CORNELL UNIVERSITY
CENTER FOR MATERIALS RESEARCH
RET2 LESSON PLAN
SCT BOCES New Visions Education Program

Rhoodak@stny.rr.com

TITLE OF THE LESSON:
Materials examination and hands on microscopy

NEW YORK STATE STANDARD:

Math, Science and Technology Standard 5: Technology
Activities designed within this research proposal will focus on how the microscope "satisfies human and environmental needs." Students will also examine how the microscopy is used as a tool for scientific investigation. Students will also focus on how knowledge is gained from use microscopes and what science does with the knowledge gained. Students will constantly be asked to think about how this information related to their professional careers.

MULTIPLE INTELLIGENCE:
Visual Spatial
Logical Mathematical

GRADE LEVEL: 12

LESSON GOALS:
1. Students will gain an increased awareness of the use of a hand held microscope as a tool for scientific inquiry
2. Students will gain the skills needed to operate both a Radio Shack 30X hand held microscope and a 40X-lab microscope to investigate a sample provided by the instructor.
3. Students will learn how to record scientific observation in a student journal

4. Students will learn how to evaluate photographs taken from both a 40X-lab microscope and a scanning electron microscope.
5. Students will learn how to compare scientific information gathered from hand held microscopes, lab microscopes and the scanning electron microscope.
6. Student will engage in a discussion dealing with the interpretation of information gained from using the microscope as an education and research tool.

RESOURCES/MATERIALS NEEDED:

Radio Shack 30X hand held microscope
One lab microscopes (40X)
Photographs from the SEM lab at Cornell University and the Center for Materials Research.
Student journals
Pen and pencil
Light microscope photographs (taken at the Cornell University Center for Materials Research

ACTIVITY/CONTENT

Students will be provided with a Radio Shack 30X hand held microscope prior to using a lab microscope. Students will be given a pre-activity lecture of the RET2 project conducted at Cornell University and the Center for Materials Research. Students will then be given a sample of a NASCAR rotor used by the #24 car driven by Jeff Gordon. The material of the rotors will consist of cast iron. Students will be asked to use the hand held microscope to identify the following areas on the rotor samples:
Areas of material tear-off
Areas of particle bedding
Areas of stress cracks
Students will then sketch the above areas into a science journal to be reviewed by the instructor

EXTENDED LEARNING

Students will then be given light microscope photographs of these very rotor samples taken at the Cornell University Center for Matreials Research. Comparisons between student sketches and the actual photographs will be made and a discussion will follow focusing on the interpretation of these microscope photos.

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TITLE OF THE LESSON:
An Introduction to Tribology

STATE STANDARD:

Math, Science and Technology Standard 3 Math, Science and Technology Standard 4: Science
This project opens up a new area of study for high school students. Since the area of tribology deals with "interacting surfaces in relative motion," students will increase their knowledge base. This is particularly important to the New Visions Education and Engineering Program. Students in these programs are preparing for a career path immediately after graduation.

MULTIPLE INTELLIGENCE:

Logical/Mathematical
Visual Spatial

GRADE LEVEL: 12

LESSON GOALS:

1. Students will gain an increased awareness of the definition of "tribology" and will understand how this scientific discipline deals with interacting surfaces.
2. Students will gain an increased understanding of the concept of "particle transfer" as it relates to the findings of the RET2 research project conducted at Cornell University and the Center for Materials Research.

3. Through the use of the video titles NASCAR Tech: The NASCAR Brake Systems, students will gain a basic understanding of how brakes work on their automobile and NASCAR racecars.
4. With the use of a hand held microscope, students will examine sections of Performance Friction and Brimbo racing rotors. As a comparison, students will also examine samples of Performance Friction and Raybestos racing pads.
5. Students will learn how to teach a lesson on "friction" at the elementary and middle school level

RESOURCES/MATERIALS NEEDED

NASCAR Tech video
Samples of both Performance Friction and Brimbo brake rotors
Samples of Performance and Raybestos brake pads
Internet Diagram explaining hoe brake rotors and brake pads interact
Lesson on "friction" with diagrams and examples

ACTIVITY/CONTENT

Students will begin this lesson by viewing an instructional video titled NASCAR Tech: Brake Systems. This video will focus on how brake pads and brake rotors work together to slow down and stop both racing vehicles and passenger vehicles. A special focus will be placed on the following terms:

Friction
Coefficient of Friction
Calibers
Pads
Rotor configuration

Students will then examine a series of photos taken during the RET2 experience at Cornell University and the Center for Materials Research. These photos will demonstrate how friction causes the material particles from the racing pads to become imbedded into the surface of the race rotor. Since all of these photos deal with how tribology works during the interaction of brake pads and brake rotors, a number of photos will be examined to gain a broad understanding on the topic

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TITLE OF THE LESSON:
How Light Microscopes Work

STATE STANDARD
Math, Science and Technology Standard 5: Technology
Activities designed within this research proposal will focus on how the light microscope "satisfies human and environmental needs." Students will also examine how the SEM is used as a tool for scientific investigation. Students will also focus on how knowledge is gained from use of the light microscope and the Radio Shack 30X microscope. Students will also focus on what science does with the knowledge gained. Students will constantly be asked to think about how this information related to their professional careers.

MULTIPLE INTELLIGENCE :
Logical Mathematical
Visual/Spatial

GRADE LEVEL:12

LESSON GOALS

Students will gain an increased awareness on the workings of the light microscopes. Parts of the light microscope to be studied include the following:

1. Ocular lens
2. Coarse focus knob
3. Fine focus knob
4. Objective lens
5. Light source
6. Stage specimen

In addition to the workings of a light microscope, students will also gain an awareness of the following terms:

1. Brightness
2. Focus
3. Specimen preparation
4. Resolution
5. Contrast

RESOURCES/MATERIALS NEEDED

Multiple copies of the article "How Light Microscopes Work" by Craig C. Freudenrich
One copy of Marshall Brain's How Stuff Works
Access to a light microscope
Visit to a light microscope lab (Corning, Incorporated)

ACTIVITY/CONTENT

After a lecture and a demonstration on how to use a light microscope, students will prove that they have gained knowledge in this area by each making an oral presentation. New Visions Education students will then work on developing a lesson plan on "How a Light Microscope Works." This lesson plan will be used at the elementary and middle school level when students are on their student teaching rotations.

Lesson plan student work evaluations can include the following:

1. Light microscopes vocabulary list
2. Actual student demonstrations on how to use a light microscope
3. Blank diagrams of light microscopes where students fill in the blanks

EXTENDED LEARNING:

Students will then make a field trip to Cornell University and the Center for Materials Research to view a scanning electron microscope.

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TITLE OF THE LESSON:
Tribology and NASCAR Racing

STATE STANDARD

CDOS 3a: Universal Foundation Skills

Through oral and written presentations, students will demonstrate their knowledge of the light microscope and the area of tribology (as it relates to this NASCAR project). Activities in this area are designed to give that student a permanent base of knowledge from which to make informed decisions.

Standard 3b: Career Majors

Students in both the New Visions Education Programs and the Engineering Program have already made a commitment as to their career goals and objectives. By adding a light microscope/tribology unit to the already established New Visions curriculum, the topics in this curriculum become more diverse and real life oriented. The knowledge from this project will provide the New Visions students with the "academic tools" for success in the workplace. It is the goal of this project to effect career paths by broadening the knowledge base.

MULTIPLE INTELLIGENCE
Logical mathematical

GRADE LEVEL: 12

LESSON GOALS

Students will gain a better understanding of tribology through the understanding of the following:

1. Particle transfer between race pad and race rotor
2. Particle transfer
3. Interaction between race caliper-pad-rotor
4. Race pad components
5. Race rotor components
6. Particle identification (with the light microscope)

RESOURCES/MATERIALS NEEDED
RET2 Research material including both SEM and light microscope photographs

ACTIVITY/CONTENT
Students will review a series of poster boards featuring all six of the above mentioned topics. Students will also examine actual brake pads and brake rotors with a Radio Shack and a light microscope. As students review the pasteboards, students will have an opportunity to diagram a caliper-pad-rotor race setup. Students will then prove their knowledge by making a verbal or written presentation in class. Student journals will also be kept during this lesson

EXTENDED LEARNING
Students will visit the SCT BOCES TEC Automotive Division and will study an actual automobile brake setup.

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TITLE OF THE LESSON:
Microscopy Outreach Program

STATE STANDARD:

CDOS 3a: Universal Foundation Skills
Through oral and written presentations, students will demonstrate their knowledge of the microscopy. Activities in this area are designed to give that student a permanent base of knowledge from which to make informed decisions.

CDOS Standard 3b: Career Majors
Students in the New Visions Education Program have already made a commitment to the area of education. The knowledge from this project will provide the New Visions students with the "academic tools" for success in the workplace. In this case, it is the educational workplace. It is the goal of this project to effect career paths by broadening the knowledge base.

Math, Science and Technology Standard 3 Math, Science and Technology Standard 4: Science
Since the area of tribology deals with "interacting surfaces in relative motion," students will increase their knowledge base by studying both the subject and the science of microscopy. This is particularly important to the New Visions Education Program. Students in these programs are preparing for a career path immediately after graduation.

MULTIPLE INTELLIGENCE :
Visual/spatial
Logical Mathematical

GRADE LEVEL: 12

LESSON GOALS:
Students will develop the hand on skills necessary to use a microscope outreach kit as an instructional tool in the classroom.
Students will learn how to develop a lesson plan designed to use the microscope kits in class.
Students will also learn how to instruct other students in the operation of the Radio Shack 30X microscope and a lab light microscope.

RESOURCES/MATERIALS NEEDED
Sectioned off rotor samples from the RET2 experience at Cornell University.
Sectioned off racing pads from the RET2 experience at Cornell University

ACTIVITY/CONTENT
Students will be given a presentation on the elements of a New Visions Education microscope outreach kit. Students will then practice operating the Radio Shack 30X scope and will be familiar with the following terms:
Objective Lens
Focus Knob
Light source
Depth of field
Radius of the sample viewed

After students have pass a rubric evaluation on microscope examination, students will then be assigned to a class in a local school. After meeting with the mentor teacher, the students will conduct a two-day workshop where the microscope outreach kit will be used as an instructional tool.
Students will have their classes record all of their observations in a science journal, which will be reviewed by the mentor teacher.

EXTENDED LEARNING

Student will then make a fieldtrip to a local manufacturing firm that has a light microscope lab. Students will then make comparisons between the operation of a Radio Shack 30X microscope and a light microscope.