Science Program Evaluation Summary
Secondary Level (6-8)

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The Program Evaluation began in the Fall of 2008 and continued through the end of the 2008-2009 school year. This period of time was approximately ten months. All science faculty at WAMS were involved in the gathering and analysis of data. Due to insufficient time, this summary did not include a review of test data (ASK scores) for the past 5 years nor did it include a comparative analysis of similar districts and their middle school science program and facilities.

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…

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.

Curricular Alignment

The desired outcomes for science instruction are based on New Jersey's Core Curriculum Content Standards. For science, there are four standards, revised in 2009, that must be addressed by the curricula. They are:

- **5.1 Science Practices:** All students will understand that science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.

- **5.2 Physical Science:** All students will understand that physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.

- **5.3 Life Science:** All students will understand that life science principles are powerful conceptual tools for making sense of the complexity, diversity, and interconnectedness of life on Earth. Order in natural systems arises in accordance with rules that govern the physical world, and the order of natural systems can be modeled and predicted through the use of mathematics.

- **5.4 Earth Systems Science:** All students will understand that Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.

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 were to the grade 6 Physical Science course and the grade 8 Earth Science course in 2010.

William Annin Middle School Science Courses

Course Title	Required/ Elective	Grade Level	Semester/ Full Year	Date Revised
Physical Science	Required	6	Full Year	2010
Life Science	Required	7	Full Year	2003
Earth Science	Required	8	Full Year	2010

The science offerings at William Annin Middle School cover the full scope of science standards. The courses are all required, full-year courses and no other science courses or electives are offered. The department currently has 2 off-team teachers who teach multiple grades and courses. Classes sizes have grown over the past several years and, in the majority of cases, are above the National Science Teachers Association (NSTA) safety guideline of 24 students in a hands-on lab situation. This has lead to an increase in teacher demonstrations and decrease in student participation in an effort to balance safety with practical experiences.

Perception of the Program

Teacher Survey

During the spring of the 2008-2009 school year, teachers completed a self-survey on their perceptions of the science program. The survey was jointly developed by the department members and conducted anonymously. A 5-point presumed Likert scale was used with a response of A = *strongly agree* through E = *strongly disagree* with C being a *neutral* response.

1. To what extent are district science objectives available to teachers?

A	***B***	***C***	***D***	***E***
7	6	3	0	0

2. To what extent do the science textbook and ancillary materials provide activities, which are based on students' previous scientific experiences and knowledge?

A	***B***	***C***	***D***	***E***
2	5	5	3	1

3. In the current science program, how well do the instructional activities provided lead students from concrete facts to abstract thinking?

A	***B***	***C***	***D***	***E***
3	9	4	0	0

4. To what extent do the provided science program instructional activities regularly include problem solving involving scientific applications that are meaningful to students?

A	***B***	***C***	***D***	***E***
2	5	6	3	0

5. To what extent do the science program textbook and ancillary materials encourage students to use hands-on materials to learn scientific concepts?

A	***B***	***C***	***D***	***E***
5	5	5	0	1

6. To what extent do the current science program materials emphasize large-group, small-group, and individualized instruction as appropriate to each lesson?

A	***B***	***C***	***D***	***E***
2	4	7	3	0

7. To what extent does the current science program material encourage laboratory activities and hands-on experiences?

A	*B*	*C*	*D*	*E*
3	11	2	0	0

8. To what extent do the provided textbook and ancillary materials encourage cooperative learning and teaching in various ways to accommodate different students' learning styles?

A	*B*	*C*	*D*	*E*
1	7	4	4	0

9. To what extent do you feel that the current program creates a positive learning environment when studying science?

A	*B*	*C*	*D*	*E*
7	7	2	0	0

10. To what extent is technology integrated within the science program's textbook and provided ancillary materials?

A	*B*	*C*	*D*	*E*
4	6	3	2	0

11. To what extent does the teacher have to work to supplement the current science program materials?

A	*B*	*C*	*D*	*E*
4	7	4	1	0

12. To what extent does the current science program and provided materials make provisions for all students?

A	*B*	*C*	*D*	*E*
1	4	8	3	0

13. To what extent does the current science program and provided materials make provisions for gifted and talented students, where needed?

A	*B*	*C*	*D*	*E*
0	3	10	2	2

14. To what extent does the current science program and provided materials make provisions for middle level students, where needed?

A	*B*	*C*	*D*	*E*
4	4	7	1	1

15. To what extent does the current science program and provided materials make provisions for remedial instruction, where needed?

A	*B*	*C*	*D*	*E*
3	1	10	2	0

16. To what extent does the current science program and provided materials make provisions for special needs students?

A	*B*	*C*	*D*	*E*
3	2	9	2	1

17. To what extent does the current science program and provided materials make provisions for economically disadvantaged students?

A	*B*	*C*	*D*	*E*
1	3	8	0	3

18. To what extent does the teacher need to supplement the current science program in order to meet the needs of all students?

A	*B*	*C*	*D*	*E*
4	10	2	0	0

19. To what extent are there system approved curriculum guides available for each teacher in the school?

A	*B*	*C*	*D*	*E*
7	3	4	1	1

20. To what extent are the guides current and consistent with state and local goals and objectives?

A	*B*	*C*	*D*	*E*
10	3	3	0	0

21. To what extent have teachers been involved in the past when developing the science program?

A	*B*	*C*	*D*	*E*
5	8	2	0	0

22. To what extent do you like the current science program?

A	*B*	*C*	*D*	*E*
1	12	3	0	0

23. To what extent does the current science program's materials and textbooks contain scientifically sound information?

A	*B*	*C*	*D*	*E*
7	6	3	0	0

24. To what extent is the level of the content information appropriate for the identified grade level group on which the material is taught?

A	*B*	*C*	*D*	*E*
3	8	3	0	2

25. To what extent are there meaningful and practical applications meshed throughout the provided materials in the current science program?

A	*B*	*C*	*D*	*E*
1	8	6	1	0

26. To what extent do you believe that our current science program is successful?

A	*B*	*C*	*D*	*E*
5	10	1	0	0

27. To what extent do you believe that the science program materials meet the preparation needs of the teacher?

A	*B*	*C*	*D*	*E*
1	5	8	2	0

28. To what extent in the past have provisions been made for teachers to participate in the evaluation of materials?

A	*B*	*C*	*D*	*E*
2	6	5	0	0

29. To what extent is the science program periodically reviewed and updated?

A	*B*	*C*	*D*	*E*
2	10	1	2	0

30. To what extent does the current science program encourage active student participation in a discovery-based manner?

A	*B*	*C*	*D*	*E*
5	5	5	1	0

31. To what extent does the classroom facility meet current safety standards?

A	*B*	*C*	*D*	*E*
6	6	1	1	2

32. To what extent does the classroom facility accommodate current class enrollments?

A	*B*	*C*	*D*	*E*
1	2	8	1	5

33. To what extent does the cross-curriculum classroom scheduling effect the science program?

A	*B*	*C*	*D*	*E*
4	3	8	0	1

34. To what extent does the classroom technology accommodate the science program?

A	*B*	*C*	*D*	*E*
2	7	4	2	1

35. To what extent do the classroom laboratory fixtures accommodate the science program?

A	*B*	*C*	*D*	*E*
3	3	3	4	4

Additional comments with regard to program evaluation and the K-8 Science Program were collected in an open response:

- Content area (Social Studies, Math, Science, etc.) textbooks should have a reading level equal to or less than the grade level using it. Studies show that students understand the concepts better in this manner.

- Every science room should have adequate storage and fixtures (lab tables, sinks, emergency shower, eye wash, etc.)

- Some classes do not have proper lab features and some safety equipment (i.e., goggle cleaning unit) does not work properly.

- With off team teachers in every subject, it makes it difficult to plan and execute cross-curricular activities.

- Labs need to be updated and enlarged to accommodate larger class sizes.

- I love teaching Earth Science; however, I think we are remiss in not including oceanography in our curriculum. Rocks and minerals are a big part of the story, but I think many students are disappointed that it is not included.

Student Survey

A sample population was surveyed in each grade level at William Annin Middle School. The survey was created by the committee over the course of several months. Students used Lime Survey to answer the questions anonymously in the computer labs.

What part of science class do you find most difficult (labs, projects, in-class discussions, teacher demonstrations, etc)?
Answer Count Percentage
No answer 0 0
Labs (A) 26.76%
Projects (B) 47.66%
In-Class discussions (C) 19.06%
Teacher Demonstrations (D) 6.52%

What aspect of science class do you find most interesting (labs, projects, in-class discussions, teacher demonstrations, etc)?
Answer Count Percentage
No answer 0 0
Labs (A) 51.34%
Projects (B) 10.03%
In-Class discussions (C) 9.03%
Teacher Demonstrations (D) 29.60%

Which statement best describes your feelings on hands-on activities (labs, projects, etc.)?
Answer Count Percentage
No answer 0 0
We don't do enough hands-on activities (A) 50.33%
We do too many hands-on activities (B) 8.36%
We do just the right amount of hands-on activities (C) 41.30%

Do teacher websites enhance your science education?
Answer Count Percentage
No answer 0 0
Yes, a lot (A) 9.53%
Yes, a little (B) 43.65%
Not really (C) 46.82%

What kind of interest do you have in a career in science?
Answer Count Percentage
No answer 0 0
A lot of interest (A) 17.06%
A little interest (B) 37.63%
Not really interested (C) 45.32%

How has science class influenced your interest in a career in science?
Answer Count Percentage
No answer 0 0
I'm now more interested in a science career. (A) 30.77%
I'm now less interested in a science career. (B) 11.37%
Science class has not influenced my future career choice. (C) 57.86%

How often do you see a connection between topics discussed in science class and your experiences outside of the classroom?
Answer Count Percentage
No answer 0 0
Often (A) 25.42%
Sometimes (B) 50.50%
Not too often (C) 24.08%

Have your studies in science class caused you to take a greater interest in science outside of the classroom?
Answer Count Percentage
No answer 0 0
Yes, a lot (A) 12.37%
Yes, a little (B) 44.82%
Not really (C) 42.81%

Check the box next to the letter of the topics that interest you.
Answer Count Percentage
Weather (A) 236 39.46%
Astronomy (B) 281 46.99%
Rocks & Minerals (C) 253 42.31%
Earthquakes & Volcanoes (D) 359 60.03%
Erosion (E) 96 16.05%
Cells (F) 142 23.75%
Life Processes (G) 136 22.74%
Classification (H) 68 11.37%
Genetics (I) 210 35.12%
Matter (J) 100 16.72%
Chemical Reactions (K) 424 70.90%
Motion (Forces) (L) 192 32.11%
Electricity (M) 355 59.36%

Check the box next to the letter of the statements which best describe your feelings on the effectiveness of homework.
Answer Count Percentage
Doing homework prepares me for the topics in class the next day (A) 32.94%
Doing homework reinforces information learned in class (B) 53.51%
Doing homework prepares me for the test (C) 41.97%
Doing homework does not help me in class (D) 31.44%

Check the box next to the letter of the statements which best apply to online science homework assignments.
Answer Count Percentage
I use the website to check my homework. (A) 46.15%
I use the website to complete online assignments. (B) 36.45%
I use the website to prepare for tests. (C) 36.45%
I use website links when I'm interested in a specific topic. (D) 16.22%
I enjoy doing online assignments more than book/written homework. (E) 27.42%
I find my teacher's website helpful in my science education. (F) 30.27%

Check the box next to the letter of all the statements that apply to the use of technology in science class.
Answer Count Percentage
We don't do enough technology related activities. (A) 46.49%
We do too many technology related activities. (B) 7.69%
We do just the right amount of technology related activities. (C) 32.27%
I would rather see PowerPoint presentations instead of chalkboard/overhead. (D) 43.81%
I enjoy doing online activities (labs, projects, etc.) (E) 38.46%
The technology available in the science class is current. (F) 32.94%

Which of the following has your science class influenced you to do? (Check the box next to the letter of all that apply)
Answer Count Percentage
Watch a science based TV show (Discovery channel, National Geographic channel, etc.) (A) 43.81%
Watch a science based TV series such as CSI, House, MythBusters, Bones, etc. (B) 63.04%
Watch a science based movie such as Armageddon, Day After Tomorrow, Volcano, etc. (C) 37.96%
Research on the Internet (about a science topic) (D) 22.74%
Read a science based magazine or newspaper article (E) 19.23%
Read a science based non-fiction book (F) 13.71%
Read a science based fiction book (G) 22.58%

State Testing Results for Science

NJASK 8 Percent of Students At or Above State Standards

Student Population	Percent 2008 (Bernards)	Percent 2009 (Bernards)	Percent 2008 (DFG J)	Percent 2009 (DFG J)
Science (GE)	100	99.5	99.1	99.1
Science (SE)	87.5	88.7	83.2	83.8
Science (Total Students)	97.8	98.1	96.8	96.8

NJASK 8 Percent of Students At or Above State Standards By Gender

Student Population	Male	Female
2008 Science (Total Students)	96.3	99.6
2009 Science (Total Students)	97.7	98.5

NJASK 8 District Mean Scale Scores By Year

	2004	2005	2006	2007	2008	2009
Science (GE)	247.6	250.8	247.0	247.3	262.6	252.3
Science (SE)	225.4	222.9	221.0	226.9	230.4	230.5
Science (Total Students)	244.7	248.2	244.1	245.4	257.8	249.4

NJASK 8 District Mean Scale Scores By Gender

Student Population	Male	Female
2008 Science (Total Students)	259.3	256.6
2009 Science (Total Students)	252.2	246.4

NJASK 8 District Mean Scale Scores By Ethnicity

Student Population	Asian	White
2008 Science (Total Students)	264.4	257.2
2009 Science (Total Students)	258.3	248.2

*Only reported for subgroups with n>40

Standardized test scores in grade 8 science have remained relatively stable and are above the mean for the district factor group (DFG). Special Education students are outperforming their DFG peers by a large margin. Females continue to outperform males and the school's Asian population continues to outscore other groups on the NJASK 8.

Past Recommendations - 2003

1. Revise the science curriculum at the middle school, insuring alignment with the New Jersey Core Curriculum Content Standards for Science, and articulation between and within grades.

The current middle school curriculum does focus an entire year on the study of physical science, life science, and earth science which is necessary and critical to a solid science program. It is recommended however that the objectives that are outlined in the curriculum are revisited and updated as necessary. It is also recommended that the teachers of these three areas work together when writing the curriculum so material is not overlapped between the three grade levels. It is also recommended that specific hands-on activities and experiments be added into the set curriculum guide.

Timeline: Completed

STATUS UPDATE:
Since the survey was completed in 2003, the Physical and Earth Science curriculum at WAMS were revised and are currently being reviewed and rewritten a second time. Life Science is scheduled for a rewrite in 2010-11 to update it from the 2003 document. Teachers have planned to incorporate common areas into each grade level curriculum (i.e., scientific method, SI measurement, variables). Hands-on activities and experiments will be added, deleted or revised based on the new curriculum and textbook in grade 6 and grade 8 (if purchased). Teachers are adopting a standardized lab report format based upon best practices. As a goal we would like to incorporate high school and middle school lab guidelines in order to properly prepare middle school students for the transition to high school.

2. Incorporate the use of technology into the presentation and delivery of instruction at the middle school level.

The use of technology should be maximized in the study of science. Many new lab activities focus on the incorporation of technology-based tools to obtain laboratory results. It is recommended that data projectors would be purchased to help with the delivery of content. A science mobile laptop cart with an access point would also serve to equip the students with immediate access to the Internet and a larger range of additional probe-based computer laboratory experiences.

Timeline: Completed

STATUS UPDATE:
Since the survey was completed in 2003, most science teachers have been equipped with Tablet PCs and wireless classroom projectors to enhance classroom technology. Laptop

carts are also available as well as access to additional computer labs and the Cybrary. A few probe-based lab experiments have been incorporated into class.

Laptop carts have been refreshed with Netbook PC's as the laptops had reached the end of their serviceable life. The carts are still used extensively in the science classroom.

3. All of the science classrooms on the secondary level should be equipped with a water and gas supply.

It is recommended that all science classrooms should be equipped with both water and gas for use in laboratory experiments. Three out of the nine classrooms would need to be modified to meet this recommendation. However, William Annin Middle School does have rooms available that do supply these needs yet they are not currently being used for science classrooms.

Timeline: Ongoing

STATUS UPDATE:
Due to the cost of adding water and gas lines to all science classrooms, this goal was not met.
Student laboratory experiments requiring water and heat are now often conducted as "micro-labs," or teacher demonstrations.

4. Focus the materials at each grade level on inquiry-based science and on a more hands-on constructivist approach to learning.

In grade six the *Voyage of the Mimi* (1985) and Prentice Hall's *Motion, Forces, and Energy* (1994) are in need of modernization. The current life science textbook package, Glencoe's *Life Science* (1999), is due for a Board approved textbook review and potential revision; however, these grade seven materials are in the best condition in comparison to the other grades. In grade eight the students are using Merrill's *Earth Science* (1994). It is recommended that all three of these grade levels be updated with regard to the New Jersey Core Curriculum Content Standards for Science. Teachers have supplemented extensively with better laboratory substitutes and updated the content to keep the material that is presented as current as possible. It would be best however to obtain a program at each grade level that incorporates technology and provides a basic set of ancillary materials and experiments. According to the latest research, it is recommended that a new program should be implemented that encourages and promotes more discovery learning.

Timeline: Completed

STATUS UPDATE:
Since the survey was completed in 2003, the curriculum changes recommended have been completed. There have also been subsequent changes in curriculum to update to the 2009 revised standards. New textbooks for the 6th grade were purchased for the

2009-2010 school year. The 6th and 8th grade science curriculum will complete revision in the summer of 2010. New books for grade 8 were cut from the 2010-11 budget. New books and curriculum for the 7th grade Life Science will follow.

Implementation of constructivist-discovery learning techniques is on-going.

5. A schedule of professional development should be provided to the teachers so they can incorporate the use of technology tools.
Teachers need to receive professional development with regard to the latest technology that can be used to help them in their delivery of the content. Instruction on the use of data projectors needs to take place. In addition, teachers would also need to be first exposed to probe-based computer laboratory experiments. After this exposure they would need to be guided on the process of the integration of this hardware and software. For example, PASCO Scientific offers an extensive array of the next generation of probeware, and professional development would need to be provided in this area.

Timeline: Completed and continually evolving as technology develops.

STATUS UPDATE:
Since the survey was completed in 2003, probe-based computer laboratory equipment training has been offered several times in the district's Staff College.

Most teachers have been assigned Tablet PC's and have received training in the use of the Tablet PC's and connection to the projectors. Various technology courses (accounting for approximately half of the staff college offerings) encourage teachers to be innovative in their use of technology and share successful Tablet PC techniques.

Survey Analysis

Teachers

The results of the teacher survey show that the teachers were generally neutral regarding most questions concerning curricular materials like textbooks and lab resources. They mostly agreed that the resources did focus on hands-on activities and through this, the ability to address a variety of learning styles. Most teachers felt that many supplemental materials were used as resources by the teachers. This is not uncommon, considering the slow textbook adoption cycle and need to inject current scientific information into the course. The results were neutral in regards to the ability of the science curriculum to meet the needs of gifted students, special education students, and the general population. This result may be because these groups are not individually addressed by the curriculum and instead the individual instructor is responsible for making adjustments as needed or as dictated in an IEP.

The teachers felt generally positive about the curriculum's coverage of the state standards, their involvement in its creation, and their ability access the information they need to successfully deliver the curriculum. One notable point of disparity was in the area of facilities. This issue remains from a goal not addressed in the 2003 evaluation. Several teachers in grades 6 and 7 have inadequate classroom square footage to accommodate their enrollment and still have room for safe utilization of science materials. These same rooms also lack the needed gas and water lines to accommodate lab activities.

Students

The students perceived the lab and demonstration portions of a lesson to be the most interesting and felt that hands-on activities should be increased. This would match research that shows hands-on activities are the most engaging. Demonstrations, while interesting to students, do not convey the same experience that a hand-on lab provides. Students also felt that projects were the most difficult part of class. This is likely due to the fact that projects require long term planning and use of time away from the classroom. Feedback on teacher websites was neutral with some students making effective use of the resources and others feeling they were not beneficial. Approximately half of the students surveyed had no interest in science as a career, with only 17% saying they had a great deal of interest in it. In both cases, the students felt that their science class was not influential on these decisions. Students did feel that their classes made connections to experiences outside of the classroom and has increased their interest in science topics. Perhaps surprisingly, students were positive about the need for homework in reinforcing information and preparing for assessments. Many students felt that the level of technology integration could be improved and more technology based lessons included in the class. In a general interest question, chemical reactions, volcanoes and earthquakes, and electricity ranked as the most popular topics.

Recommendations

1. The district should reconsider room utilization at William Annin Middle School. Current large class sizes combined with inadequate gas and water supplies have lead to a diminished lab program in many 6 and 7th grade classrooms. This goes against our district philosophy, NJ CCCS, and research in best practices. The issue was noted in the 2003 program evaluation and was not addressed.

2. Adopt and implement the recommendations of the district lab report committee. The committee composed of teachers from grades 6-12 has made recommendations that will provide consistency across grade levels to limit the need to re-teach lab format and to provide consistent goals for science labs.

3. Rewrite the grade 7 curriculum in 2010-11 to match the new CCCS with a focus on evolution, ecology, and genetics. The current curriculum does not correctly balance the topics in proportion to their coverage in the NJCCCS. A new textbook should be adopted to better match these topics and provide better support materials.

4. Incorporate more technology-based lab experiences into the curriculum. Utilize the recommendations in the 2010-2013 technology plan to better integrate the science curriculum and the 8.1 NJCCCS.