BERNARDS TOWNSHIP PUBLIC SCHOOLS
BASKING RIDGE, NEW JERSEY

TECHNOLOGY USE IN SCIENCE ELECTIVES

(Grades 11-12)

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Basking Ridge, New Jersey

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2006/2007

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DISTRICT GOALS 2006-2008

To promote active and relevant student learning.
To promote the improvement of instruction through relevant assessment.
To promote the improvement of instruction through differentiation.

DISTRICT PHILOSOPHY

Education is our first priority.
Intellectual, social, physical and emotional development is essential to a student's education.
Children learn in different ways; we have a responsibility to help all students maximize their potential. Students will benefit from a challenging curriculum with high standards. Individual student achievement is maximized by high expectations.
Co-curricular and community service activities are important components of effective education.
Education provides a foundation for life-long learning, critical and analytical thinking, problem solving, decision-making and respect for the individual.

PHILOSOPHY OF SCIENCE EDUCATION

Education in science introduces students to the community of scientists, to the traditions of science, and to scientific exploration. Through the experiences provided in learning science, students become acquainted with the processes by which scientific concepts are created and then explored. Knowledge of these processes and concepts leads to the awareness that science is not a set of findings but rather the search for them. This awareness is accompanied by the understanding that issues created by the advance of science can only be resolved by moral judgment and political choice.

Science education addresses the students' need to deal with science as part of our culture. For some students, the experiences of science education initiate or respond to a personal interest in preparing to enter those courses of study and training that led to participation in the democratic community of pure and applied scientists. In addition, science education prepares all students to respond to scientific information regarding the social and personal issues raised by technology and to be functional members of the society.

Students need to understand the interrelations between science and technology and develop a conceptual understanding of the nature and process of technology. Students will combine their understanding of the nature of technology and science in order to develop their abilities to make predictions, decisions, think critically, and ultimately to problem solve. Science will continue to advance with the knowledge and application of technology.

Students learn science best when they have opportunities to model the methods of science, to learn by doing. This complements students' development as they move from dependence on concrete activities to tentative experiences with abstract thinking. At all grade levels, educators strive to provide guidance and stimulate students' curiosity and interest in science.

The content of science education is selected to meet students' needs. The content provides for the development of science concepts that are encountered and explored using the processes of science. There are opportunities for independent critical thinking through hands-on activities and a discovery-based program. These encourage a healthy skepticism.

Students learning science collect real data in classrooms, laboratories, and the outdoors. They record observations and measurements done on large and small scales, in qualitative and quantitative modes. They manipulate apparatus and follow directions to assemble and disassemble it. They analyze, manipulate, and communicate data using scientific terminology. They use mathematics to find patterns, discover relationships, and generate explanations and employ quick mental estimates for many mathematical operations.

Through the exploration of matter, motion, forces, space, and earth, students will find that science is connected to their everyday lives. Students need to understand the environment as a system of interdependent components affected by human activity and phenomena. From the study of organisms to how our universe was created, students can see the relationship between their lives and global issues.

The outcomes of science education are recognized when students…

- demonstrate the knowledge and use of the processes of science
- demonstrate knowledge of and appreciation for the nature of science
- apply knowledge in the science disciplines
- demonstrate skills for applying the processes, the knowledge, and the appreciation of science to issues wherein science, technology, and society meet
- demonstrate an understanding of the interrelationship between science and technology
- demonstrate an understanding of the interrelationship between human activity and the environment

The student who has achieved mastery in science education has experienced, can describe, and can choose to use the overall purpose of science: to search for truth in the world in which we live and beyond.

Bernards Township Public Schools

K-12 SCIENCE GOALS

As a result of studying science, students should have experienced activities in which they experiment with and develop mastery of the following skills:

1.0 PROCESS SKILLS

1.1 Students shall be able to state questions about nature that can be answered using the methods of science.

1.2 Students shall be able to make and record measurements and observations in well defined settings.

1.3 Students shall be able to organize sets of measurements and observations at a level consistent with their mathematical and language arts skills.

1.4 Students shall be able to examine sets of data and observations so as to identify patterns and relationships and use mathematical models to account for these when appropriate.

1.5 Students shall be able to develop explanations of natural phenomena consistent with analyzed data and their prior knowledge of scientific principles.

1.6 Students shall be able to develop written and oral descriptions and presentations of their observations, methods, and explanations.

1.7 Students shall be able to design and carry out experiments appropriate to their age and experience with science.

2.0 KNOWLEDGE IN THE DISCIPLINES

2.1 Students shall be able to describe and use the particulate model of matter to account for the properties of matter at large and small scales.

2.2 Students shall be able to describe the characteristic properties of matter and account for changes in these properties under given conditions.

2.3 Students shall be able to use the concept of energy and energy conservation to account for the states and changes in state of a system.

2.4 Students shall be able to relate force, motion, mass and energy account for the behavior of objects and systems.

2.5 Students shall be able to use the concepts of conservation of matter and energy account for changes in objects and systems.

2.6 Students shall use models for the structure of matter to account for chemical and physical changes.

2.7 Students shall be able to identify and use knowledge of the variation and diversity of organisms to account for the interactions in and the evolution within a biological community.

2.8 Students shall be able to relate changes in the ecosystems to changes in interrelationships and populations within the ecosystem.

2.9 Students shall be able to describe how cell specialization enables tissues, organs, and organ systems to function together to account for life activities in a multicellular organism.

2.10 Students shall use their knowledge of matter and energy to explain the chemical nature of life processes including the molecular basis of heredity.

2.11 Students shall be able to use models and geologic evidence for the origin and change of planetary surfaces and structures to account for the geology of the earth and similar bodies in the Solar System.

2.12 Students shall be able to account for the meteorology of the Earth's atmosphere at large and small scales.

2.13 Students shall be able to account for the large and small-scale properties of oceans, fresh water lakes, rivers, and streams.

2.14 Students shall use their knowledge of matter, energy, and motion along with theoretical models to account for astronomical data.

3.0 NATURE OF SCIENCE

3.1 Students shall be able to describe the historical development of significant scientific concepts and methods that are identified for study at specific grade levels.

3.2 Students shall be able to describe the interaction of scientific theory and scientific activity.

3.3 Students shall be able to describe the assumptions that underlie significant scientific concepts.

3.4 Students shall demonstrate the ability to use and describe the accepted rules and methods of science including procedures that ensure safety.

3.5 Students shall be able to describe at least two methods scientists use to solve an identified scientific problem.

3.6 Students shall be able to identify and/or describe the interaction of science and technology for an identified technological development.

3.7 Students shall be able to identify the creative components of identified scientific achievements or activities.

3.8 Students shall be able to identify and participate in the cooperative nature of scientific activity.

3.9 Students shall be able to identify, use, and create scientific models, including physical, mathematical, and theoretical types.

4.0 SCIENCE, TECHNOLOGY, AND SOCIETY

4.1 Students shall be able to describe the interaction of a given society's attitudes and beliefs with the technology and science developed by that society.

4.2 Students shall be able to describe the interaction of economic activity and scientific/technological activity for an identified technological development.

4.3 Students shall be able to describe the interaction of our political democracy with our national scientific and technological communities relative to an identified scientific or technological development.

4.4 Students shall be able to describe the impact and possible risks of an identified scientific/technological development on themselves or their families.

4.5 Students shall be able to relate science and technology issues to their knowledge of social studies.

4.6 Students, regardless of their gender or race, shall demonstrate an awareness of the demands, rewards, and responsibilities of possible careers requiring training in scientific or technological fields.

4.7 Students shall be able to identify scientific and/or technological careers that are compatible with their abilities and interests.

4.8 Students shall be able to read an editorial or feature article from a major metropolitan newspaper that deals with a technological or scientific issue, identify the relevant scientific concepts addressed or alluded to, and describe the alternative approaches for dealing with the issue.

Mission Statement RHS Science Department

We believe that the mission of the Science Department of Ridge High School is to:

- Educate the students of Bernards Township with excellence in instruction.
- Provide students with varied opportunities to grow and develop scientific skills and knowledge at their maximum capacity.
- Provide students with the skills they need to function as citizens in the 21st century.

Adopted April 1997

Lecture 123 in the Science Department

Introduction – What is Lecture123?
Lecture123 is a web-based software tool that allows lectures to be recorded and later accessed by students. With the aid of a tablet PC, the instructor is able to teach using a converted PowerPoint presentation through the Lecture123 program. Everything the instructor writes on the screen, as well as his/her voice, is recorded in real-time and stored on the Lecture123 server. Students later log in and replay the lecture. Additional features allow students to ask questions virtually by clicking on a presentation in progress, and teachers to publicly post answers to these questions for the benefit of the rest of the class. These basic features may be adapted in a variety of ways to serve various purposes in the classroom.

I. Set-up and Use

A. Getting Started

To be used on any computer, the Lecture123 Presenter and Lecture123 Recorder programs must be downloaded from the website for use on that specific PC. In addition, the user must be assigned to a specific "community" within the site and enter the key word for this community. The user then chooses a login and password. Username set-up is a one-time occurrence, but the programs must be installed on every computer on which they are to be used. Students may need guidance or class time to get started using the program.

B. Recording and Playing a Lecture

To be used in Lecture123, a PowerPoint file must be uploaded to the web, where it is converted and then downloaded back to the PC in another format. It can then be saved and is ready for presentation offline from that PC at any time using the Lecture123 Presenter program. To make the lecture accessible to the rest of the class community, it must be uploaded to the Lecture123 server, where it will remain stored and available for download. Instructors and students may replay a recorded lecture using the Lecture123 Player program.

II. Current Utilization in the Classroom

Ways in which the program is currently utilized in the classroom:

- Lecture Content Delivery
- Asynchronous Access to Lectures
- Introductions to Projects and Labs
- Student Presentations

Note: Please see individual courses for detailed descriptions of how the program is utilized.

III. Challenges and Concerns

A. Classroom Management

Use of the tablet laptop as currently configured requires the instructor to be "tethered" to the front of the room during the presentation. A new configuration involving a wireless projector connection or a tablet that connects wireless to a stationary PC might alleviate the challenge, allowing the instructor to walk freely around the room during lecture. Currently that challenge is confronted by the "pause" feature, which the instructor may use to halt the recording so that he/she may walk around the room, answer student questions, or deal with any disciplinary issues as needed.

B. Student Access at Home

The largest concern voiced by students participating in our pilot Lecture123 program was difficulty using the program on home computers. Because of the variety of machines, operating systems, and software configurations, students met with very individualized challenges in downloading and accessing the program. The Lecture123 staff was willing to work with students to resolve the issues as they came up, but it did require additional time and initiative on the part of each student to make sure the system was working at home. This challenge might be better met by the new pod-casting feature in which the lecture is recorded as an MPEG file that can be played on commonly available programs such as iTunes or Windows Media Player.

C. Student Access in the Classroom

In some instances, students may be required to revisit a lecture while working independently on the class set of laptop computers. The challenge this presents is a severe drain on the wireless internet connection, leading to difficulty in downloading lectures. For now, this challenge would be well met by an MPEG version of the lecture which could be transmitted to each laptop via burned CD or memory key, negating the reliance on the internet connection.

D. Student Access in the Computer Lab

Currently the Lecture123 program is not installed in the computer labs or library computers, limiting student access to lecture content, and making it difficult for students without home computer/internet access to view lectures outside of class. This challenge will need to be addressed as use of the program increases within the building.

E. Password Protection

A concern to any teacher using a password-protected resource is maintaining password security. It is recommended that the teacher assign students a username and password, rather than letting them choose their own. This allows the instructor to keep a record of usernames and passwords for the purpose of rescuing forgetful students.

IV. Future Possibilities

A. Collaboration with Universities

Ridge High has a connection with Seton Hall University and has piloted a collaboration program within the Environmental Science course. The basic design involved Seton Hall faculty and students creating interactive presentations using Lecture123 to be watched and responded to by Ridge students. A similar collaboration may be possible at some point within the other elective courses.

B. Collaboration within Ridge

As the availability of the necessary technology improves, Lecture123 would be useful for interdisciplinary collaboration. Students in one course may design lectures to be viewed by students in another course; for example, Genetics students could create presentations to teach the Forensics classes about the technical aspects of DNA fingerprinting, while Forensics could respond with the practical aspects of evidence collection and analysis. Genetics students could also create presentations appropriate for younger students, 9th grade Biology for example. This could be done live as a guest-presentation, or asynchronously, alleviating the scheduling concerns associated with presenting to other classes. The advanced Genetics students could then further interact with the other class by answering questions posted with the presentation online or building in an assessment using the "Ask a Question" function. In the other direction, Genetics students could also critique presentations submitted by freshmen students, or review introductory concepts using presentations created by students in an introductory course.

C. Homework Assignments

With reliable student access outside the classroom, it would be possible for the instructor to create homework assignments in lecture format, which students could complete by using the "Ask a Question" function.

Technology Integration in Genetics: Principles & Issues

Lecture123

Lecture Content Delivery

Lecture123's primary use in the Genetics course is as a tool for effective direct instruction. In addition to the convenience of a typical PowerPoint presentation, the lecture becomes interactive as the instructor is able to supplement the slides by writing/drawing on them in a variety of colors and styles or inviting student volunteers to do so. This not only keeps students' attention more than a traditional PowerPoint slideshow, but also guides them in their own note-taking process. Furthermore, images, links, and videos may be embedded into the lecture, allowing for a truly multimedia approach. In a course such as Genetics, that heavily stresses discussion and both hands-on and virtual laboratory experiences, this tool for direct instruction is most appropriately used 1-2 times per week on average.

Asynchronous Access to Lectures

Lectures used for direct instruction are saved on a server that students may then access from home at any time. Students are encouraged to revisit confusing portions at home and post questions for the instructor. This feature is also useful for students who are absent on lecture-day, as they can watch the entire lecture (rather than trying to piece it together from a classmate's notes) and then ask questions as appropriate. This asynchronous approach also allows students to pay full attention during the lecture rather than scrambling to write all important points, as they have the reassurance that they can watch the lecture later at their own speeds.

Introductions to Projects and Labs

Lecture123 is a useful tool to introduce laboratory activities and problem or project-based lessons. By recording introductions and instructions, it ensures that students have the ability to revisit this important information as needed and is invaluable for students who are not in the classroom when instructions are delivered.

Student Presentations

Lecture123 presentations can be recorded and uploaded by students as well as by instructors. This provides a challenge for the students, and they tend to deliver a higher quality presentation when they know it is being recorded. Many students are also very enthusiastic about the interactive features that personalize their presentations by elaborating on their slides with drawings and text. Recording student presentations is also useful to the instructor, who can revisit presentations as needed in order to determine a more objective grade, rather than an on-the-spot decision or an attempt to remember one of many student presentations at a later time.

United Streaming

Supplement to Lecture Content

United Streaming contains a database of and access to many educational videos, including detailed programs addressing various aspects of genetics. By allowing the instructor to include relevant video clips (often not more than 5 minutes in length) in lecture presentations, it provides the instructor a means of illustrating difficult concepts with the help of animations and real-time footage of complicated processes. This is especially useful in a course such as Genetics, in which many of the relevant processes are abstract or microscopic in nature.

Introduction to Issues and Controversies

A large component of the Genetics course is the consideration and discussion of ethical issues and controversies generated by advances in genetic technology. Often we will discuss specific case studies as a means of considering a larger issue. The video clips provided by United Streaming allow students to get a more authentic and personal view of many case studies by including original news footage or helpful illustrations. This multimedia approach to case study introduction increases student interest and involvement.

Student Use of Technology Resources

Laptops

Students in the Genetics course have access to a class set of laptop computers. One of the primary uses for this resource is Internet research. With such a constantly changing base of content information, it is useful to keep students informed and in touch with the scientific community. Internet research is usually done either in the form of a structured "WebQuest" in which students access pre-selected sites to obtain specific information, or at times in response to a more open-ended question or problem that must be solved. Another primary use of the laptops in Genetics is providing students with access to relevant software. Currently, students participate in virtual lab activities, either web-based or using the GSL CD correlating to their textbook. These simulations allow students to "use" pieces of equipment that would not normally be accessible in a high school environment (such as a $30,000 thermal cycler, for example) to design and run simulated experiments. Additionally, the laptops provide a resource in terms of student work output, as they are available during class for students to word-process assignments and create PowerPoint presentations or Inspiration concept-maps.

Digital cameras and camcorder

Many of the laboratory activities incorporated into the Genetics course generate data in the form of a visual output. For example, a pattern will be created by DNA run in a gel or genetically modified bacteria grown in a plate. Because these results are temporary in nature, digital cameras are an invaluable data-collection tool in this course. Students are able to shoot pictures of their dishes and gels, to be analyzed at a later point and included in lab reports. Likewise, the camcorder allows students to document difficult procedures and lab techniques. It also aids in asynchronous presentations – the students are able to

create video projects to be shared with our class and other classes at different times. For example, students created an episode of "CSI" collaboratively with the Forensic Science classes.

Presentation Tools

The variety of presentation technologies in the Genetics classroom allows students to share data and research efficiently and effectively. The projector and speaker systems allow for serious formal presentations on the part of the students. Furthermore, the document camera allows student volunteers to share results of an experiment with the rest of the class or the answer to a question on a worksheet or practice quiz.

Technology Integration in Environmental Science

GIS Deer Tracking Project

Background information
Geographic Information System (GIS) is a collection of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. We intend to use the software in the Environmental Science classes at Ridge on a project to track and analyze the deer population in Basking Ridge. The project continues throughout the year ending in analysis, reporting, and community outreach.

Timeline

INTRODUCE AND BEGIN PROJECT
September

- Introduce Project – Tracking the deer population in Basking Ridge
- Begin gathering data in a log book
- Review of GIS software – Overview, benefits, capabilities, use, data entry
- Begin sightings, data, into GIS software
- Review initial entries for correctness

N.J State Standards, K-12 Science Goals = 1.2
Rigor and Relevance = Quad A

DATA GATHERING AND INPUT
October – December

- Input sightings into GIS program, weekly during lab period
- Review class data monthly
- Research and prepare a report on the biology, problems, environmental impact of White-Tailed Deer in NJ

N.J State Standards, K-12 Science Goals = 1.2, 1.4, 1.5, 1.6
Rigor and Relevance = Quad A

DATA ANALYSIS
February

- Review data, per class and for all CP Environmental classes
- Prepare graphs, plots, maps of data
- Review data parameters – density, geography, type, age, gender
- Prepare individual student reports

N.J State Standards, K-12 Science Goals = 1.4, 1.5, 1.6,2.7, 2.8, 2.8, 3.5
Rigor and Relevance = Quad C

ASSESSING IMPACT OF DEER POPULATION
March

- Analyze the environmental impact of the deer population, health, numbers, residents, township
- Estimate the economic affect of the deer population on automobiles, accidents, auto insurance, township, homeowners

N.J State Standards, K-12 Science Goals = 1.4, 1.5, 2.7, 2.8, 3.3, 3.6, 4.2
Rigor and Relevance = Quad B

COLLABORATION
April

- Communicate the results of the study on the deer population with township officials
- Confer with the NJ Department of Fish and Wildlife about the results of the study

N.J State Standards, K-12 Science Goals = 1.6, 3.3, 3.6, 4.2, 4.8,
Rigor and Relevance = Quad B, D

Goals

- Increase students' use and knowledge of computer technology through the use of Geographic Information Systems (GIS) software
- Participate in an environmental science research project tracking the deer population in Basking Ridge
- Perform an in depth analysis and reporting of the data collected
- Collaborate with local community and state officials about the findings

Objectives

- Successfully input data into GIS Software
- Research the current state of the White-Tailed Deer population in New Jersey
- Explain the biology, habitat, reproduction, behavior of the deer in New Jersey
- Analyze the deer sightings using GIS software for trends in the demographics of the population
- Estimate the environmental impact of the deer population in Basking Ridge
- Estimate the economic impact of the deer population in Basking Ridge

Deliverables

- Use of GIS software, data entry, reports, ongoing and demonstration
- Report on biology and environmental impart of White-Tailed Deer
- Report – data analysis, graphs, maps, plots, interpretation
- Presentation – To be determined

Program Outline

Lesson 1

- Introduce project. What is GIS? View GIS website examples. Watch a GIS animation about benefits. Begin gathering data/sightings.

Lesson 2

- School GIS Website – login, classes, goals, how to input data, expectations
- Input data points/sightings

Lesson 3

- Review some initial entries, assess, and correct

Data Gathering

- October – December
- Continue to input data/sightings
- Monthly review of data

Data Analysis

- Plot data
- Prepare graphs, tables, plots, maps
- Live, killed, antlered, non-antlered
- Trends in data
- Correlations with roads, population, roads/highways, food
- Predictions about data and deer population, behavior
- Solutions

Correlate Data

- Accidents
- Auto insurance
- Economics
- Township budget
- Residential damage
- NJ Department of Fish and Wildlife

River City Project – Harvard University

Overview of Project

The River City Project is an interactive computer simulation designed by Harvard University as an inquiry-centered activity. In the simulation, participants enter a river town set in the 1800's and are asked to solve the many health problems the town is besieged with. Students will use their knowledge of the scientific method, environmental science, biology, problem solving and prior knowledge to work their way through River City.

The simulation is designed to appeal to students with digitalized Smithsonian artifacts and an interactive computer based approach

This will be one of the capstone projects done as part of the Environmental Science curriculum.

N.J State Standards, K-12 Science Goals = 1.5, 1.6, 2.7, 2.8, 3.2, 3.5, 3.6, 3.8, 4.2
Rigor and Relevance = Quad B

APPENDIX A: Lesson Plans to be used with the GIS Tracking Project

Raymond Schnell, Environmental Science 2006-2007

Lesson Plan - Topic: Introduction to Deer Tracking Project
Week: Sept 18, 2006

Objectives: Students will be able to:

- Explain what the GIS software is and its benefits
- Summarize how geography is important in our everyday lives
- Record deer sightings in preparation for input into the GIS software

Instructional Materials and Resources

- Computer
- Projector
- Handout
- Video

Focus Activity/Do Now

- How often do you see deer in Basking Ridge? Where do you see them?

Instructional Methods

Agenda

- Do Now
- Project Overview
- GIS Software
- Review
- Homework

Do Now

How often do you see deer in Basking Ridge? Where do you see them? Review their answers and discuss the deer population in Basking Ridge and New Jersey.

Introduction

Watch a short video clip about the White Tailed Deer. This will be used to spark interest in deer in NJ and the project.

Project Overview

Review the Deer Tracking project parameters, goals, and timeline.

Geographic Information System (GIS) Software

Introduce the GIS software. What is GIS? Why use GIS? Review some examples of applications of GIS. Review the benefits of GIS. Watch a short animation on the importance of geography in our everyday lives.

Data Collection
Present the information necessary to record when entering a deer sighting. Review the form that will be used in the Project Log Book. Set through entering a deer sighting. This information will be added after the next lesson on the Ridge GIS website.

Review
Students will fill out a mock example of a deer sighting. We will answer questions in a class question and answer.

Homework
Begin to record deer sightings in Basking Ridge. Input the data into the log book.

Means of Evaluation
The review will be an informal assessment of today's lesson.

N.J State Standards, K-12 Science Goals = 1.2
Rigor and Relevance = Quad A

Raymond Schnell, Environmental Science 2006-2007

Lesson Plan - Topic: Ridge Deer Tracking GIS Website
Week: Oct 2, 2006

Objectives: Students will be able to:

- Log in to the Ridge GIS website
- Input data on deer sightings in Basking Ridge into GIS

Instructional Materials and Resources

- Computer
- Projector
- Laptop computers
- Handouts

Focus Activity/Do Now

- Review one of your deer sightings that you have recorded. Check that all of the information is filled in.

Instructional Methods

Agenda

- Do Now
- Ridge GIS Website
- Data Entry
- Review
- Homework

Do Now

Review one of your deer sightings that you have recorded. Check that all of the information is filled in.

Ridge GIS Website

Present an overview of the Ridge GIS website. Show the students how to login and navigate the software. Step through how to enter a data point (deer sighting). Review how to view the data points and features of the program.

Data Entry

Students will use the laptop computers in class and input the data points they have collected. They will work with a partner.

Review

Class discussion; describe the process, questions, and problems.

Homework

Gather deer sightings and input data weekly during lab periods.

Means of Evaluation
The review will be an informal assessment of today's lesson.

N.J State Standards, K-12 Science Goals = 1.2, 1.4,
Rigor and Relevance = Quad A