

***Evaluation of Renaissance High School's  
California State Integrated Science Standards Instruction***

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A report  
submitted to

Renaissance High School  
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## **Evaluation of Renaissance High School's California State Integrated Science Standards Instruction**

Renaissance Continuation High School of La Selva Beach, California is a small school of 200 students and 14 full time instructors. Due to the small nature of the school, collaboration is both encouraged and easily scheduled. In March of 2009, the Western Association of Schools and Colleges (WASC) committee will be visiting the school for an update regarding the school's progress in it's previously submitted three-year-plan. In preparation for the visit, the instructors within each of the school's content disciplines (e.g., Algebra, Integrated Science, U.S. History, etc.) have selected "essential standards" from the master list of California State Standards. Essential standards are defined by the school as those standards guaranteed to be taught in every section of a course by each instructor.

The agreement upon which standards to teach was the initial task completed by the instructors within content disciplines, followed by an agreement for how to assess whether students have actually mastered each standard. This evaluation is designed to determine whether students of Renaissance High School's Integrated Science classes may demonstrate having learned each standard. If the instructors find their students are deficient in a content area where a fellow instructor had success, further dialogue regarding the best instructional practice is to ensue, thereby improving the overall level of instruction throughout the school.

This document is the summative evaluation report of Renaissance High School's Integrated Science *Investigation* and *Chemistry* content units. This report contains a description of how the science standards were selected, a description of the evaluation procedures, a presentation of evaluation results, and a final evaluation for Renaissance High School in assessing whether the Integrated Science students are learning the prescribed essential standards.

## **Description of Renaissance High School's Integrated Science Instruction**

The California State Integrated Science Standards were printed by the California Department of Education, and were selected from the State's High School Chemistry, Physics, Biology, and Earth Science standards. The two Integrated Science instructors at Renaissance High School collaboratively selected 12 of 62 state Integrated Science standards and deemed them "essential standards". Although the essential standards are taught in each classroom, the instructional methods and activities are individually determined by each instructor.

The objective of the Integrated Science course is to effectively teach the essential integrated science standards at a high enough level that students will retain the content and demonstrate their learning on a standardized exam.

The *Investigation* and *Chemistry* Integrated Science units were designed and delivered by two collaborating high school teachers during October and November of Renaissance High School's 2008-2009 academic school year. Within the master list of Integrated Science essential standards, *Investigation* and *Chemistry* possess the five standards taught earliest in the academic calendar.

The standards being taught are:

### **INVESTIGATE/EXPERIMENT:**

- d. Formulate explanations by using logic and evidence.
- k. Recognize the cumulative nature of scientific evidence.

### **CHEMISTRY:**

#### **1. Atoms & Molecules**

- a. Students know how to relate the position of an element in the periodic table to its atomic number and atomic mass.
- d. Students know how to use the periodic table to determine the number of electrons available for bonding.

#### **2. Chemical Bonds**

- a. Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.

Although the activities designed to teach the content vary due to the style of each instructor, each student was given the same pretest and posttest, along with an advance reference copy of the standards to be taught in the course.

## Evaluation Method

This evaluation was designed to assess whether four classes of 10-12<sup>th</sup> grade high school students learned the intended California High School Integrated Science Standards embedded within the *Investigation* and *Chemistry* units.

In order to determine whether students learned the intended content, 4-answer multiple-choice assessment questions were taken from a test bank of questions designed by Data Director, a company that stores an online database of student scores across multiple disciplines. In order to avoid confounding data through repetition, the two Integrated Science instructors selected a single pretest question for each of the 5 standards and tested students before the *Investigation* unit. After the *Chemistry* unit, a different posttest question was administered to students. Mastery was determined by the pretest-posttest gains derived from the 5 quiz items. All questions are included in Appendix A.

In addition to the quantitative data received through the multiple-choice scoring, triangulation of results occurred through qualitative attitude surveys given to students and qualitative interviews given to the two instructors after the completion of the *Chemistry* unit.

The attitude survey was designed to measure how much students “felt” they were learning, and the interview was designed to determine teacher perception of how well the units were taught as well as a prediction for how well the students had learned the five standards. The student survey consisted of five Likert-type questions rated 1 for “Strongly Disagree”, 2 for “Disagree”, 3 for “Agree”, and 4 for “Strongly Agree”. The attitude survey was completed by each student one week after the completion of the *Chemistry* unit.

The teacher interview consisted of 5 open-ended questions and was administered the day after the *Chemistry* unit and posttest exam were completed.

In order to objectively assess validity, an experienced science teacher from another high school in the district reviewed the curriculum of both instructors in order to determine whether the activities possessed an appropriate level of quality for teaching the intended content.

## Results

### *Assessment Performance*

Student performance on the pre and posttest exams is summarized in Table 1. The results from the students of each instructor are displayed in columns, while the course sections for each instructor are divided horizontally. The bottom row combines the data from all four sections of Integrated Science.

The table reveals that student achievement of the four combined classes improved by 36.1% in the 4 Integrated Science courses, as the combined pretest score of 21.2% improved to 57.3% on the posttest. Although improvement occurred at varying rates for each test item, an increase in correct responses occurred for each standard in each course.

TABLE 1:

Integrated Science Instructor A					Integrated Science Instructor B				
<b>Per. 1</b>	Pretest	%	Posttest	%	<b>Per. 1</b>	Pretest	%	Posttest	%
<b>16 Students</b>	Correct	Correct	Correct	Correct	<b>18 Students</b>	Correct	Correct	Correct	Correct
I/E 1.d	6	32.5	8	50	I/E 1.d	5	27.7	8	44.4
I/E 1.k	2	12.5	10	62.5	I/E 1.k	4	22.2	11	61.1
CH 1.a	3	18.75	12	75	CH 1.a	3	16.6	9	50
CH 1.d	4	25	9	56.25	CH 1.d	3	16.6	10	55.5
CH 2.a	3	18.75	13	81.25	CH 2.a	4	22.2	11	61.1
<b>Per. 1 Total:</b>	18/80	22.5	52/80	65	<b>Per. 1 Total:</b>	19/90	21.1	49/90	54.4
<b>Per. 2</b>	Pretest	%	Posttest	%	<b>Per. 2</b>	Pretest	%	Posttest	%
<b>17 Students</b>	Correct	Correct	Correct	Correct	<b>16 Students</b>	Correct	Correct	Correct	Correct
I/E 1.d	4	23.5	7	41.1	I/E 1.d	5	31.25	7	43.75
I/E 1.k	1	5.9	8	47	I/E 1.k	3	18.75	10	62.5
CH 1.a	4	23.5	9	52.9	CH 1.a	4	25	9	56.25
CH 1.d	3	17.6	10	58.8	CH 1.d	2	12.5	8	50
CH 2.a	4	23.5	12	70.6	CH 2.a	5	31.25	11	68.75
<b>Per. 2 Total:</b>	15/85	17.6	46/85	54.1	<b>Per. 2 Total:</b>	19/80	23.75	45/80	56.25
<b>Per. 1 &amp; 2</b>	33/165	20	98/165	59.4	<b>Per. 1 &amp; 2</b>	38/170	22.4	94/170	55.3
<b>TOTALS:</b>					<b>TOTALS:</b>				
<b>ALL CLASSES</b>	71/335	21.2	192/335	57.3					

### *Student Attitude Responses*

Responses to the student attitude survey are summarized in Table 2. The summary shows the number of students selecting each response, the average score for each item, and the overall mean for each group.

#### **The Survey's possible responses were:**

1. Strongly Disagree      2. Disagree      3. Agree      4. Strongly Agree

TABLE 2.

<i>Question</i>	<i>1. Strongly Disagree</i>	<i>2. Disagree</i>	<i>3. Agree</i>	<i>4. Strongly Agree</i>	<i>Mean</i>
1. Possessing the Standards before the start of the unit helped me learn more during instruction.	3	124	166	37	<b>2.71</b>
2. I feel like I learned all the standards taught by my teacher.	22	101	183	22	<b>2.63</b>
3. I thought the pre-test was easy.	54	196	64	8	<b>2.08</b>
4. I thought the post-test was easy.	44	161	98	19	<b>2.29</b>
5. I feel I could explain chemistry better to someone now than before we began the unit.	10	52	204	61	<b>2.97</b>
<b>Totals:</b>	<b>133</b>	<b>634</b>	<b>715</b>	<b>147</b>	<b>2.54</b>

The table reveals that a majority of the students felt possessing a copy of the standards improved their learning (2.71 for question #1). The students also indicated a belief they had learned the standards (mean 2.63 for question #2) and they could better explain chemistry after the unit than they could beforehand (2.97 in question #5). Also important to note is that the students felt the posttest was easier than the pretest, as the agreement score rose from 2.08 to 2.29 when comparing questions #3 and #4.

### *Teacher Interviews*

The responses of the classroom teacher interviews are summarized in this section. The teacher interview focused on whether the instructors believed they taught the essential standards, and how well they thought the students would score on the prescribed assessments. One teacher indicated, “all the standards were covered, but our (continuation) students do not have good test taking skills which may have meant that the success students can demonstrate on assignments may not translate into good scores on a standardized test”. Another instructor stated, “I think the students will show improvement on the posttest because we are giving it to the students immediately after completion of the unit. If our posttest was given as a final exam at the end of the semester, our scores probably would not improve very much from the pretest”.

Overall, both instructors were confident they had properly presented the material and that while students demonstrated their understanding within various classroom assessments, instructors were dubious in the abilities of their students to demonstrate learning in the form of an exam.

### *Program Review*

The standards, curricular materials from both instructors, and aligned pretest/posttest questions were reviewed by an experienced science teacher after the unit was completed. The reviewer believed that each standard was clearly identified for students and addressed to a sufficient degree within the implemented activities. In regards to the pretest & posttest questions, the reviewer observed that the *Investigation* pretest question 1d. was easier than the posttest question 1d., and recommended the posttest question be changed. She also noted that I/E 1k. posttest question was easier than the pretest question and may have skewed the results to show a false improvement for that question. Less drastic, our reviewer noted that the *Chemistry* 1d. posttest question was marginally easier than the pretest question.

## Discussion

This evaluation revealed that the students of Renaissance High School Integrated Science classes are demonstrating overall mastery of the essential standards for the *Investigation* and *Chemistry* units. The entire collection of students largely agreed with statement, "I feel like I learned all the standards taught by my teacher" and fully agreed with the statement, "I feel I could explain chemistry better to someone now than before we began the unit". These subjective feelings are evidenced by an improvement in standards assessment scores. Students increased from 21.2% rate of correct responses on the pretest to a 57.3% correct on the posttest.

Interestingly, the instructors were not the only ones to lack confidence in their students' test taking abilities. The students' own insecurities may have shown in their survey responses as well. When asked to respond to the statement "...the pretest was easy.", the integrated science classes scored a combined mean of 2.08 on a 4-point scale, meaning that the group disagreed overall. This number rose only slightly to 2.29 when describing the posttest. Although student confidence did not rise drastically, the students' collectively increased their correct responses on the exams by 36.1% (21.2 to 57.3).

As identified by the content reviewer, the *Investigation* standard 1d possessed a more difficult posttest than pretest question. Accordingly, there was only slight improvement from 29.9% of integrated science students answering correctly on the pretest to 44.8% answering correctly on the posttest. Conversely, for *Investigation* 1k the posttest question was much easier than the pretest question, skewing the results towards a large improvement from 14.9% on the pretest to 58.2% on the posttest. Future tests should be revised so that the pre- and post assessment questions for both these standards are of equal difficulty.

Craig Miller recommends that the instructors continue to use their curriculum for the *Investigation* and *Chemistry* units of Renaissance High School's Integrated Science course. This summative report addresses the first two units of the Integrated Science curriculum. The teacher instruction, assessment process and subsequent evaluation should be continued and follow the same methodology for all additional units containing the identified essential standards.

## Appendix A

### STANDARD ASSESSMENT QUESTIONS

#### Investigate/Experiment 1.d Pretest:

Which question cannot be answered by an experiment?

- a. Does penicillin kill Salmonella bacteria?
- b. Is rabies caused by a virus?
- c. (X) Did a comet impact kill the dinosaurs?
- d. Can radiation cause cancer?

#### Investigate/Experiment 1.d Posttest:

Most typically, the order in which the steps of scientific investigations are applied is

- a. observations, predictions, hypothesis, controlled testing, conclusions, questions.
- b. predictions, observations, hypothesis, conclusions, controlled testing, questions.
- c. (X) observations, questions, hypothesis, predictions, controlled testing, conclusions.
- d. observations, hypothesis, predictions, controlled testing, questions, conclusions.

#### Investigate/Experiment 1.k Pretest:

Linnaeus' s two-word system for naming organisms is called

- a. taxonomic evolution.
- b. Genus species.
- c. Greek polynomials.
- d. (X) binomial nomenclature.

#### Investigate/Experiment 1.k Posttest:

Taxonomy is

- a. the study of life.
- b. (X) the science of naming and classifying organisms.
- c. the evolutionary history of a species.
- d. the sequence in which different groups evolved.

#### Chemistry 1.a Pretest:

An element has 5 protons, 5 electrons and 6 neutrons. What is its atomic number?

- a. (X) 5
- b. 10
- c. 11
- d. 16

#### Chemistry 1.a Posttest:

As you move from right to left on the periodic table

- a. (X) the atomic number increases.
- b. the atomic number decreases.
- c. the atomic mass decreases.
- d. the radioactivity increases.

#### Chemistry 1.d Pretest:

Elements found in group 13 or IIIA of the periodic table have how many electrons available for bonding?

- a. 2
- b. (X) 3
- c. 4
- d. 5

#### Chemistry 1.d Posttest:

Which two elements each have 4 electrons available for bonding?

- a. beryllium (Be) and magnesium (Mg)
- b. (X) carbon (C) and silicon (Si)
- c. oxygen (O) and sulfur (S)
- d. neon (Ne) and argon (Ar)

#### Chemistry 2.d Pretest:

A molecule with covalent bonds forms when atoms

- a. (X) share electrons.
- b. fuse nuclei.
- c. split nuclei.
- d. exchange electrons.

#### Chemistry 2.d Posttest:

Ionic bonds form when two atoms

- a. (X) exchange outer shell electrons.
- b. exchange inner shell electrons.
- c. share inner shell electrons.
- d. share outer shell electrons.

## Appendix B

### PROPOSED BUDGET AND ACTUAL COST

ITEM	DESCRIPTION	PROPOSED	ACTUAL
<b>Personnel</b>			
Craig Miller	2 days testing & data analysis		2 x \$300 = <b>\$600</b>
Craig Miller	1 day survey & data analysis		1 x \$300 = <b>\$300</b>
Craig Miller	1 day interviews & analysis		1 x \$300 = <b>\$300</b>
Craig Miller	2 days creating & summarizing report		2 x \$300 = <b>\$600</b>
<b>Travel &amp; Per Diem</b>			
Automobile	4 days round trip to La Selva Beach, Ca		4 x \$35 = <b>\$140</b>
Automobile	1 day round trip to Santa Cruz, Ca		1 x \$25 = <b>\$25</b>
<b>Miscellaneous</b>			
	Communications, Supplies, Copies, Postage, etc.		<b>\$25</b>
<b>TOTAL BUDGET</b>			<b>\$1990</b>