BERNARDS TOWNSHIP PUBLIC SCHOOLS
BASKING RIDGE, NEW JERSEY 07920

Science Program Evaluation
Secondary Level (9-12)

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Committee Leaders

Survey Data	**Comparison**	**Recommendations**
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The Program Evaluation began in the fall of 2004 and continued through July of 2005. This period of time was approximately ten months. All science faculty at Ridge were involved in the gathering and analysis of data and worked to prepare a list of recommendations based on this information.

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. Opportunities for independent, critical thinking through hands-on activities and a discovery-based program and 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…

1. demonstrate the knowledge and use of the processes of science
2. demonstrate knowledge of and appreciation for the nature of science
3. apply knowledge in the science disciplines
4. demonstrate skills for applying the processes, the knowledge, and the appreciation of science to issues wherein science, technology, and society meet
5. demonstrate an understanding of the interrelationship between science and technology
6. 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.

Changes Since 1997

The science program was last evaluated as part of the Middle States Evaluation in 1997. At that time, the department at Ridge consisted of eight full-time teachers. The department had a curriculum supervisor who was responsible for science and mathematics. A teacher received a stipend to serve as the department coordinator. This individual served as a liaison between the department and the administration at the building and district level. In 1998, the district supervisory responsibilities were transferred to the supervisor of science and the coordinator position was eliminated. Among the high school department members, six teachers had Master's degrees and two had an earned a Ph.D.

The number of science teachers at Ridge High School has increased proportionally with the student population. Currently there are seventeen teachers assigned to the high school for all of their day.

Current Status

Of the seventeen teachers in the science department at Ridge High School, nine have Master's degrees and five have doctorates. One additional teacher was added in September of 2005.

There are seventy-three sections of science currently being taught at the high school with an average class size of 22 students. The department offers a number of required and elective courses in the sciences. These include:

Course Title	Required/ Elective	Grade Level	Semester/ Full Year	Date Established
CP Biology Conceptual	Required	9	Year	Post 1996
CP Biology Mathematical	Required	9	Year	Post 1996
Honors Biology	Required	9	Year	Prior to 1996
CP Chemistry Conceptual	Required	10	Year	Post 1996
CP Chemistry Mathematical	Required	10	Year	Post 1996
Honors Chemistry	Required	10	Year	Prior to 1996
CP Physics Conceptual	Required	11	Year	Prior to 1996
CP Physics Mathematical	Required	11	Year	Prior to 1996
Honors Physics	Required	11	Year	2001
CP Environmental	Elective	11-12	Year	2003
Astronomy	Elective	11-12	Semester	1999
Forensic Science	Elective	11-12	Year	2005
Genetics: P&I	Elective	11-12	Year	2005
AP Biology	Elective	11-12	Year	2003
AP Chemistry	Elective	11-12	Year	2003
AP Physics I	Elective	11-12	Year	Prior to 1996
AP Physics II	Elective	12	Year	Post 1996
AP Environmental Science	Elective	11-12	Year	2003

All required courses are offered at the college preparation conceptual, college preparation mathematical or the honors level. Students must meet pre-determined criteria to be enrolled in honors or Advanced Placement courses. Two new electives were added for the 2005-2006 school year, in response to a perceived need for more non-AP academic electives. Prior to this, the science department had two non-AP elective and five AP electives. Only one course in the department is run as a semester course. In the required courses, the CP mathematical courses have the highest enrollment followed by the honors and conceptual levels.

There are five AP courses taught in the Science department at Ridge High School. Enrollment and exam scoring data are highlighted below.

	AP Biology	**AP Chemistry**	**AP Physics I**	**AP Physics II**	**AP Environmental Science**
Enrolled 03-04	36	32	62	16	24
Tested 03-04	29	17	55	15	15
% Scored 3-5	**97**	**71**	**93**	**100**	**80**
Enrolled 04-05	37	21	68	22	70
Tested 04-05	29	11	65	17	52
% Scored 3-5	**100**	**73**	**88**	**100**	**79**

Comparison to Other Similar Districts

Ridge High School was compared to eight other high schools with similar size, socioeconomic status, and district configurations. The committee focused their attention on the number and type of courses offered. The seven comparison schools were:

Required Courses

School	Freshman	Sophomore	Junior
Ridge	Biology	Chemistry	Physics
Millburn	Physical Science	Biology	Chemistry
Hillsborough	Geophysical Science	Biology	Chemistry
Montgomery	Biology	Chemistry	Physics
Princeton	Earth Science	Biology	Chemistry
Chatham	Earth Science	Biology	Chemistry
Holmdel	Biology	Chemistry	Physics
Livingston	Earth Science/Biology	Chemistry	Physics

The survey of other districts found that some follow the Biology, Chemistry, and Physics progression that we currently have in place, while others still use a Physical or Earth Science course as the freshman science. We feel that the current requirements will best prepare our students for the upcoming science portion of the HSPA and ensure that all students that graduate Ridge will be well prepared in what can be considered the three core areas of science. In Bernards Township, the Earth Science component of the state standards is addressed by a rigorous 8th grade Earth Science course.

Elective Courses

School	AP Classes	Other Electives
Ridge	Biology Chemistry Physics I+II Environmental Science	Astronomy Environmental Science Forensic Science Genetics Principles and Issues
Montgomery	Biology Chemistry Physics B+C	Environmental Science
Millburn	Biology Chemistry Physics B+C Environmental Science	Anatomy Environmental Science Oceanography Science and Technology
Hillsborough	Biology Chemistry Physics B+C	Environmental Science Laboratory Techniques Science Lab Service (Semester) Student Research in Science
Princeton	Biology Chemistry Physics Environmental Science	Ecology (Semester) Bioethics Horticulture Genetics Anatomy and Physiology
Chatham	Biology Chemistry Physics/Calculus	Aviation Science Forensic Science
Holmdel	Biology Chemistry Physics Environmental Science	Marine Science Earth and Space Science Forensic Science Honors Advanced Research
Livingston	Biology Chemistry Physics B + C Environmental Science	Bio-Nuclear Chemistry (Semester) Organic Chemistry (Semester) Forensic Science Physiology Science, Technology and Society

Curricular Alignment

The desired outcomes for science instruction are based on New Jersey's Core Curriculum Content Standards. For science, there are ten standards that must be addressed by the curricula. They are:

- Standard 5.1 (scientific processes) all students will develop problem-solving, decision-making and inquiry skills, reflected by formulating usable questions and hypotheses, planning experiments, conducting systematic observations, interpreting and analyzing data, drawing conclusions, and communicating results.

- Standard 5.2 (science and society) all students will develop an understanding of how people of various cultures have contributed to the advancement of science and technology, and how major discoveries and events have advanced science and technology.

- Standard 5.3 (mathematical applications) all students will integrate mathematics as a tool for problem-solving in science, and as a means of expressing and/or modeling scientific theories.

- Standard 5.4 (nature and process of technology) all students will understand the interrelationships between science and technology and develop a conceptual understanding of the nature and process of technology.

- Standard 5.5 (characteristics of life) all students will gain an understanding of the structure, characteristics, and basic needs of organisms and will investigate the diversity of life.

- Standard 5.6 (chemistry) all students will gain an understanding of the structure and behavior of matter.

- Standard 5.7 (physics) all students will gain an understanding of natural laws as they apply to motion, forces, and energy transformations.

- Standard 5.8 (earth science) all students will gain an understanding of the structure, dynamics, and geophysical systems of the earth.

- Standard 5.9 (astronomy and space science) all students will gain an understanding of the origin, evolution, and structure of the universe

- Standard 5.10 (environmental studies) all students will develop an understanding of the environment as a system of interdependent components affected by human activity and natural phenomena.

The curriculum in Bernards Township has been aligned to the New Jersey Core Curriculum Content Standards through a program of curriculum review and revision. The most recent updates are the AP and CP Conceptual Physics and Chemistry programs. Every student graduating from Ridge High School will meet or exceed all New Jersey Core Content standards as measured by the cumulative progress indicators.

Perception of the Program

Student Survey

During the spring of the 2004-2005 school year students in grade 11 were surveyed about their perception of the science program. Students did not provide names and the data was compiled from all levels of 11th grade science

If you are presently taking an AP or Honors level course, do you plan to take the AP exam or the SAT II test when offered?

Yes	No
24	118

Do you feel that the size of your science class is conducive to learning?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
60	134	41	8	5

Do you feel that lab activities reinforce the classroom lecture?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
60	120	41	7	4

Do you feel that your science textbook adequately helps to explain the material presented in class?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
24	92	84	38	8

Does science class address real world application of the material presented?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
74	120	34	9	2

Is your science room adequately stocked with the materials and equipment needed for lab activities?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
94	101	22	14	8

Are there enough working computers available for your science classroom?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
14	34	68	72	55

Is your science teacher knowledgeable and current in the science he/she is teaching?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
198	47	3	1	0

Do you feel that lab activities and classroom demonstrations help to explain the subject?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
77	131	31	6	2

Do you plan to pursue a career in the sciences?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
23	48	50	59	63

If digital projectors and laptops were available, would you use these technologies for research and/or presentations? Would you like to see more of an infusion of technology in the classroom?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
80	95	60	10	2

Do you feel that the amount of homework is enough and that it adequately reinforces classroom materials?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
81	130	35	4	1

Is the depth and breadth of material covered in the course appropriate?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
65	142	34	3	0

What new science electives would you like to see offered at Ridge?

TOTALS:

67 Meteorology

38 Anatomy and Physiology

40 Projects in Physics

38 Earth Science

25 Independent Study

46 Biochemistry

123 Oceanography

32 Botany

41 Organic Chemistry

Parent Survey

In 2003, parent opinion inventories, student opinion inventories, and teacher opinion inventories were administered district-wide through the National Study of School Evaluation. Some selected responses related to science are indicated below.

Response choices were: Strongly Agree (SA)/Agree (A), Neutral (N), Disagree (D)/Strongly Disagree (SD), or Not Applicable (N/A). One hundred and ninety parents responded.

Statement	SA/A	N	SD/D	N/A
Parent Opinion Inventories				
Our school is doing a good job in Science.	63.2%	15.8%	21%	0%
Our school is preparing students to deal with issues and problems they will face in the future.	58.7%	23.4%	21.1%	0.5%
Our school is doing a good job of helping students understand their moral and ethical responsibilities.	57.9%	21.1%	14.8%	6.3%
Our school's programs help students to understand and get along with other people.	65.8%	20.5%	11.1%	2.6%
Students see a relationship between what they are studying and their everyday lives.	50%	25%	20.4%	2.6%

Teacher Survey

During the spring of the 2004-2005 teachers in the Ridge Science Department constructed and completed a survey about their perception of the science program.

No.	Question	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree	N/A
1.	Overall, I am satisfied with the quality of the science program at Ridge.	4	3	3	2	2	0	0
2.	The science classrooms at Ridge are adequate in size and number.	0	2	3	5	4	0	0
3.	The science classrooms at Ridge are adequately equipped with technology such as projectors, televisions, and computers.	0	2	1	1	5	5	0
4.	The science classrooms at Ridge are adequately stocked with science specific equipment.	2	5	3	3	1	0	0
5.	The quality of science instruction at Ridge is negatively affected when teachers have to switch rooms multiple times during the course of the day.	8	5	1	0	0	0	0
6.	“Mobile” computer equipment (such as laptops and probes) is sufficient and well maintained.	0	0	3	0	3	8	1
7.	Current science class size at Ridge does not interfere with student safety.	0	5	3	2	4	0	0
8.	Current science class size at Ridge does not interfere with student learning.	1	3	3	2	5	0	0
9.	The biology program at Ridge adequately prepares students for college and is relevant to students’ everyday lives.	0	7	3	0	0	0	4
10.	The chemistry program at Ridge adequately prepares students for college and is relevant to students’ everyday lives.	0	3	4	0	0	0	7
11.	The physics program at Ridge adequately prepares students for college and is relevant to students’ everyday lives.	2	3	2	0	0	0	7

No.	Question	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree	N/A
12.	The science electives at Ridge adequately prepare students for college and are relevant to students' everyday lives.	1	2	5	0	0	0	6
13.	The AP science courses at Ridge meet college-board standards.	3	4	1	0	0	0	5
14.	Students leaving the Ridge science program are inspired to continue study in science or to consider a career in science.	2	7	0	1	1	0	3
15.	Students leaving the Ridge science program have a heightened level of environmental awareness.	2	3	5	0	0	0	4
16.	Curriculum for all individual science courses at Ridge is updated frequently.	2	5	4	1	1	0	0
17.	Science teachers have adequate input in the revisions of individual curriculum.	3	5	2	2	1	0	0
18.	Science teachers regularly consult and implement the district curriculums in their lessons.	4	5	3	0	1	0	0
19.	The individual science course curriculums do not allow teachers enough freedom and choice in lesson planning.	0	2	5	1	3	2	0
20.	The Ridge science program adequately supports and challenges all students.	2	7	1	0	2	0	1
21.	The Ridge science program is aligned with the math program meaning that students have adequate math skills for the science classes in which they are placed.	1	0	1	3	5	2	1
22.	Students at Ridge have an adequate array of science elective choices.	0	2	3	2	4	2	0

No.	Question	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree	N/A
23.	Science related extracurricular activities are readily available to interested Ridge students at the academic level (such as science league).	1	5	6	1	0	0	0
24.	Science related extracurricular activities are readily available to interested Ridge students at the practical and/or environmental level (such as the green team).	1	4	6	1	2	0	0
25.	Science textbooks at Ridge contain up to date and accurate information.	2	7	3	2	0	0	0
26.	Science textbooks at Ridge are appropriate for course level in which they are used.	1	7	5	0	1	0	0
27.	Daily lessons in science classes at Ridge encourage discovery-based learning.	1	4	6	2	1	0	0
28.	Daily lessons in science classes at Ridge facilitate cooperative learning.	2	5	6	1	0	0	0
29.	Daily lessons in science classes at Ridge include sufficient hands-on student involvement.	0	7	5	2	0	0	0
30.	The science program at Ridge is competitive with other similar school districts.	5	6	2	0	0	0	0
31.	Science teachers at Ridge have sufficient opportunities to share materials and ideas with other teachers in our district.	1	1	3	3	4	2	0
32.	Science teachers at Ridge have sufficient opportunities to attend conferences and seminars for continuing education.	1	6	0	2	4	1	0

Previous Recommendations
(Middle States evaluation)

1. **That the Science teachers review the curriculum to insure that it is meeting the needs of all of the students**.
   This recommendation has been satisfied as follows: during the 1996-97 school year the science curriculum underwent review and revision. Biology, Chemistry and Physics have each incorporated an honors, mathematical and conceptual level. All of the courses are topic locked thus allowing students to change levels when appropriate. Since the changing of the state standard requiring 3 years of science, our students have been required to take a biology, chemistry, and physics course at the appropriate level. In addition, five AP courses plus environmental science and astronomy are offered to juniors and seniors. Two new electives will be offered this year to provide more elective choices to students who do not wish to take AP courses.

2. **That time be provided to allow for both interdepartmental and intradepartmental collaboration.**
   The science teachers at the high school meet monthly for department meetings and informally for articulation purposes. Teaches collaborate to create a common mid-term and final for each course to assure uniform teaching standards. Teachers no longer meet with science teachers from the middle school. The science supervisor has sought input from the high school science teachers as to desired middle school academic outcomes in order to achieve integration between the two schools. This year, 9th grade science teachers will meet in core teams to collaborate on cross content curriculum.

3. **That the laboratory station work surfaces be refinished and cabinet doors in rooms 307 and 309 be replaced.**
   The chemical storage area that is located between these two rooms has been moved to a new safer area between rooms 312-313 and the resulting area is being made into a small office area for 3 teachers. Rooms 307 and 309 have not had any renovations made to them.

4. **That the "Core Proficiencies" and "Standards" as published by the New Jersey State Department of Education be reflected and accounted for in the Science Curriculum Guide.**
   This recommendation has been satisfied by the current curriculum revisions. All "core proficiencies" and "standards" were incorporated into the revised curriculums and linked to specific objectives and activities. To complete the proficiencies and standards, students are required to take Biology, Chemistry, and Physics at any level.

Survey Analysis

The results of the survey pointed out that most members of the Ridge High School community were satisfied with the current science program. In general, the program is considered to be rigorous, relevant, contain appropriate content, and prepare our students for college. Students feel that the instructors are knowledgeable in their content area and present the material in an appropriate and understandable fashion. Students and teachers seem to differ on the effectiveness of science textbooks. Textbooks continue to be reviewed on a regular basis and are updated when necessary. Age appropriate, current content along with readability are criteria for all text reviews. Students and teachers both agree that the science classrooms are well supplied with material for conducting scientific investigations. The department maintains a chemical storeroom for use by all teachers. The storeroom is monitored and stocked by the department's chemistry teachers. Teachers review current supplies and conduct all ordering as a department to maximize efficiency when ordering. Students and teachers also agree that the department would benefit from more available technology to both teachers and students. Approximately 28% of students said they would plan to pursue a career in science.

Areas of Strength

The science department at Ridge High School has many areas of significant strength. Teachers in the department have a high degree of content knowledge and the majority possess advanced degree in their fields. The teachers are active in assisting students with many extra curricular science competitions at which the students have met with a high degree of success. The current curriculum ensures all students will have exposure to biology, chemistry, and physics prior to graduation and meet all state standards in the process. Our curriculum compares favorably in core content and AP offerings when compared to other districts. Students at all levels of biology, chemistry and physics are given lab periods to provide for a more thorough understanding of the content. Students do extremely well in AP, SAT II and state testing in the sciences.

Areas Needing Improvement

The department has several lab rooms that have not been renovated since original construction. As mentioned in the 1997 evaluation, they are in need of repair and updating to function as modern, safe, science labs. Both of the rooms in question have lab facilities (sinks, outlets, and cabinetry) or safety equipment that is not functional.

While science supplies have been well maintained and funded, the department does not currently have enough technology resources to reach the level of implementation desired by the teachers and administration. The department has a single laptop cart that will be 4 years old and nearing the end of its functionality for high school science. There are four digital projectors for 18 teachers and each projector sees almost continuous usage according to sign out logs. Many teachers who desire to use the digital projectors and

laptops are unable to do so. While new technology has been added to the department every year, it has not kept pace with the increase in staff, student population, or district expectations on use of technology.

The lack of electives has been addressed this year with the addition of two full year science electives: Forensic Science and Genetics: Principles and Issues, but a richer section of electives including more semester courses would benefit the department and student body. Currently only one semester course in science is available. The addition of more semester courses would allow students to take semester electives in other content areas and pair them with a science elective.

Recommendations

- Develop Meteorology and Oceanography as semester course offerings in the science department
- Refurbish rooms 307 and 309 to complete goal as specified in the 1997 Middle States Evaluation
- Review current technology hardware and develop a needs assessment for upcoming year
- Survey seniors to validate number of students planning to pursue careers in science
- Conduct articulation meetings between William Annin and Ridge High

Timeline for Implementation of Recommendations

Develop Meteorology and Oceanography as semester courses	Summer 2006
Offer Meteorology and Oceanography as electives	2006-2007 school year
Refurbish rooms 307 and 309	As funding is available
Review current technology hardware	Fall 2005
Develop and conduct technology needs assessment	2005-2006 school year
Survey seniors on careers	Spring 2006
Conduct two articulation meetings per year between William Annin and Ridge High	Ongoing