

Initial Report Written by Curriculum Leads Reflecting Discipline Panel Faculty Feedback at June 2013 Professional Development Workshop

Lab Prospectus Summary for Biology/Allied Health Generated During Break-out Sessions June 13 and June 14, 2013 - Faculty & Staff Professional Development Workshop:

On June 13, biology and allied health faculty met together in the breakout session. On June 14, after initially meeting together during the breakout session, we broke into a Biology faculty group and an Allied Health faculty group. Kate Lormand served as the Curriculum Lead for Biology and Farah Bennani served as Curriculum Lead for Allied Health.

Those in attendance were: Allison Albertson (A&P), Catherine Bollacker (A&P), Suzanne Buie (A&P), Mona Gleysteen (A&P/BIO), Henri Santiago (BIO), Quinci Lords (A&P), Chris Hurley(A&P), Shanda Vidmar (BIO), Mary Chavez, Dawnelle Mathis (A&P), Michelle Sweeney (A&P), Kristina Long (A&P), Jeff Wingham (A&P), PJ Bennett, and Curriculum Leads: Kate Lormand and Farah Bennani

Potential labs identified during breakout sessions:

- Bacterial Growth lab- uses the spectrophotometer for bacterial growth at different temps.
- Bomb Calorimeter – Chemistry, biology or nutrition would be applicable as well
- *Enzymes - Spectrophotometer
- Photosynthesis Respiration – Spectrophotometer
- Respiration versus Oxygenation
- *Buffers Acid Base Balance – pH meter titration and roles of urinary and respiratory systems
- *Cell Types Prokaryote and Eukaryote, plant and animal cells.
- Glucose Test–Beers Law use the unknown as the patient case study potential
- Macromolecule lab – Spec with a carousel
- ELISA Fluorescence –with calibrators using spectrophotometer so students could plot a graph and determine the control and unknown patient values. FIA
- Blood typing as part of a genetics lab- can be used in A&P and various bio classes
- Any Biology, A&P, Micro, Allied Health labs that require slides
- *Histology Labs
- Pathology Tissues for human diseases
- *Parasitology: using parasites slides and fungal slides
- *Osmosis and diffusion
- Urinalysis – synthetic urine
- *Hematology

Other thoughts for additional labs

- Habitats/ecosystem- Remote webcam
- DNA Melting
- Muscle Twitch Neuro Stimulation
- Inter thoracic Pressure
- Cranial nerves stimulation

The second day we broke into two groups one group -- one group focused on potential biology experiments that could be done using remote web-based science technology and the second one focused on the potential allied health experiments that could be done using remote web-based science technology.

BIOLOGY NANSLO RWSL PRIORITIES

From the above list of experiments, the **Biology faculty** gave priority to: Enzymes – Spectrophotometer, Buffers Acid Base Balance – pH meter titration and Cell Types- Prokaryote and Eukaryote, plant and animal cells.

Enzymes – This laboratory activity would focus on the use of the spectrophotometer to determine the rate of a reaction as it is catalyzed by an enzyme. The rate would be measured by the amount of substrate transformed in other words the amount of product formed in a period of time.

Part 1: The lab will test the activity of the enzyme in various conditions such as temperature and substrate concentration.

Part 2: Additionally student would plot the data to create a standard curve.

Part 3: The following would be a third part (I am concerned about how long this lab would take and hesitate to add this in right now). Analysis of an enzyme (for example alkaline phosphatase) because then the student would experience a kinetic reaction where you take two different measurements to see a change in absorbance as the enzyme depletes the substrate. The calculation used, units, and wavelength (has to be UV wavelength) are totally different than in the glucose measurement. **Note** - Kate has the Kinetic Enzyme Lab from Mona Gleysteen for additional review.

Learning Objectives Parts 1 and 2:

1. Gather data using a spectrophotometer.
2. Discuss enzymatic specificity and activity.
3. Demonstrate the effect of temperature on enzymatic activity.
4. Demonstrate the effect of substrate concentration on enzymatic activity.
5. Graph data into a calibration curve.
6. Interpret data.
7. Calculate an unknown's concentration using a calibration curve.
8. Extrapolate data points on a graph.
9. Make predictions using data.

Learning Objectives Part 3:

1. Perform a kinetic enzyme procedure.
2. Construct a graph to illustrate the relationship between time and absorbance change during an enzymatic reaction.

3. Calculate the amount of enzyme activity present in the sample.

Critical Thinking Questions:

1. Describe how you would change the reaction rate of an enzyme, use specific examples from the data you collected in this lab to support your answer.
2. What are some of the practical applications of using a standard curve?
3. What are some other conditions that could impact the activity of an enzyme? Propose a method to test this.
4. Propose an explanation for the shape of the absorbance vs time graph. Mark the lag, linear, and substrate depletion areas on your graph.
5. The temperature at which the enzymatic reactions are run in your laboratory is set at 37 C. You notice that the temperature is now reading 50C. How is this going to affect your analyses? Can tests be accurately run?

Buffers Acid Base Balance – In this experiment, students will explore the principles of acids and bases by using digital pH meters to accurately determine the pH of a solution. Additionally students will investigate how several materials respond to the addition of an acid and a base to determine whether living materials have buffering capacity

Learning Objectives:

1. Collect and analyze data using a drop counter and digital pH probe
2. Define acid, base, pH and buffer.
3. Describe the principle involved in the measurement of pH
4. Explain the relationship between acids and bases in a simple titration
5. Explain the effect of a buffer on the pH of a liquid.
6. Interpreting the data on a graph to determine the point at which buffer stabilization fails.

Critical Thinking Questions:

1. Based on your understanding of the pH scale explain what it means to be a logarithmic scale give examples showing what happens when the pH changes from a pH of 7 to a pH of 9.
2. What is the biological importance of natural buffers? Use the lab and specific examples to support your answer.

Cell Types – Prokaryote and Eukaryote, Plant and Animal Cells – The goal of this laboratory is to allow students to explore the differences in cell types from prokaryotic and eukaryotic to plant cells and animal cells. The primary focus of the lab is to use microscopy to identify the specific characteristics that categorize cells into the above groups. Students will observe and capture images from the slides (prepared and fresh) of bacteria identifying the primary shapes and structures viewed. Similarly, students will observe and capture images from a set of slides containing various protozoans. To investigate the differences between plant and animal cells students will be provided with both prepared and fresh sample slides. Students will capture microscopic images for the purposes of identifying and labeling structures and identifying differences. Using the fresh tissue samples students will observe and contrast the impact of tonicity on living cells.

Learning Objectives:

1. Use direct observation to examine living microorganisms.
2. Examine and identify the similarities between prokaryote and eukaryote cells.
3. Examine and identify the differences between plant and animal cells.
4. Explain the differences in structure as they relate to the organisms function.
5. Diagram and explain the movement of materials into and out of a cell.

Critical Thinking Questions:

1. Can you distinguish the prokaryotic organisms from the eukaryotic organisms? Explain
2. Do some background research on Brownian motion; in the living samples of bacteria did any of the bacteria exhibit true motility? How do you distinguish true motility from Brownian movement or motion of the fluid?
3. Looking at the prokaryote and eukaryote cells which do you think would be most successful in extreme environments and why?
4. What kinds of cell environmental conditions might affect tonicity in cells; give examples to support your answer.
5. Think about the cell wall of a plant cell as compared to the cell membrane in an animal cell. Discuss the structure function relationships of these cell boundaries.

ALLIED HEALTH NANSLO RWSL PRIORITIES

The **Allied Health Faculty** gave priority to the following labs: Acid Base Balance (role of the respiratory and urinary systems following the Human Anatomy and Physiology Society (HASP) objectives), Osmosis and Diffusion lab, Histology lab (focusing on the Epithelial and Connective tissues), parasitology lab and hematology.

Acid/Base Balance lab:

Learning Objectives:

1. Buffer systems & their roles in acid/base balance
 1. Define acid, base, pH and buffer
 2. State the normal pH range for arterial blood
 3. With respect to the bicarbonate buffer system, the phosphate buffer system and the protein buffer system
 1. State the chemical equation for each buffer system
 2. Explain the role of each buffer system in the regulation of blood, intestinal fluid, and intracellular pH, including how each system responds to increases or decreases in pH.
 4. Explain the role of hemoglobin in pH buffering
2. Role of the respiratory and urinary systems in acid/balance
 1. State the normal ranges for PCO₂ and HCO₃⁻ in arterial blood and summarize their relationship

2. Describe the role of the respiratory system in the regulation of blood pH and predict how hypo-and hyperventilation will affect blood pH
3. Explain the mechanisms by which the kidneys secrete hydrogen ions and how this process affects blood pH
4. Explain the mechanisms by which the kidneys retain bicarbonate ions, and how this process affects blood pH
5. Discuss the concept of compensation to correct respiratory and metabolic acidosis and alkalosis
6. Given appropriate arterial blood gas values, determine whether a patient has normal blood pH or is in respiratory acidosis or alkalosis or is in metabolic acidosis or alkalosis, and whether the acidosis/alkalosis is partially or fully compensated or uncompensated.

Critical Thinking Questions:

1. Describe when and how pH stimulates respiration
2. How would an increase in cellular metabolism affect blood pH and the oxygen Hb dissociation curve?
3. Describe how the urinary system will attempt to compensate for pH imbalances of respiratory origin and how the respiratory system will attempt to compensate for pH imbalances of metabolic origin.

Osmosis and diffusion lab:

Learning Objectives:

1. With respect to the following membrane transport processes: Simple diffusion, facilitated diffusion, osmosis, active transport, exocytosis, endocytosis, phagocytosis, and filtration
 - a. State the type of material moving in each process
 - b. Describe the mechanism by which movement of material occurs in each process
 - c. Discuss the energy requirements and, if applicable, the sources of energy for each process
 - d. Give examples of each process in the human body.
2. Describe the effects of hypertonic, isotonic and hypotonic conditions on cells
3. Demonstrate various cell transport processes and , given appropriate information, predict the outcomes of these demonstration

Critical Thinking Questions:

1. Identify five factors that can affect the rate of diffusion through a membrane

Histology lab:

Learning Objectives:

1. Overview of histology and tissue types
 1. Define the term histology
 2. List Four major tissue types
 3. Contrast the general features of the four major tissue types
2. Microscopic anatomy, location, and functional roles of epithelial tissues
 1. Classify the different types of epithelial tissues based on distinguishing structural characteristics
 2. Describe locations in the body where each type of epithelial tissue can be found
 3. Describe the functions of each type of epithelial tissue in the human body and correlate function with structure for each tissue type.
 4. Identify the different types of epithelial tissue using proper microscope technique.
3. Microscopic anatomy, location, and functional roles of epithelial tissues
 1. Classify the different types of connective tissues based on distinguishing structural characteristics
 2. Describe locations in the body where each type of connective tissue can be found
 3. Describe the functions of each type of connective tissue in the human body and correlate function with structure for each tissue type.
 4. Identify the different types of connective tissue using proper microscope technique.

Critical Thinking Questions:

1. Brandon sprained his ankle in a mountain biking race. Based on the definition of a sprain, what specific histological type of tissue has Brandon injured?
2. Explain why you would expect this type of tissue to have a high or low mitotic index.
3. How will the mitotic index affect the rate of healing of Brandon's injury?

Parasitology Lab:

Learning Objectives:

1. Using reference material, pictures, or textbook, the student will identify parasites on prepared slides. (The list of prepared parasites slides, the Faculty sent me is below)
2. The student will find and identify protozoan parasites (trophs and cysts, plus other).
3. The student will find and identify helminth parasites.

Critical Thinking Questions:

1. What parasite are you viewing on the slide?
Answers: Vary depending on the slide
2. Cellophane tape ("Scotch" tape) preparations are the preferred method of diagnosing _____ infections.
Answer: *Enterobius vermicularis* (pin worm)

List of slides from Tropical Biologicals

- #12. *G. lamblia* trophs and cysts (2.0 ml only)
- #20 *A. lumbricoides* embryonated eggs (2.0 ml)
- #23. *Necator americanus* eggs (2.0 ml)
- #38 *Taenia saginata* eggs (2.0 ml)
- #46 *Balantidium coli* cysts
- #47 *B. coli* trophs
- #52 *Entamoeba coli* cysts
- #53 *E. coli* trophs
- #56 *E. histolytica* cysts
- #57 *E. histolytica* trophs
- #58 *Giardia lamblia* cysts
- #59 *Giardia lamblia* trophs
- #60 *Iodamoeba buetschlii* cysts
- #61 *I. buetschlii* trophs
- #62 *Trichomonas muris* trophs
- #63 Cysts of four amoebae
- #66 *Plasmodium falciparum* rings
- #70 *Pl. vivax* all stages in blood
- #81 *E. granulosus* cysts
- #82 *Taenia solium* pig muscle cysticercus--\$10

Hematology Lab:

Learning Objectives:

1. Perform leukocyte differential and peripheral blood smear evaluations.
2. List the basic characteristics of cell maturation and, when given cell characteristics, determine the stage of maturation.
3. State the various erythrocyte disease states in terms of cells observed on a prepared slide.

Critical Thinking Questions:

1. What type of erythrocyte morphology is observed on the slide and what disease state does the morphology correlate with?
Answers—could be:

1. Drepanocytes (sickle cells); Sickle cell anemia
 2. Spherocytes; Hereditary spherocytosis or immune hemolytic anemia (or others)
 3. Target cells: Liver disease or others
 4. Microcytes: Iron deficiency anemia (or others)
 5. Macrocytes: Megaloblastic anemia (or others)
 6. Schistocytes: Microangiopathic hemolytic anemia
2. What is the predominant type of leukocyte seen on the slide and what disease state does the morphology correlate with?

Answers—could be:

1. Bands and segmented neutrophils; bacterial infection
2. Lymphocytes; viral infection (infectious mononucleosis) or blood from young child
3. All ages and stages of granulocytes; chronic myelogenous leukemia
4. Mature lymphocytes and smudge cells; chronic lymphocytic leukemia
5. Myeloblasts; Acute myeloblastic leukemia
6. Lymphoblasts: Acute lymphoblastic leukemia

Lab Prospectus Summary for Chemistry/Allied Health Generated During Break-out Sessions June 13 and June 14, 2013 - Faculty & Staff Professional Development Workshop:

The chemistry break-out sessions were attended by Dan Brannan, Farnosh Family and Dan Casmier (by phone). At the sessions, 7 potential chemistry experiments were discussed. The following three were given priority in development:

1. Avogadro's Number Determination and Density Lab
2. Modern Cathode Ray Experiment
3. Gas Chromatography

These three were given priority for several reasons. One is because they presented unique learning opportunities directly related to course content of any first semester general chemistry course. Two, these labs are not possible in a lab kit and done remotely, offer an advantage over face-to-face labs in that the results will be more accurate. Three, the development of the lab is feasible and the equipment to be purchased is presumably reasonably priced. More research on each of those labs will need to be done to confirm that presumption. The Avogadro's number lab requires the development of a volume delivery system that can be controlled remotely. The Modern Cathode Ray experiment requires some tube with a cathode ray and magnetic and electric fields. The Gas Chromatography experiment requires the purchase of a GC. The other labs that are being considered are:

4. Mass Spectrometry
5. Titrations
6. Kinetics

7. Equilibrium Constant

The instrumentation required for the mass spectrometry lab may be cost prohibitive. The titrations lab is one that needs to be explored further. It is unclear what advantage is made by performing a titration remotely. The kinetics lab will be similar to the "Iodine Clock" lab that is often performed in face to face settings. The advantage in the remote labs is that the experiment can be performed using a spectrometer to detect when the reaction has occurred. The students can watch both the absorbance readings and the actual experimental flask to see the presence of light absorbing compound indicating the reaction has occurred. The kinetics and equilibrium constant labs are excellent candidates for a second semester general chemistry course and will be developed further. Both of those experiments will also improve in the remote labs setting because in the remote lab, the experiment can be temperature controlled much more accurately than in a face-to-face lab setting. Below is a description of the first three lab experiments:

Potential Lab Experiments

1 – Avogadro's Number Determination/Density

Learning Objectives:

- Employ the use of a volume delivery system to determine the density of several solvents
- Evaluate the relationship between density and temperature of a solvent
- Apply dimensional analysis to determine Avogadro's number from experimental data
- Gain experience preparing a monolayer

Students will use a volume delivery system and to first determine the density of a series of solvents. Then the temperature of a solvent will be varied and the same measurements will be taken to calculate the density at the elevated temperature. Once their experimental control of this system is mastered, they will then use the same system to create a monolayer of stearic acid on water. The stearic acid will be delivered in a hexanes solution of known concentration. The stearic acid is delivered dropwise and the hexanes evaporate leaving a monolayer of stearic acid exactly one molecule thick. The lab cameras will be set up so that the students can watch the formation of this monolayer from different angles and will therefore be able to see when the monolayer has completely covered the water surface. From zooming in on one of the camera angles, the students will be able to see when they have added one drop too many since that drop will simply sit on top of the monolayer. The remote lab set-up offers an advantage over the face-to-face lab for this aspect because the camera will be able to zoom in and the students will be able to more easily tell when the monolayer has formed.

Through a series of calculations from the known concentration of the stearic acid solution, the density of stearic acid, and the volume of the monolayer, students will be able to determine the number of molecules per mole, Avogadro's number.

Total Volume = (Volume of 1 molecule)(Number of molecules)

Total Volume = (Area)(Thickness)

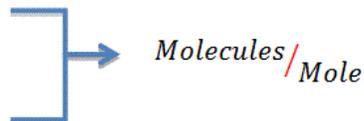
- *area of monolayer is the area of water underneath monolayer*

- assume each molecule is a cube, length of cube is thickness of monolayer

$$(\text{Thickness})^3 = \text{Volume of 1 molecule}$$

$$\frac{\text{Total volume}}{(\text{thickness})^3} = \text{Number of molecules}$$

Experimentally determined volume → Mass → moles



- using density of stearic acid, the mass can be calculated
- using molar mass of stearic acid, the mass of the sample is calculated

2 – Modern Day Cathode Ray

Learning Objectives:

- Reproduce JJ Thomson's cathode ray experiment with modern equipment
- Relate the charge and mass of an electron to the electric and magnetic field applied to an electron beam
- Calculate the charge to mass ratio of an electron
- Compare the experimental value to the known value of an electron's charge to mass ratio

Using a modern-day version of the cathode ray experiment, students will see the effect of a magnetic field and an electric field on an electron beam. Students will then be able to control the strength of an electric field and a magnetic field on the electron beam to prove that the electron is negatively charged. From the amount of deflection caused by the electric and magnetic fields, students will then calculate the charge to mass ratio of an electron.

3 – Gas Chromatography

Learning Objectives:

- Evaluate the effects of polarity on the separation of compounds
- Gain exposure to chromatography
- Design an experimental plan for determining the identity of an unknown

Students will be given a series of compounds with different functional groups varying in polarity. The students will then use an autosampler to see how the compounds behave on a particular column. The students will be able to decide which compounds they would like to see basing their decision on the polarity of the compounds. This will give the students an idea of how that particular column retains certain functional groups. They will then be given an unknown and asked what functional groups that unknown does or does not have.

Learning Objectives of some other potential labs:

4 – Mass Spectrometry

Learning Objectives

- Evaluate the relationship between isotopic abundance and atomic mass
- Gain exposure to new instrumentation (mass spectrometer)

6 – Kinetics (Iodine Clock)

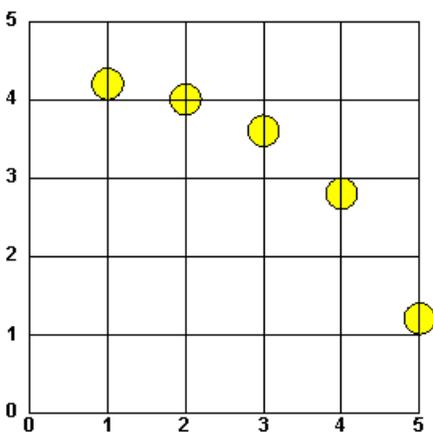
Learning Objectives

- Determine the relationship between temperature and the rate constant of a reaction
- Gain experience with the spectrometer and be able to evaluate absorbance readings

Lab Prospectus Summary for Physics/Allied Health Generated During Break-out Sessions June 13 and June 14, 2013 - Faculty & Staff Professional Development Workshop

First Semester Physics - Mechanics

2D Kinematic Motion



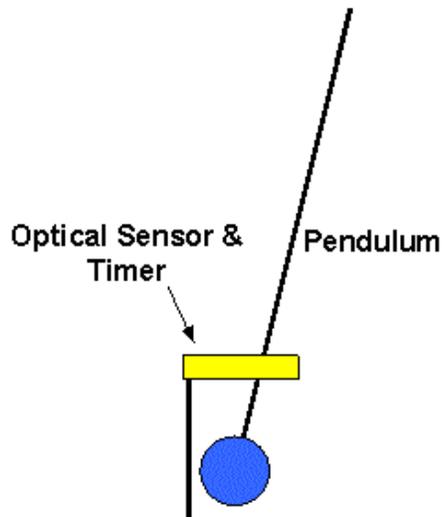
In this lab, students will be studying the 2 dimensional kinematic motion of a ball. A simpler lab with only 1 dimension could also be implemented instead of the more complex 2 dimensions described here.

The lab setup would consist of a ball with a launching device that triggers a camera or clock that would allow for precise timing. Behind the falling ball would be a grid with markings that would allow students to measure the displacement (both x & y) of the ball in time. Students would measure the ball location every 0.1 to 0.5 seconds. This could be achieved by either stopping the recorded video at the correct time, or triggering a camera to take pictures at the appropriate time.

Learning Objectives:

1. Calculate 2D kinematic motion
2. Separate 2D motion into independent and orthogonal axes

Pendulum Lab



In this lab, students will be able to calculate the acceleration due to gravity (g) by measuring the period of a pendulum.

The lab would consist of a simple pendulum and an optical sensor and timer. When the pendulum breaks the optical sensor beam, the time would be logged. From this data, students will be able to calculate the value of g .

A more advanced idea could be explored in this lab. The larger the amplitude of the pendulum bob, the larger the error in the calculated value of g . Students performing this experiment at home would not have the equipment to notice the increasing error with amplitude. However, this topic may be too advanced for algebra-based physics but should fit nicely for a calculus-based physics course.

Learning Objectives:

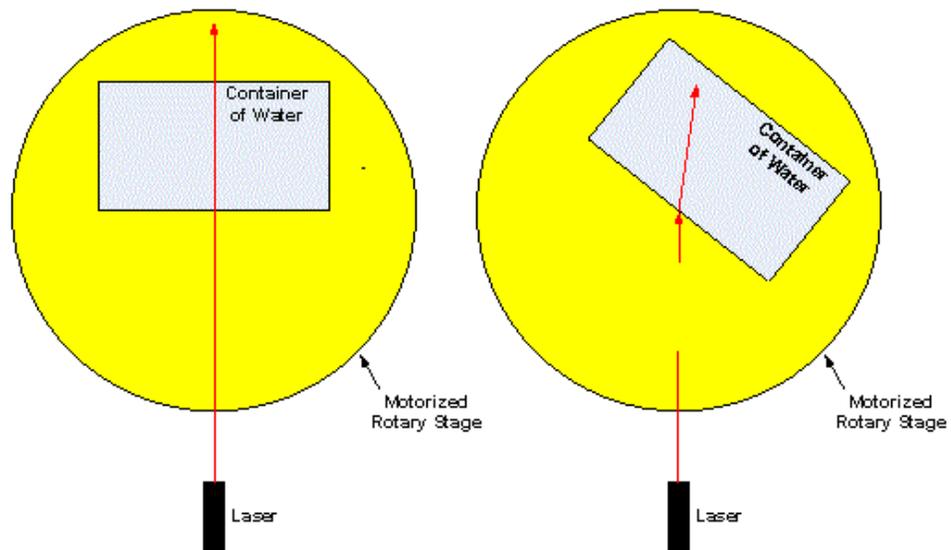
1. Apply simple harmonic motion concepts to the pendulum
2. Calculating and determining the value of g
3. Analyze data with error analysis, approximations, and estimates

Second Semester Physics – Light, Electricity & Magnetism

Snell's Law

In this lab, students will learn about Snell's law, refraction, critical angle and total internal reflection.

The setup for this lab includes a laser and a

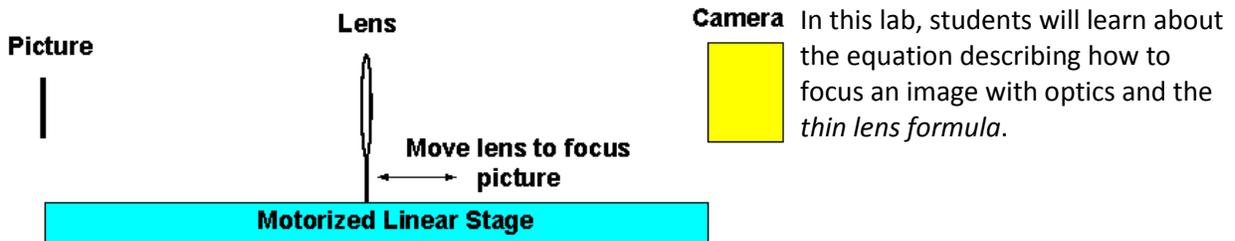


container of water on a motorized rotational stage. A laser illuminates through the container of water. As the container of water rotates, the angle of refraction of the laser beam changes until the setup approaches the critical angle and finally total internal reflection. Students would measure the angles of the laser beams to test Snell's law.

Learning Objective:

1. Calculate angle of refraction, critical angle, and total internal reflection

Focusing Lab



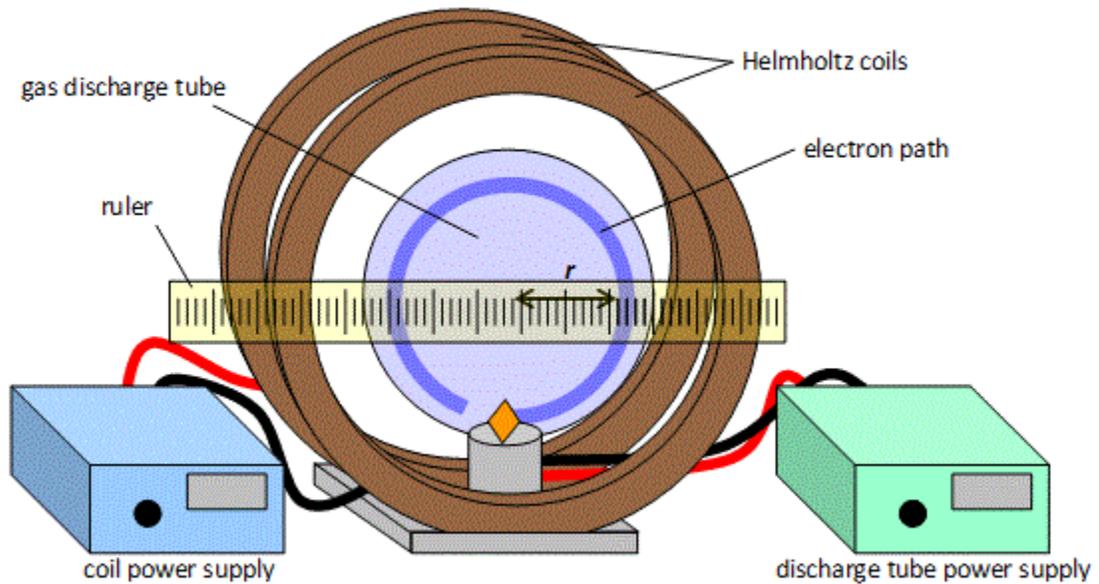
The setup involves a picture the students will focus on to a camera. In between the two will be a lens on a motorized stage. By moving the lens back and forth, the students will be able to find the best focus location of the lens and thus test the thin lens formula.

Learning objectives:

1. Calculate optical imaging distance
2. Apply the thin lens formula
3. Calculate magnification for different lenses and focal lengths

Electron Charge to Mass Ratio Lab

In this lab, students will be able to observe the effects of a magnetic field on moving charged particles.



(Figure to right provided by Albert Balbon, North Island College, British Columbia)

The test setup consists of a gas discharge tube that releases electrons. A pair of coiled wires make up the Helmholtz coils that produce a relatively uniform magnetic field. Moving electrons in a uniform magnetic field will move in circles. The radius of these circles determines the electron charge to mass ratio.

Learning Objectives:

1. Calculating charged particle motion in an magnetic field
2. Relate centripetal acceleration to microscopic objects (electrons)

Information on Allied Health Labs Posted on CHEO Wiki September 30, 2013

In June 2013, a professional development workshop was held in Boulder, CO for faculty who were developing courses under the CHEO initiative. As part of that workshop, breakout sessions were conducted each of the two days to discuss potential NANSLO lab activities that could be included in allied health courses. Through the dialogue with faculty, the Curriculum Leads identified a number of activities of interest to faculty.

Since that initial meeting, additional conversations have taken place and the following NANSLO Lab Activities have been selected and prioritized. This list is a work in progress as some adjustments may be made based on continuing dialogue with faculty. As changes are made, this information will be modified so that it is current and represents the activities that represent the 12 NANSLO activities to be delivered under this grant.

BIOLOGY/ALLIED HEALTH

Priority	Title	Description/Equipment needed
1	Histology	Slides only, possible multiple activities due to size of slide set (200+)
2	Membrane Diffusion	Iodine diffuses into starch solution. Spectrometer is used to monitor color change. <i>(could also use for Chemistry with slight modification)</i>
3	Membrane Osmosis	TBD - probably microscope-based, perhaps with live cells
4	Enzyme Activity	Glucose oxidase is injected into sugar solution, resulting in a color change, which is quantified with a spectrometer <i>(could also use for Chemistry with slight modification)</i>
5	Hematology	Slides, with optional blood-typing kit. Part of the lab will be activities to do with the blood-typing kit if the institution opts to have their students order it (we can't require it).
6	Buffer Systems	Acid and base is added to Water, phosphate buffer and albumin buffer to demonstrate the buffering capacity of each. <i>(could also use for Chemistry with slight modification)</i>
7	Parasitology	Slides only.
8	Cell Type Comparison	Slides only.
9	Diseased Cell Comparison	Slides only.

CHEMISTRY/ALLIED HEALTH

Priority	Title	Description/Equipment needed
1	Electron Charge/Mass	Uses Helmholtz coil to determine charge/mass ratio of electron (modern-day version of Thomson Cathode Ray experiment)
2	Gas Chromatography	A gas chromatograph is used to discern between various types of organic compounds
3	Titration	TBD – could be acid/base titration with pH probes for much more accurate results than possible with kit, or might be a kinetics activity using iodine clock and adding different amounts of reactants to several flasks to see effect of concentration on reaction rate.
4	Avogadro's Number	Using a precision liquid delivery system, a small amount of organic solvent is added to the surface of water in a dish. Microscope is used to measure diameter of organic solvent monolayer and determine Avogadro's number.