Brighton Central School District K-12 Science Program Evaluation

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Introduction

Program evaluation plays a key role in school performance. As a learning community concerned with continued improvement, Brighton Central School District utilizes a program evaluation process to access information about student achievement and how effectively current curriculum, instruction and assessment practices support that achievement. More than an audit, the evaluation uses pertinent data to assess the ongoing efforts to improve student learning. Every five years educators evaluate each content area in grades K-12 to gain a comprehensive view of the district-wide scholastic program. Along with annual reviews of individual grade levels, this study helps the district in its continued efforts to improve instruction. The data used in this evaluative process reveal areas of success and identify areas in need of attention.

The current Science committee began its work by identifying key scientific skills and concepts that all Brighton students should acquire as they advance through the grades. Using New York State standards for math, science and technology, research on 21st century skills, the recently adopted Common Core Learning Standards, National Science Education Standards and the recently published K-12 Conceptual Framework for Science, the committee developed a plan to determine how district practices reflect the best practices in the field. In addition, members reviewed research studies and gleaned ideas to help inform their process design as well as their analysis and interpretation of the data.

Currently, the scientific community and its respective disciplines are in a state of flux with regards to the educational standards defined for students in grades K-12. The 2011 publication of the Conceptual Framework paved the way for the development of a new set of standards which will prioritize learning expectations for students in the sciences for the coming years. This yearlong study by researchers and other scholars from the field was conducted in response to the growing need to strengthen science education as well as respond to the new and growing body of research on learning and teaching in science. The intent of the Framework was to inform a revision of the standards and revitalize science education. In anticipation of the publication of new science standards, the Framework was used as much of the basis for the program evaluation design.

Evaluation Design

Evaluating Student Achievement

The evaluation design was created with two objectives:

1.) To evaluate the extent to which Brighton students achieve the goals of the K-12 science program and meet local, state, and national standards, especially those outlined through the Conceptual Framework.
2.) To evaluate the extent to which the district supports student achievement through curriculum development, instructional practices and assessment alignment.

The committee focused on three essential dimensions of scientific study; literacy, inquiry and general knowledge. In order to conduct a comprehensive evaluation, it was decided to further define each dimension into corresponding indicators so that data from multiple sources could be used to triangulate the results and support subsequent conclusions. The following table summarizes the entire design for the dimensions, indicators and planned data sets to evaluate student achievement. Note the table below represents the initial plan for data collection. During the data gathering period, it became difficult to gather some of the planned data sets and the committee was therefore unable to use these data in their final conclusions. A delineation of data sets that were not used is included in the limitations section of this report.

Guiding Question: What are the expectations for student learning in science at BCSD?	**What are the essential knowledge and skills students are expected to achieve across the curriculum?**	**How will we measure each dimension? What data will be used?**
Dimension 1: Students are scientifically literate. **Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity.*	Students: 1. work both collaboratively and independently to locate or determine answers to questions derived from curiosity about everyday experiences. 2. pose and evaluate arguments based on evidence and apply conclusions from such arguments appropriately by thinking critically, problem solving and making decisions. 3. have and use content-specific knowledge. 4. describe, explain, and predict natural phenomena. 5. are proficient readers and communicators of the various forms of scientific text and are able to think critically and evaluate information for specific purposes. They: a. read articles about science in the popular press and engage in social conversation about the validity of the conclusions. b. understand the relevance of the scientific concepts to the world as well as how the information affects their lives. c. identify how personal beliefs impact their interpretation of scientific information. 6. Identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed. 7. Assess credibility of information sources and ideas.	1. Use student work 2. State tests a. 4 & 8 Science, all Regents, AP b. 5 year trend c. Analysis by subgroups and comparative data sets 3. Local finals 4. Survey students & focus groups 5. Survey teachers 6. Checklist for teachers 7. Teachers swap – HS/Primary & Primary/HS 8. Curriculum audits

Dimension 2: All students, K-12, will be actively engaged in the scientific inquiry process through self-directed work. *The* National Science Education Standards *(*NSES *p. 23) defines scientific inquiry as "the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Scientific inquiry also refers to the activities through which students develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world."*	Students will identify an authentic scientific problem from the world around them and come up with a feasible solution by: 1. generating hypotheses and seeking evidence to support. 2. designing and conducting experiments based on scientific principles. 3. creating models which simulate authentic scenarios in order to test hypotheses and/or demonstrate understanding of abstract concepts 4. coordinating knowledge and skills simultaneously. 5. collecting, interpreting, and analyzing data. 6. confirming/revising predictions 7. using scientific tools appropriately. 8. collecting and interpreting evidence from a variety of sources, developing an explanation from the data, and communicating and defending their conclusions to peers and others. 9. listening to, interpreting, and evaluating conclusions of others 10. using digital tools to produce and publish writing.	1. Analysis of lab experiment work in different courses/grades/ ESP/BoSAT kits/lab manuals 2. Demographics 3. School processes 4. State tests a) 4 & 8 Science, all Regents b) 5 year trend c) Analysis by subgroups and comparative data sets 5. Survey students 6. Survey teachers 7. Checklist for teachers 8. Curriculum map analysis

Dimension 3: Students develop a knowledge base of scientific concepts, theories, and processes which they will use to integrate all of the fields of science as well as the humanities.	Students: 1. have a strong background in physical sciences, life science, mathematics, engineering*, and technology which will prepare them for college and career. 2. will meet or exceed NY state and national science standards. 3. develop a comprehensive vocabulary of science terms and be able to apply appropriately. 4. are aware of the vast career opportunities in science. **the art or science of making practical application of the knowledge of pure sciences*	1. Analyze program of study at TCMS & BHS & K-5 2. Curriculum map analysis 3. Survey teachers 4. Survey students 5. Student focus groups 6. Parent survey 7. Graduate survey 8. Demographics 9. State tests a. 4 & 8 Science, all Regents, AP b. 5 year trend c. Analysis by subgroups and comparative data sets 10. Look at student work samples 11. School processes

Evaluating the Work of the Organization

The second construct for this evaluation focused on organizational supports. The purpose of this examination was to determine the extent to which organizational conditions align to established principles and indicators of high performing systems. Areas of inquiry which were determined to be appropriate for evaluation included:

1. Curriculum- Are there systems in place for developing, implementing and renewing curriculum?

2. Instruction- Is instruction aligned with curricular goals? Is it data driven? Does it actively engage students? Are there additional supports, such as remediation and/or enrichment services, in place beyond initial instruction for students at all levels?

3. Assessment- Are assessments based on a process of gathering evidence about

students' knowledge of, ability to use, and disposition toward English Language Arts and of making inferences from that evidence in order to plan future instruction.

Multiple surveys, focus groups, and audits of curriculum maps were used to measure these organizational structures. Delineation of the evaluation design for the work of the organization follows.

Area	In each of the areas, what supports would inform student achievement?	How will we measure each? What data will we use?
Curriculum	1. Curriculum maps are routinely updated to represent our current goals and standards, including inquiry and scientific literacy. 2. Expectations are consistent, articulated, and sequential throughout the curriculum, both within grade levels and across grade levels and reflect key disciplinary ideas which are well defined. A common vocabulary is used throughout. 3. Common themes of science (the nature of science) are explicitly taught K-12. 4. The curriculum is flexible enough to allow for "teachable" moments and to take advantage of current events. 5. The K-12 science curriculum integrates math and technology concepts and supports real world connections between the four disciplines (science, math, technology and engineering).	1. Survey teachers a. Including engineering principles 2. Interview students 3. Curriculum map analysis

Instruction	1. Teachers have the skills, knowledge and confidence to direct true inquiry experiences for students. 2. Teachers have the skills, knowledge and confidence to incorporate literacy strategies into their instruction. 3. There are adequate opportunities for students to engage in scientific inquiry in each grade level K-12. 4. Current materials, instructions and activities incorporate the best way to meet the science goals and standards in a developmentally appropriate way. 5. There is consistency in the expectations for writing lab reports which incorporate the writing practices of the discipline and the Common Core Learning Standards. 6. There are adequate opportunities for students to excel in science at each grade level. 7. There are adequate opportunities for non-college bound students to excel in science and perceive themselves as scientists. Vocational opportunities are adequately available to non-college bound students to promote careers in science. 8. Instructional practices take advantage of the wealth of knowledge found in the Brighton community.	1. PD on inquiry.—availability and participation 2. Parent Survey 3. Graduate survey a) How many have careers in STEM 4. Teacher survey 5. Student samples
Assessment	1. State tests as well as locally developed formative and summative assessments within each classroom are good indicators of student learning and help measure Brighton's goals and standards. 2. Students' ability to engage in scientific inquiry is assessed throughout the curriculum at each grade level. 3. Scientific literacy is assessed throughout the curriculum at each grade level. 4. Assessment practices are varied to suit different learning styles and abilities. 5. Assessment tools are used to assess student learning from interdisciplinary units of instruction so as to avoid multiple tests (one for each subject) on one unit.	1. State tests a. 4 & 8 Science, all Regents, AP, PET b. 5 year trend c. Analysis by subgroups & comparative data sets 2. Analyze Kits

Other	1. Teachers are provided with ample opportunities to collaborate on interdisciplinary units of study which incorporate scientific inquiry and the Common Core Learning Standards. 2. There are opportunities for K-12 discussion on a consistent basis. 3. Opportunities exist for collaboration and professional development in assessment design. 4. K-6 teachers have adequate background information regarding the core science concepts that relate to their curriculum topics. 5. *There is a minimum graduation requirement for science*. 6. Interesting electives are offered to meet the needs of a diverse population of science learners.	1. Checklist 2. PD – BoSAT Training

Results of the analysis of the data for both constructs, Student Achievement and Work of the Organization, follow. Of note, each section is organized with a summary of the dimension, indicators, and data collection techniques.

Results

Dimension 1: Students are scientifically literate.

Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity.

In order to evaluate whether or not students are scientifically literate, data were reviewed across all grade levels. In many instances, standardized test scores were used to make these determinations. It was felt by the committee that these data were valid indicators of student performance for this dimension. Additionally, students' perceptions and teachers' integration of scientific literacy were collected and analyzed. Finally, K-12 curriculum maps were analyzed regarding the expectation of scientific literacy for all students.

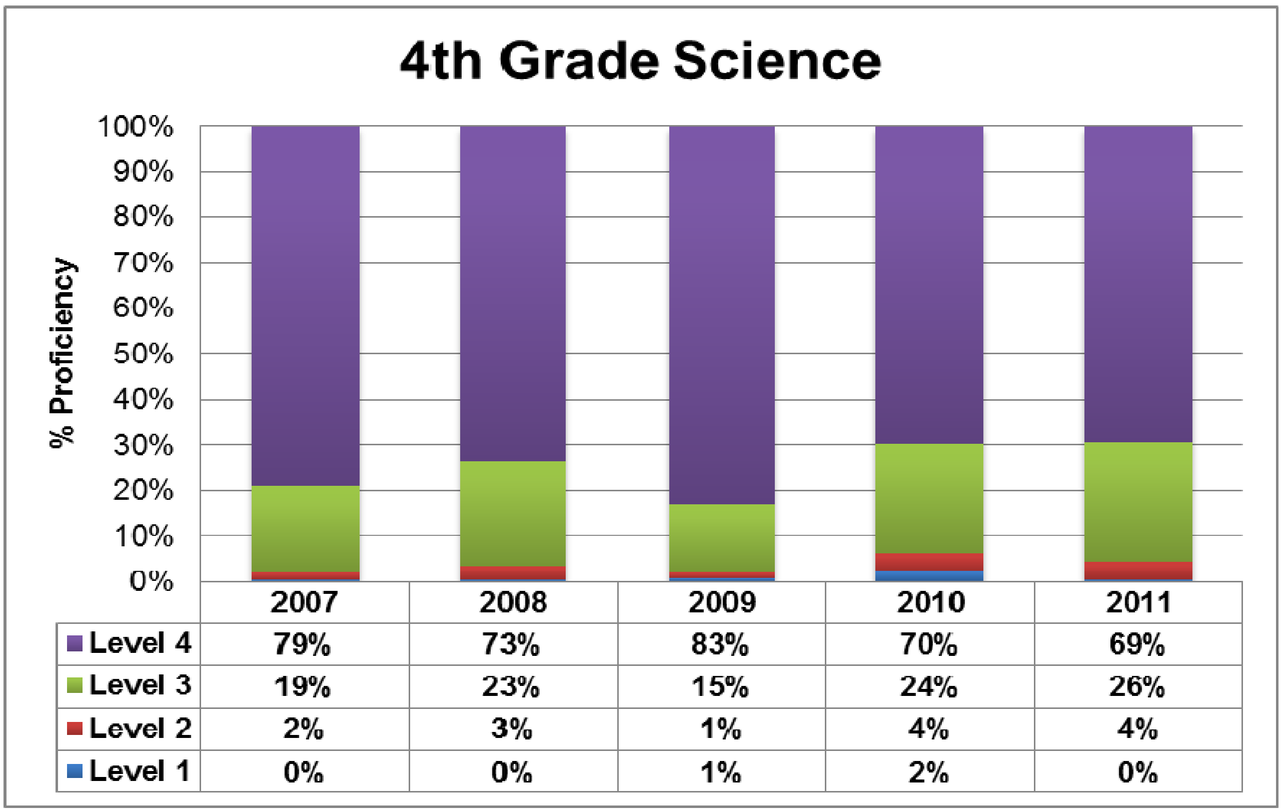
Specifically, the following data were used and analyses performed:

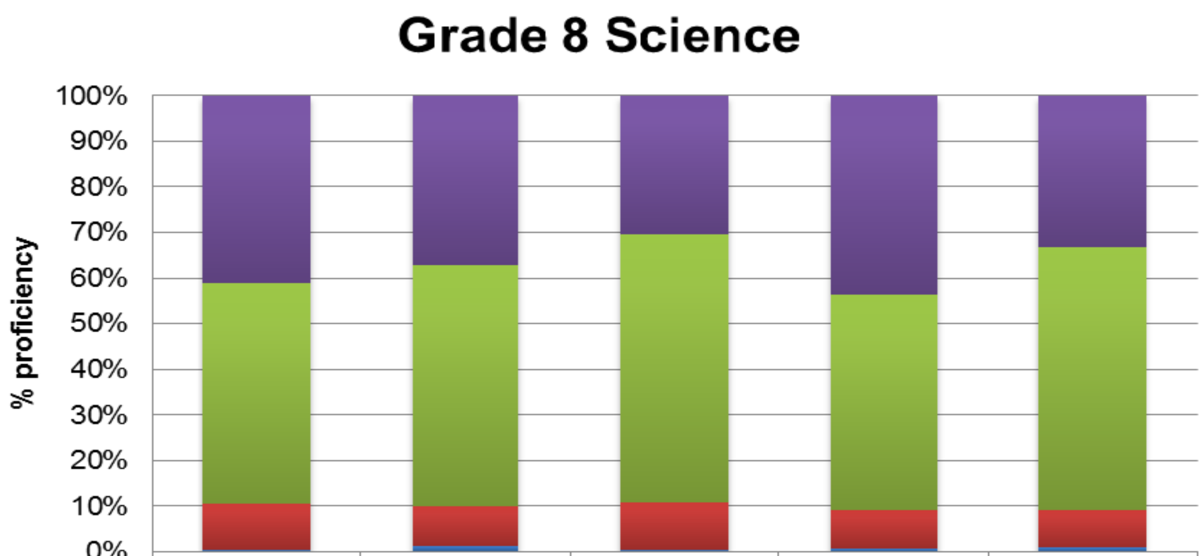
1. New York State Science Tests for 4th and 8th grades.
2. New York State Regents Examinations in Earth Science, Living Environment, Chemistry, and Physics
3. Student survey for students in grades 7-12
4. Student focus groups for students in grades K-6
5. Teacher survey

6. Curriculum maps for all grade levels

New York State Testing Program in Grades 4 and 8

In evaluating the performance of students in grades 4 and 8, a variety of analyses were conducted. Trends within a given grade level were taken into account. Changes in performance between years for grade levels may be a result of differing cohorts of students as well as changes in curriculum. Comparisons were also made between students in the same year across similar school districts. Results from this comparison would rule out any cohort differences and may indicate an area of curricular/instructional difference. This conclusion would be especially true if a different trend were noted between similar schools across years. Comparisons were also made between the subgroups of Brighton students which have been identified by New York State.





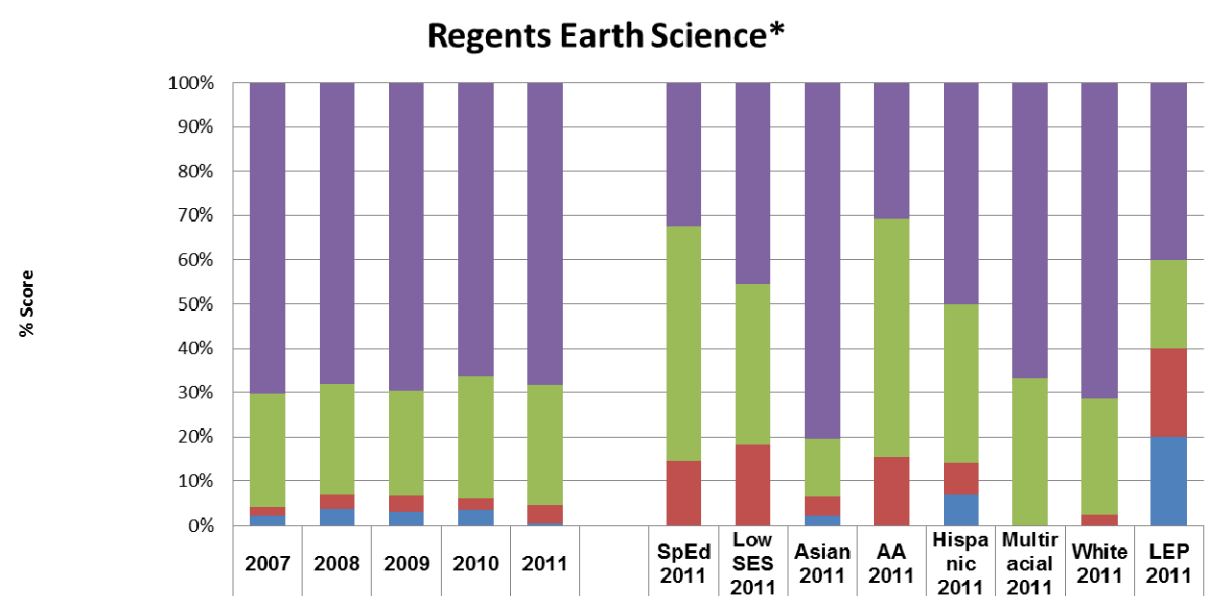
	2007	2008	2009	2010	2011
Level 4	41%	37%	30%	44%	33%
Level 3	48%	53%	59%	47%	58%
Level 2	10%	9%	10%	9%	8%
Level 1	1%	1%	0%	1%	1%

Analyses of these data indicate the following trends:

- Overall, there was a consistent trend of proficiency (defined by level 3 and level 4) for both 4th and 8th grade students across years. It should be noted however, that not all 8th grade students in Brighton take the 8th grade science test. Students who are enrolled in Regents Earth Science in 8th grade, only take the Regents Earth Science exam.
- Consistent numbers of students with disabilities (SWD) display proficiency. However, the percentage of SWD achieving proficiency is lower than the general education population.
- Males out performed females on both the 4th grade and 8th grade tests.
- Fewer economically disadvantaged (Low SES) students achieve proficiency when compared to their non-low SES peers.
- When comparing Brighton progress with that of similar schools, students consistently performed as well or better at L3/4 than students of the same grade level across years.
- The biggest achievement gaps are on the Constructed Response questions and on Life Science topics on both tests.

New York State Regents Exam in Earth Science

The Earth Science Regents exam is taken by most students at the end of the ninth grade year. Those students enrolled in Earth Science during their eighth grade year also take the Earth Science Regents exam, and are exempt from the New York State Science Exam in eighth grade. In conducting the analysis of student performance on this exam, data from the previous five years were reviewed. As in the previous analyses, data were disaggregated by subgroup, as well as comparisons to regional and similar schools were made.



	2007	2008	2009	2010	2011		SpEd 2011	Low SES 2011	Asian 2011	AA 2011	Hispanic 2011	Multiracial 2011	White 2011	LEP 2011
Scored 85-100%	70%	68%	70%	66%	68%		32%	45%	80%	31%	50%	67%	71%	40%
Scored 65-84%	26%	25%	24%	28%	27%		53%	36%	13%	54%	36%	33%	26%	20%
Scored 55-64%	2%	3%	4%	3%	4%		15%	18%	4%	15%	7%	0%	2%	20%
Scored below 55%	2%	4%	3%	4%	1%		0%	0%	2%	0%	7%	0%	0%	20%

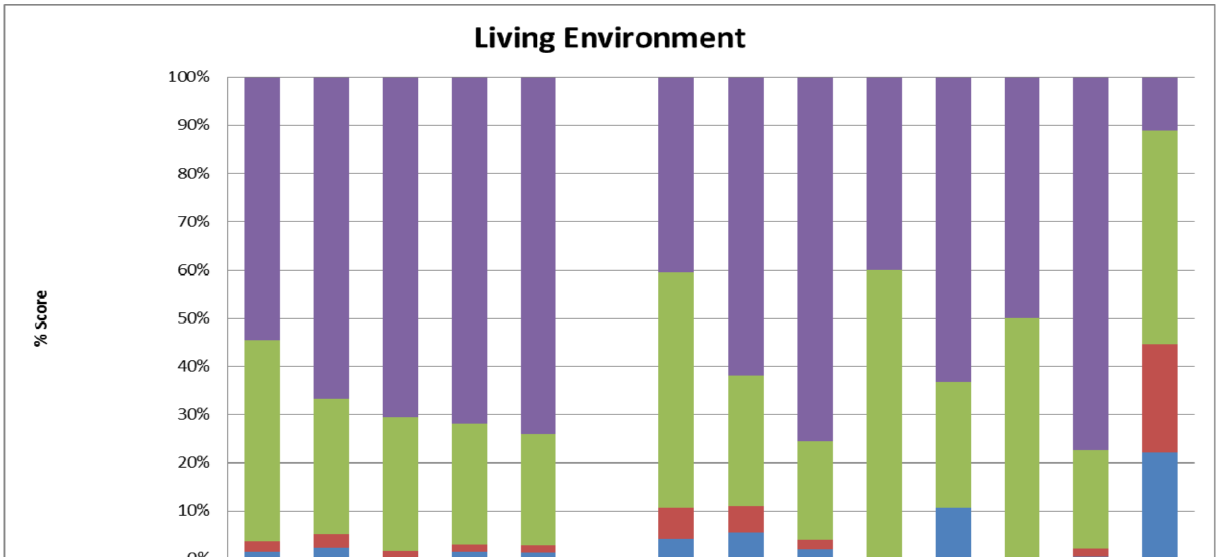
*Note: Includes 8th grade Accelerated Earth Science students

Observations of student performance on the Earth Science Regents include:

1. Over the past five years, Brighton students have a very high passing rate (measured by a score of 65 or higher).
2. Brighton students show a high degree of mastery (85% or higher) on the exam.
3. SWD scores showed a consistent passing rate, however, the rate is lower than general education students. SWD achieve a consistently lower rate of mastery than general education students.
4. No significant pattern was established between female and male students.
5. Economically disadvantaged (Low SES) students score consistently lower when compared to their non-low SES peers. African American and Hispanic students score consistently lower when compared to their White and Asian peers.
6. Students with limited English proficiency (LEP), while an extremely small percentage of those taking the exam, score consistently lower than non-LEP students.
7. Brighton passing and mastery rates are above all other similar schools, except Pittsford.

New York State Regents Exam in Living Environment

The Living Environment Regents exam is taken by most students at the end of the tenth grade year. Those students enrolled in Living Environment during their ninth grade year also take the Living Environment Regents exam. In conducting the analysis of student performance on this exam, data from the previous five years were reviewed. As in the previous analyses, data were disaggregated by subgroup, as well as comparisons to regional and similar schools were made.



	2007	2008	2009	2010	2011		SpEd 2011	Low-SES 2011	Asian 2011	AA 2011	Hispanic 2011	Multiracial 2011	White 2011	LEP 2011
Scored 85-100%	55%	67%	70%	72%	74%		40%	62%	76%	40%	63%	50%	77%	11%
Scored 65-84%	42%	28%	28%	25%	23%		49%	27%	20%	60%	26%	50%	20%	44%
Scored 55-64%	2%	3%	2%	1%	2%		6%	5%	2%	0%	0%	0%	2%	22%
Scored below 55%	1%	2%	0%	1%	1%		4%	5%	2%	0%	11%	0%	0%	22%

Observations of student performance on the Living Environment Regents include:

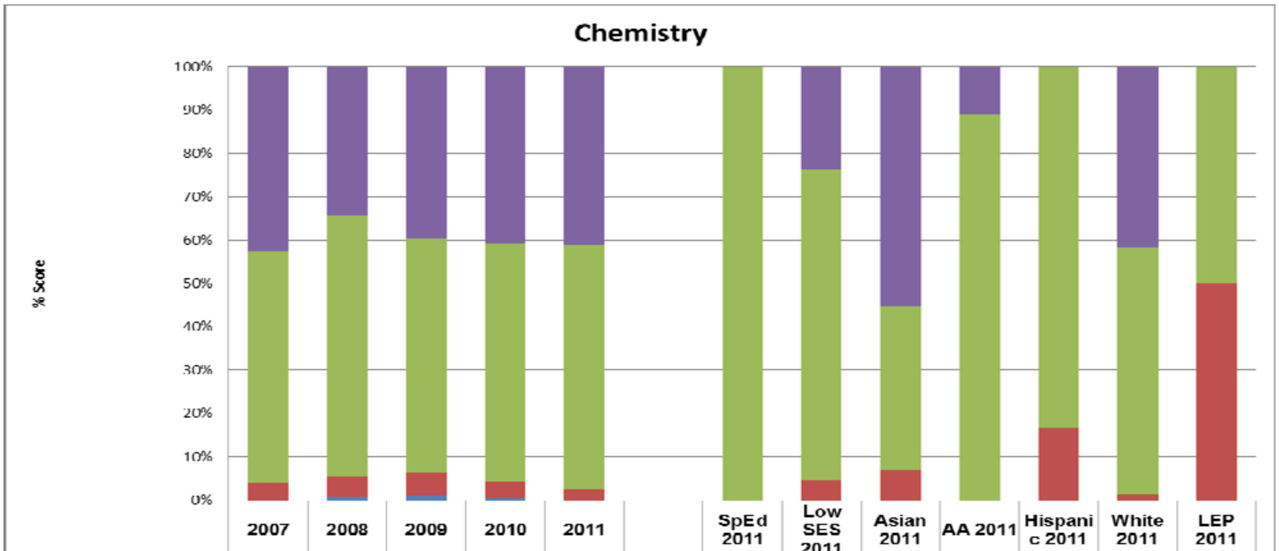
1. Over the past five years, Brighton students have a consistently high passing rate.
2. Brighton students show a high degree of mastery (85% or higher) on the exam.
3. SWD scores showed a consistent passing rate. However, while not as discrepant as the Earth Science exam, the passing rate is lower for SWD students than general education students. SWD achieve a consistently lower rate of mastery than general education students.
4. No significant pattern was established between female and male students.
5. Economically disadvantaged (Low SES) students score consistently lower when compared to their non-low SES peers.
6. African American and Hispanic students score consistently lower when compared to their White and Asian peers.
7. Students with Limited English Proficiency (LEP), while an extremely small percentage of those taking the exam, score consistently lower than non-LEP students.
8. Brighton passing and mastery rates are above many other similar schools, with the

exception of HFL, Penfield and Pittsford.

Note for Earth Science and all remaining Regents analyses: It is acknowledged that in some instances, particularly those analyses represented by demographic subgroups, sample sizes were small, therefore increasing room for error. Analysis was conducted on trends within each subgroup and it was felt by committee members that this analysis was important and should be conducted and also represented. It is noted however, that this may be considered a limitation of the data set.

New York State Regents Exam in Chemistry

The Chemistry Regents exam is taken by most students at the end of the eleventh grade year. Those students enrolled in Chemistry during their tenth grade year also take the Chemistry Regents exam. In conducting the analysis of student performance on this exam, data from the previous five years were reviewed. As in the previous analyses, data were disaggregated by subgroup, as well as comparisons to regional and similar schools were made.



	2007	2008	2009	2010	2011		SpEd 2011	Low SES 2011	Asian 2011	AA 2011	Hispanic 2011	White 2011	LEP 2011
Scored 85-100%	43%	34%	40%	41%	41%		0%	24%	55%	11%	0%	42%	0%
Scored 65-84%	53%	60%	54%	55%	56%		100%	71%	38%	89%	83%	57%	50%
Scored 55-64%	4%	5%	5%	4%	3%		0%	5%	7%	0%	17%	2%	50%
Scored below 55%	0%	1%	1%	0%	0%		0%	0%	0%	0%	0%	0%	0%

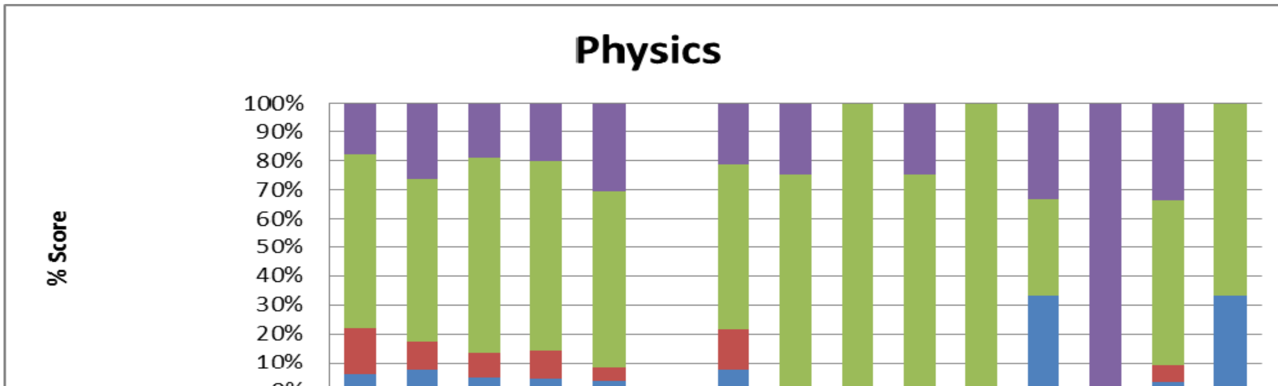
Observations of student performance on the Chemistry Regents include:

1. Over past five years, Brighton students have a very high passing rate.
2. Brighton students show a good degree of mastery (85% or higher) on the exam when compared to other schools.
3. SWD scores showed a consistent passing rate, with no significant differences between SWD and the general education population. However, SWD achieve a

consistently lower rate of mastery than general education students.
4. No significant pattern was established between female and male students.
5. Economically disadvantaged (Low SES) students score consistently lower when compared to their non-low SES peers, however, the gap is narrowing. Also noted was the decreased enrollment of low SES students in Regents Chemistry over the past five years.
6. African American and Hispanic students score consistently lower when compared to their White and Asian peers. Also noted was the decreased enrollment of African American and Hispanic students in Regents Chemistry over the past five years.
7. Patterns with students with Limited English Proficiency (LEP) were hard to determine due to the unusually small sample size.
9. Brighton passing and mastery rates are above many other similar schools, with the exception of Pittsford.

New York State Regents Exam in Physics

The Physics Regents exam is taken by most students at the end of the twelfth grade year. Those students who are accelerated in science enroll in Physics during their eleventh grade year. These students also take the Physics Regents exam. The exam is not however, taken by students in AP Physics. In conducting the analysis of student performance on this exam, data from the previous five years were reviewed. As in the previous analyses, data were disaggregated by subgroup, as well as comparisons to regional and similar schools were made.



	2007	2008	2009	2010	2011		SpEd 2011	Low-SES 2011	Am Ind/AK Native 2011	Asian 2011	AA 2011	Hispanic 2011	Multiracial 2011	White 2011	LEP 2011
Scored 85-100%	18%	26%	19%	20%	31%		21%	25%	0%	25%	0%	33%	100%	34%	0%
Scored 65-84%	60%	56%	67%	65%	61%		57%	75%	100%	75%	100%	33%	0%	57%	67%
Scored 55-64%	16%	10%	9%	10%	5%		14%	0%	0%	0%	0%	0%	0%	6%	0%
Scored below 55%	6%	7%	5%	4%	3%		7%	0%	0%	0%	0%	33%	0%	3%	33%

Observations of student performance on the Physics Regents include:

1. Over past five years, Brighton students have a high passing rate. The percentage

of students passing the Physics exam has steadily increased over the past five years.
2. Only one third of Brighton students achieve mastery (85% or higher) on the exam.
3. SWD scores showed a consistent passing rate (65% or higher), with no significant differences between SWD and the general education population. However, SWD achieve a consistently lower rate of mastery (85% or higher) than general education students.
4. No significant pattern was established between female and male students.
5. Economically disadvantaged (Low SES) students score consistently lower when compared to their non-low SES peers. However, this gap is narrowing. Also noted was the decreased enrollment of low SES students in Regents Physics over the past five years.
6. African American and Hispanic students score consistently lower when compared to their White and Asian peers. Also noted was the decreased enrollment of African American and Hispanic students in Regents Physics over the past five years.
7. Patterns with students with Limited English Proficiency (LEP) were hard to determine due to the unusually small sample size.
8. Brighton passing rate is above all other similar schools. However, Brighton mastery rates are below all other similar schools, with the exception of Rush-Henrietta. As noted earlier, students enrolled in AP Physics do not take the Regents Physics exam which may explain some of the discrepancy.

Student Surveys

Surveys were administered to students during their science classes. In order to manage the information, surveys were administered to all students in grades 4-12. In addition, focus groups were conducted with all students in second grade as well as a sampling of students in grades 3-5. Focus group questions can be found in Appendix B. The surveys were designed using the defined outcomes and participants were asked to respond to a series of statements about their science classes using the following scale: Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree (*see Appendix A for student survey*). Note, unlike other data analyses performed, student surveys were disaggregated by grade level and gender only.

Results of the surveys for the statements pertaining to the students' perception of their exposure and ability regarding scientific literacy revealed the following:

1. Students generally have a positive attitude toward their science experiences at Brighton.
2. Students are problem solvers.
3. Students are aware of careers within the world of science.
4. Nearly half of all students are unsure or disagree that they are given opportunities to read "real" scientific literature (newspaper articles, webpages)
5. Current events exposure seems infrequent across grade levels, but especially infrequent at the secondary level.
6. No significant difference between perceptions occurred between female and male students.

From 6-12 student survey:

15. My teacher gives me opportunities to evaluate and critically think about scientific information and literature.

Response	Frequency	Percent	Mean: 4
Strongly Agree	198	16	
Agree	501	41	
Not Sure	343	28	
Disagree	127	11	
Strongly Disagree	31	3	
Missing	9	1	

20. I am aware of many career opportunities available in the field of science.

Response	Frequency	Percent	Mean: 4
Strongly Agree	482	40	
Agree	458	38	
Not Sure	168	14	
Disagree	67	6	
Strongly Disagree	29	2	
Missing	5	0	

On the use of current events in grades 6-12 science classes:

9. In science class, we often learn about and discuss current events and world news.

Response	Frequency	Percent	Mean: 3
Strongly Agree	112	9	
Agree	330	27	
Not Sure	289	24	
Disagree	358	30	
Strongly Disagree	117	10	
Missing	3	0	

Teacher Surveys

Surveys were administered to all teachers who teach science. This means all grade level teachers, kindergarten through grade six, and secondary science teachers, grades seven through twelve, were surveyed. The surveys were designed using the defined outcomes and participants were asked to respond to a series of statements about the frequency of science literacy and inquiry activities using the following scale: Not Applicable, Never, Infrequently, Monthly, Weekly, or Daily (*see Appendix C for teacher survey*).

Results of the surveys for the statements pertaining to the teacher's integration of scientific literacy topics revealed the following:

1. Students are infrequently exposed to current events at the secondary levels.
2. Students in kindergarten through fifth grade are more frequently exposed to current events as they relate to science.
3. Discrepancies were found in the use and frequency of vocabulary terms among teachers, even among teachers in the same grade level. The greatest variance in vocabulary use occurs at the primary levels (kindergarten through grade six).
4. Expectations for written science work do not exist among and across grade levels.

K-2 Teacher Responses:

3. How often do your students read popular press, scientific journal articles, or nonfiction leveled readers about science?

Response	Frequency	Percent	Mean: 5
Not Applicable	0	0	
Never	0	0	
Infrequently	1	6	
Monthly	1	6	
Weekly	12	75	
Daily	1	6	
Missing	1	6	

Grade 3-5 Teacher Responses:

3. How often do your students read popular press, scientific journal articles, or nonfiction leveled readers about science?

Response	Frequency	Percent	Mean: 4
Not Applicable	0	0	
Never	0	0	
Infrequently	7	23	
Monthly	14	47	
Weekly	9	30	
Daily	0	0	
Missing	0	0	

Grade 6-8 Teacher Responses:

3. How often do your students read popular press, scientific journal articles, or nonfiction leveled readers about science?

Response	Frequency	Percent	Mean: 4
Not Applicable	0	0	
Never	0	0	
Infrequently	5	56	
Monthly	2	22	
Weekly	0	0	
Daily	2	22	
Missing	0	0	

Grade 9-12 Teacher Responses:

3. How often do your students read popular press, scientific journal articles, or nonfiction leveled readers about science?

Response	Frequency	Percent	Mean: 4
Not Applicable	0	0	
Never	1	9	
Infrequently	4	36	
Monthly	2	18	
Weekly	4	36	
Daily	0	0	

On questions pertaining to use of common vocabulary:

K-2 Teacher Responses:

13. How often is a common vocabulary used consistently across grade level?

Response	Frequency	Percent	Mean: 4
Not Applicable	2	13	
Never	0	0	
Infrequently	2	13	
Monthly	5	31	
Weekly	5	31	
Daily	1	6	
Missing	1	6	

Gr 3-5 Teacher Responses;

13. How often is a common vocabulary used consistently across grade level?

Response	Frequency	Percent	Mean: 5
Not Applicable	2	7	
Never	0	0	
Infrequently	4	13	
Monthly	6	20	
Weekly	5	17	
Daily	13	43	
Missing	0	0	

Curriculum Maps

Analysis of curriculum maps supports the views revealed by the teacher survey. Discrepancies exist regarding the use of vocabulary terms. In fact, all of the curriculum maps fail to detail expectations regarding the use of “real world” texts, current events, and written work produced by students among and across grade levels. While most curriculum maps of the secondary science courses were rich with detail and learning targets, the curriculum maps of the primary grades lacked such detail to guide instruction. In addition, teacher perceptions reinforced the conclusion that maps are infrequently updated and may not necessarily reflect current curricular practices.

K-12 Teacher Response:

12. How often are curriculum maps updated to represent current goals and NYS standards?

Response	Frequency	Percent	Mean: 3
Not Applicable	10	15	
Never	2	3	
Infrequently	45	68	
Monthly	4	6	
Weekly	1	2	
Daily	0	0	
Missing	4	6	

Dimension 2: All students, K-12, will be actively engaged in the scientific inquiry process through self-directed work.

The National Science Education Standards (NSES *p. 23) defines scientific inquiry as "the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Scientific inquiry also refers to the activities through which students develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world."*

In order to evaluate whether or not students are actively engaged in scientific inquiry, data were reviewed across all grade levels. Standardized tests were evaluated to determine how often inquiry was a topic on the exam. Additionally, student and teacher perceptions of how often inquiry is carried out in the classroom were collected and analyzed. K-12 curriculum maps were examined to ascertain the expectation of scientific inquiry for all students. Elementary Science Program (ESP) kits and BOCES #1 Science and Technology (BoSAT) kits used in kindergarten through grade five were reviewed for their ability to expose students to scientific inquiry. Further reviewed were the professional development opportunities available to staff focusing on bringing scientific inquiry to the classroom. Finally, extra-curricular opportunities for students in science were analyzed to determine if students were exposed to scientific inquiry outside of the classroom.

Specifically, the following data were used and analyses performed:

1. New York State Science Tests for 4th and 8th grades.
2. New York State Regents Examinations in Earth Science, Living Environment, Chemistry, and Physics
3. Student survey for students in grades 7-12
4. Student focus groups for students in grades K-5
5. Teacher survey for all teachers, K-12
6. Curriculum maps for all grade levels
7. Analysis of ESP and BoSAT supplemental kits used in kindergarten through grade five.
8. Professional development opportunities for staff
9. Analysis of extra-curricular opportunities for students at all grade levels

It was determined that scientific inquiry has very little, if any, representation on any of the New York State tests analyzed. In fact, despite its importance, the word “inquiry” appears only a few times in any of Brighton’s curriculum maps, with most entries appearing at the secondary level. Students perceive having many opportunities for being engaged in scientific inquiry. Interestingly, this does not appear to be supported by teacher statements, as many teachers reported infrequent use of scientific inquiry processes in their lessons. This is particularly true during kindergarten through grade eight.

While many secondary science teachers perceive their students’ exposure to inquiry as more frequent (as much as weekly in some cases), to what extent this is *true*, student-guided inquiry was immeasurable. ESP and BoSAT kits did provide exposure to inquiry in the grades they are used (kindergarten through grade five), with the BoSAT kits offering the best overall experiences for students. Many opportunities exist for Brighton students to engage in scientific inquiry outside of the classroom. These are mostly at the secondary level in the form of after-school clubs. The most obvious exception is the Science Buddies program at French Road Elementary School. Teachers hoping to offer more inquiry to their students have historically been unable to participate in professional development to aid in this quest, as professional development opportunities have not existed locally in recent years.

These conclusions can be evidenced by the following student survey responses, while teachers perceived the opposite.

Responses from grades 6-12 student surveys:

7. My teacher gives me opportunities to pose and evaluate evidence I collect in the lab.

Response	Frequency	Percent	Mean: 4
Strongly Agree	441	36	
Agree	572	47	
Not Sure	155	13	
Disagree	29	2	
Strongly Disagree	10	1	
Missing	2	0	

8. In science class I often develop and support my own ideas using evidence from experiments and/or research.

Response	Frequency	Percent	Mean: 4
Strongly Agree	305	25	
Agree	615	51	
Not Sure	205	17	
Disagree	63	5	
Strongly Disagree	13	1	
Missing	8	1	

Responses from grades K-12 teacher surveys:

6. How often do your students generate their own hypotheses and seek evidence to support those hypotheses?

Response	Frequency	Percent	Mean: 4
Not Applicable	1	2	
Never	2	3	
Infrequently	23	35	
Monthly	22	33	
Weekly	15	23	
Daily	3	5	
Missing	0	0	

7. How often do your students design their own experiments to investigate scientific principles?

Response	Frequency	Percent	Mean: 3
Not Applicable	1	2	
Never	13	20	
Infrequently	43	65	
Monthly	9	14	
Weekly	0	0	
Daily	0	0	
Missing	0	0	

Dimension 3: Students develop a knowledge base of scientific concepts, theories, and processes which they will use to integrate all of the fields of science as well as the humanities.

Dimension 4: Evaluating the Work of the Organization

In order to evaluate whether or not students are using their scientific knowledge base across disciplines and the related extent to which the organization supports the goals of the science program, data were reviewed across all grade levels. Programs of study as well as K-12 curriculum maps were examined to ascertain the extent to which science is integrated across disciplines, such as the humanities, the scope and depth of vocabulary, and career options. Additionally, student and teacher perceptions of how often inquiry is carried out in the classroom were collected and analyzed. Elementary Science Program (ESP) kits and BOCES #1 Science and Technology (BoSAT) kits used in kindergarten through grade five were reviewed for their ability to expose students to other disciplines through the scientific inquiry they provide.

Specifically, the following data were used and analyses performed:

1. Programs of study in all four buildings, Council Rock, French Road, Twelve Corners Middle School, and Brighton High School
2. Teacher survey for all teachers, K-12

3. Curriculum maps for all grade levels
4. Analysis of ESP and BoSAT supplemental kits used in kindergarten through grade five.

Upon analysis, Brighton students are exposed to a variety of scientific content across all grade levels. The BoSAT kits, more than the ESP kits, move students from basic understanding to mastery as they progress through the kits in subsequent grade levels. Additionally, the BoSAT kits move away from teacher directed to more student guided activities as students move through grade levels. These kits also afford children the opportunity to connect their science knowledge with other core curriculum areas, such as math, language arts, and technology.

While there are many redundancies in content in kindergarten through grade five, chemistry topics appear to be infrequently covered, if at all. Additionally, the life science topics of genetics and plants tend to be topics students struggle with on the fourth and eighth grade state science assessments. Furthermore, there is a lack of specificity of content and vocabulary in kindergarten through grade five, as is evident upon review of the curriculum maps. While there has been a more recent shift in K-5 to include more integration of science with the humanities, this shift is not evident in the secondary grades. However, there is more of a focus in grades six through twelve on integrating science instruction with math and technology, a trend lacking in the primary grades. Teacher surveys revealed the need to update curriculum maps with relevant vocabulary, literacy, and inquiry strategies to ensure a firm science base for all students, even at the primary levels. These surveys also noted very little time exists for collaboration between teachers to help all teachers (K-12) create science lessons that integrate other disciplines.

Another focus of evaluation incorporated into Dimension 4 was the area of professional development. Three years of data were reviewed including topics of professional development workshops which had been offered to staff members as well as attendance. In general, the data were inconclusive. They seemed to indicate that there were a lack of professional development opportunities in science for teachers of all levels. In addition, when there were opportunities available, few teachers participated. In fact, the only professional development opportunity that was consistently attended was the scoring of the science tests. While one would not argue the value of this type of activity to the professional growth of Brighton staff, it certainly cannot be viewed as a comprehensive learning opportunity for all of the content and pedagogical expectations of Brighton science staff.

Discussion

The purpose of this program evaluation was to determine the degree to which Brighton students are being engaged in the processes of scientific literacy, inquiry, and how well students will use their scientific knowledge to make the decisions asked of them as they become part of the global community. The evaluation design as well as subsequent data analyses led to the conclusion that overall students are very successful in science. They are learning science concepts and making connections between those concepts and their own lives. On formalized measures of student achievement, most Brighton students exhibit a consistently high rate of passage for all state science assessments. Furthermore, the rate of students achieving mastery on Regents exams is above many comparable districts. While there are specific subgroups that may not traditionally perform as well, in general, the percentage of students reaching proficiency and mastery has been consistent and/or improving in the last five years. Overall, Brighton students feel positive about the science program and are engaged in the related work.

At a curricular level, teachers at the primary/elementary levels use more current events to teach concepts and skills than those at the secondary levels. However, curriculum maps indicate a much more specific focus in scientific concepts at the secondary (grades six through twelve) level. While the vast majority of Brighton students perform well on state science assessments, these assessments do little to evaluate students' ability to create their own questions and solve them using the processes of scientific inquiry. Additionally, while surveys and curriculum analysis indicated that scientific inquiry is present in Brighton's science program, evidence suggests that it is inconsistent across grade levels. As inquiry is of paramount importance to Brighton's science program, as identified by the committee, more inquiry should be woven into the science program's fabric, from kindergarten through grade twelve. Furthermore, a way to measure this important inquiry skill must be devised.

Despite the high achievement of the overall student population, there was one area in which the data indicated need of further study and attention. Specifically, a portion of the students, primarily those within the subgroups of students with disabilities, low socioeconomic status, Hispanics, and African Americans, are not achieving at the same passing or mastery rates as the general population on the state science assessments. At this point, it is unclear as to whether or not this disparity is caused by the lack of enrollment by minority students in the Regents level courses and/or the performance of students on the Regents exams themselves. It is hoped that further investigation of this specific topic will lead to clarity of cause. Once determined, interventions can be implemented in order to provide all students with opportunities for success within the sciences.

Recommendations

Curriculum and Instruction

1. Regularly integrate current events into classroom instruction across all grade levels.
2. Create a continuum (K-12) for scientific writing/lab report expectations.
3. Re-evaluate and change curriculum maps based on emerging trends and the future standards in order to accurately reflect the importance of scientific literacy and inquiry among and across grade levels.
4. Evaluate the placement of life science and chemistry related curriculum topics in kindergarten through grade eight.

Assessment

5. Create local benchmarks and assessments that allow analysis of student achievement beyond the narrow scope of standardized tests.
6. Explore the causation for disparities in student performance across subgroups and respond accordingly.

Organizational Work

7. Actively seek to provide multi-grade level professional development to assist teachers in creating more student-guided lab experiences that are in line with curricular standards.

Limitations

As in any focused study, limitations will occur simply by the nature of the work at hand or in this case, because of the lack of available data in some instances. As was discussed previously, the original evaluation design called for the inclusion of analysis of student work, particularly in the area of scientific inquiry, and surveying of parents and post-Brighton graduates. In the former instance, it was difficult to obtain work samples of examples of student inquiry that would consistently represent a given grade level of science discipline (i.e. living environment, Earth science, physics or chemistry). Interviews with departmental teachers at the secondary level revealed that, while many attempted to incorporate inquiry related principles into their instruction, none did so on a routine, consistent basis. It was felt by the committee to try to evaluate and make subsequent generalizations on these data would not be reliable. In addition, no data on results of AP exams were analyzed. AS Advanced Placement courses in Brighton are the cornerstone of upper level academic programs for Brighton High School students, future program evaluations need to consider these data in conjunction with the other data sets.

Administering surveys to parents and post-graduates also proved to be difficult due to a lack of a consistent mechanism to conduct such surveys. Furthermore, in terms of career knowledge, students reported an awareness of careers available in science. However, the scope of this awareness could not be ascertained. For example, doctor or researcher are two jobs most students readily associate with careers in science, thus the perception of many students as being “aware” of science careers. However, vast opportunities beyond these two obvious jobs potentially await students. Lastly, there was consensus from the committee as to the limitations of the New York State assessment data. Besides doing little to shed light on students’ inquiry skills, it was difficult to ascertain if the discrepancies in student achievement on specific topics (such as genetics and plants) were due to lack of student understanding of these topics or flaws in question design or test taking.

Appendix.

Appendix A. Student Survey.

Course	Level	Gender	Grade level
O General	O Regents	O M	O 7
O Liv Env	O Accelerated	O F	O 8
O Earth	O AP		O 9
O Physics	O N/A		O 10
O Chem			O 11

Reflecting on your science experiences, please answer the following questions **by filling in the bubble completely.** Do not use check marks or "x's".

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1. In science class, I solve problems or reach conclusions by myself.	O	O	O	O	O
2. In science class, I often listen to others and help others to solve problems.	O	O	O	O	O
3. I sometimes use science words or concepts in other classes.	O	O	O	O	O
4. I often have the opportunity to use skills from math, English, and other subjects in my science classes.	O	O	O	O	O
5. In science class I often think critically and evaluate information for a specific purpose.	O	O	O	O	O
6. In science class, I often have the opportunity (or I am required) to read real science articles from scientific journals or other periodicals (e.g. newspaper, web pages.	O	O	O	O	O
7. My teacher gives me opportunities to pose and evaluate evidence I collect in the lab.	O	O	O	O	O
8. In science class I often develop and support my own ideas using evidence from experiments and/or research.	O	O	O	O	O
9. In science class, we often learn about and discuss current events and world news.	O	O	O	O	O
10. My science teachers often encourage students to evaluate scientific knowledge from different points of view.	O	O	O	O	O
11. What I learn in science class can and does affect my personal beliefs about the world.	O	O	O	O	O
12. Science is very important in my everyday life.	O	O	O	O	O
13. My teacher gives me opportunities to connect my science knowledge with my personal needs.	O	O	O	O	O
14. Science has been and will continue to be a benefit to the world's population	O	O	O	O	O
15. My teacher gives me opportunities to evaluate and critically think about scientific information and literature.	O	O	O	O	O
16. My teacher gives me opportunities to identify scientific issues underlying national and local decisions.	O	O	O	O	O

17. I am given opportunities to think scientifically and use technology tools to gather information and express myself.	O	O	O	O	O
18, In the last 4 years of science class, I feel the expectations of my science teachers have been similar and consistent.	O	O	O	O	O
19. In the last 4 years of science class, I feel that what I learn in one year helps me in the next year.	O	O	O	O	O
20.I am aware of many career opportunities available in the field of science.	O	O	O	O	O
21.I believe that my grades on New York State assessments in science, including Regents examinations, are good indicators of my knowledge and understanding of science.	O	O	O	O	O
22. My work in science class usually requires me to remember the answer to a question rather than reaching my own conclusion based on observations.	O	O	O	O	O
23. My school offers multiple electives in science that meet the needs of a diverse student population	O	O	O	O	O

24. Of the following media, which do you routinely read and assess for validity of the information? (bubble all that apply)

O World news

O Scientific literature

O Local News

O Current events

O Other ____

25. How do you access scientific literature in your science class? (bubble all that apply)

O On-line articles

O On-line text

O Hard copy textbooks

O Newspapers

O Scientific articles

O Non-fiction novels

O Other ____

26. Which of the following are you given the opportunity to do in science class? (bubble all that apply)

O Create a hypothesis

O Design a unique experiment

O Conduct an experiment

- O Create models of science concepts
- O Collect data
- O Analyze data
- O Use scientific instruments/equipment
- O Listen and evaluate others' conclusions
- O Use technology to complete assignments
- O Other ______________________________________

26. Is there anything else you'd like to share about the science program at Brighton Central School District (K-12)?

Thank you for answering these questions for us.

Appendix B. Focus Group Questions

French Road:

1. What are some science words that you think are important?
2. Where can kids get information if they want to know more about science?
3. This (tape recorder) is broken. What might you do to find out what's wrong? (fix it?)
4. In what jobs is science used?

Council Rock:

1. What are some science words that you think are important?
2. Where can kids get information if they want to know more about science?
3. What is this? (pan balance) and what could it be used for?
4. In what jobs is science used?

Appendix C. Teacher Survey.

The district is in the process of studying the science program.   Identifying information:

Grade level you teach	Number of years teaching	On average, how much time per cycle do you spend on Science content?
K-2	<1 year	<60 minutes
3-5	1-5	60-90 minutes
6-8	6-10	91-120 minutes
9-12	11-20	121-180 minutes
	>20	

Please answer these questions using

X = Not Applicable   N = Never   I=Infrequently   M = Monthly   W = Weekly   D = Daily

**The diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work (NSES, p.23)

X   N   I   M   W   D

1. How often do you have students work collaboratively on inquiry** activities?
2. How often do you have students work independently on inquiry** activities?
3. How often do your students read popular press, scientific journal articles, or nonfiction leveled readers about science?
4 How often do your students discuss the relevance of scientific concepts to current events or other real world applications?
5. How often do your students identify how their own personal beliefs impact their interpretation of scientific principles?
6. How often do your students generate their own hypotheses and seek evidence to support those hypotheses?
7. How often do your students design their own experiments to investigate scientific principles?
8. How often are students given opportunity for science outside of the classroom? (i.e., clubs, etc.)
9. How often do your students collect, interpret, and analyze scientific data?
10. How often do your students communicate and defend their scientific conclusions to peers?
11. How often do your students listen to and evaluate their peers' conclusions?
12. How often are curriculum maps updated to represent current goals and NYS standards?
13. How often is a common vocabulary used consistently across grade level?
14. How often does the science curriculum integrate math?
15. How often does the science curriculum integrate technology?

16. How often do you incorporate literacy strategies in the teaching of science?
17. How often do you believe the current science materials and activities meet the science goals outlined in the curriculum?
18. How often are there consistent expectations for writing lab reports across grade level?
19. How often to you take advantage of the scientific resources found in the community?
20. How often are state tests used as indicators of student learning?
21. How often are summative assessments from classrooms used as indicators of student learning?
22. How often are assessment practices varied to suit different learning styles and abilities?
23. How often are assessment tools based on interdisciplinary units, rather than one test for each unit?
24. How often do you collaborate on interdisciplinary units of study that incorporate scientific inquiry?
25. How often do you collaborate on interdisciplinary units of study that incorporate the Common Core learning Standards?
26. How often are there opportunities for K-12 discussion on science?
27. How often do you collaborate within your grade level or subject area?
28. How often are there opportunities for professional development in assessment design?

Do students in the Brighton Central School District develop a strong background in physical science, life science, mathematics, engineering, and technology in order to make them college and career ready? Please explain your answer in the space below with as much detail as possible.

As a teacher, do you have the equipment you need, enough space, and enough training to implement high quality science education?

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