(See Figure 3)**. An advanced lab, based on fabrication of a Dye-Sensitized Nano-crystalline Solar Cell using titanium dioxide and raspberry juice is available for students and faculty who want to imbed a challenging activity in their course.

RAIN is available to any educator at any level and we hope you will implement our experiments into your classroom and take advantage of our remotely accessible instruments at no cost to your educational institution.

Figure 3: Nanoparticles Synthesized and Characterized in RAIN Experiment: A. Silver Nanowires, B. Gold Nanoparticles and C. Nickel Nanowires