

ATTITUDES TOWARD SCIENCE: GETTING STUDENTS ENGAGED

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## **Abstract**

### **Attitudes Toward Science: Getting Students Engaged**

It is a teacher's responsibility to deliver content and compel the students to learn, so how can teachers get students more excited about science? The purpose of this research is to understand what students enjoy about science and what may help to get them more engaged. First, students were asked to complete a twenty question survey using a response scale, from strongly disagree to strongly agree. Then, students and teachers were asked a series of interview questions that reflected their feelings about science. By collecting the student and teacher responses, I found that active, hands-on learning is what students enjoy the most and what teachers generally feel keeps the students more engaged. The hands-on learning that students value most is active lab work, as well as group work or activities. I also found that teachers enjoyed this as well, since more of the learning can take place with peers and teacher assistance, versus just lecture and note taking by the teacher.

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## **Introduction**

The bell has just rung, ending second period and John is dragging his feet as he walks down the hall to his biology class. It is at this point in the day when John wishes he was anywhere else but in his dreaded science class. He excels in his English, history and speech classes, but wants nothing to do with his science class. John finds himself continually daydreaming of where he wishes he could go for vacation, what plans he has for the weekend, and what his best friend Mike is probably learning in history class at that moment. During lab time he just fumbles and plays with all of the equipment and instruments, ignoring the task at hand. John just cannot seem to get himself engaged in the biology class, whatsoever.

Every teacher wants their students to be involved and excited about their particular class. Most importantly, they want them to connect with the content, absorb the material and excel in the subject matter. It is understandable that each student varies in their interests in certain subjects, but rarely do you hear children mention how excited they are, or how much fun they have in their science classes. Of course, there are the few who delve right into science, becoming completely immersed and entranced by the ever changing information it brings, but realistically, this is quite rare.

Many students have preconceptions about how the world works, not realizing that new theories are continuously being introduced with ongoing scientific research and findings. It is important to get students engaged in the material in order for them to truly comprehend the value it has pertaining to their own lives. Students need a drive, an eagerness and determination to absorb and understand the information, followed by excitement for what comes next.

Science is more than just reading the text or doing the required labs, it is about critical thinking, conceptualization, inquiry, discovery and a level of experimentation that is not experienced in other subjects. Connecting to the material helps students grasp factual information and details of what is really going on around us and why. It is a teacher's responsibility to deliver the content and compel the students to learn, so how can teachers get students more excited about science?

Because science can be applied to daily life in so many ways, I think it is important for students to be intrigued and eager to learn how they can connect science with their own lives. Understanding what students enjoy about science and what makes them excited to learn about different topics and themes may help instructors improve how we approach teaching science courses. This research project is targeted at examining students' negative attitudes toward science, taking a look at what makes students disinterested and what may help to get them engaged. In the section that follows, a review of relevant studies are examined and summarized.

### **Literature Review**

The struggle to get students engaged and enthusiastic about science education has been discussed widely and is continually being researched and challenged. "A significant amount of research in science education is devoted to understanding ways we can improve the quality of science education and increase enrollment in science courses and degrees" (George, 2006, p.571). Osborne, Simon, & Collins (2003) go so far as to note how "the low uptake of mathematics and science and the negative attitudes towards these subjects poses a serious threat to economic prosperity" (p.1051). Regardless of the outcome, the main focus has most commonly and specifically been on the way science is

taught in the classroom. “Many variables influence an educational environment. These include the ability of the students, the subject being taught, how it is being presented, the personalities of the teacher and of the students, the background experience and knowledge of the students and the social environment in and out of the school” (Ornstein, 2006, p.295). The way teachers utilize their time in the classroom and how they teach could greatly change how students, like John, feel about going to science class.

#### *Attitudes Toward Science*

In more recent years a significant decline in the number of students pursuing education in science, or science-related fields, has been seen. “One of the key factors in learning science is students’ attitudes” (George, 2006, p.571). Hollenbeck (2006) says, “Public perceptions have represented science to [be] a ‘feared’ discipline that only few students willingly attempt to study” (p.1). It is “imperative that educational systems recognize the important role played by student attitudes and seek actions that will achieve a positive view” (Ornstein, 2003, p.285). The idea is that if we can develop positive attitudes towards science subjects, then students will be more interested and motivated to take part in science education, or science-related careers.

“The quality and value of learning is diminished when students lose their motivation to be engaged. The benefits of learning are annulled by negative attitudes and behavioral patterns” (Darby, 2005, p.425). This conclusion has been seen, not only in recent times, as a research study done by Blanc (1956) revealed that students who received higher grades their first semester of class showed a positive interest in science. Along with academic scores, students have noted that much of the disinterest in science is caused by the idea that the learning seems to be merely “remembering a lot of facts”

(Darben, 2009, p.25). They have also reported that they experienced disappointment, specifically in high school science classes, because what “they are taught is neither relevant nor engaging and does not connect with their interest and experiences” (Darby, 2005, p.426). It is important to listen to the voice of the students in order to understand how they want to be engaged. Kreiser and Hairston (2007) mention that a “common approach is to provide students with interactive opportunities to apply knowledge gained from lecture or reading” (p.6). Being able to apply their learning experiences in problem solving and life situations, student attitudes towards science are likely to improve.

Attitudes about science also include the perceptions of the utility of science. Although there tends to be a generally negative attitude toward learning science, it has been shown that there is a common, positive attitude about the usefulness of science. A longitudinal research study done by George (2006) revealed that “high initial attitudes toward science are associated with high initial attitudes about the utility of science” (p.578). The research explains that positive attitudes about science and its usefulness that begin at a young age tend to continue throughout life for students - as long as interest and motivation is kept high as well. “Students who actually practice the use of science have more accurate perceptions of the usefulness of science” (George, 2006, p.574). Being able to take what is learned in the classroom and applying it to daily life helps to spark the understanding and interest of science; that it is clearly useful for daily tasks and not just a lesson being learned. Even if they do not know it themselves, “students are always observing and constructing their understanding of science and its application in their lives simply to try to make sense of their world” (Hollenbeck, 2006, p.2).

### *Gender Differences*

Though there has not been specific studies conducted on the aspect of gender on influencing attitudes toward science, it has been included as one of the factors among all the others. Each study appears to vary in its conclusions on whether or not gender does weigh-in, however, more factors that pertain to gender are included. Uitto, Juuti, Lavonen, & Meisalo (2006) said, "Gender roles affect pupils' self-esteem, motivation and interest in studying science subjects..." (p.128). "Previous [research on] gender differences have reported boys to have better attitudes toward science than do girls" (Moffat & Others, 1992, p.2). This may be a result of the societal bias, formed from the historical basis, that mostly males have represented the majority of the science field (Yerrick, Ross, & Molebash, 2004). There is also the traditional stereotype that boys prefer the physical sciences, while girls prefer the biological sciences (Moffat & Others, 1992). This is supported by data that reports higher grades for girls in biology and higher grades for boys in physics (Uitto et al., 2006). However, Osborne et al. (2003) have noted recent evidence reporting "that girls no longer hold such a stereotypical aversion to careers in science and are confident of their ability to undertake science courses" (p.1063).

Yerrick et al. (2006) note that "research in science classes has found that girls receive less positive reinforcement and less of the teachers' attention, are asked fewer complex questions, get less remedial help, and volunteer less than boys" (p.17).

According to Moffat and Others (1992):

Girls [tend] to correlate continued enrollment in science courses with the decision to pursue a science career... Role models [appear to] play a significant factor in

female science career aspirations. A number of girls who express interest in future science careers reported significant persons (male or female) in their lives who assisted them to become aware that they possessed the attributes and abilities necessary for careers in science... Boys who expressed interest in science careers did not necessarily report significant persons in their lives who had influence on their career aspirations. Possibly because boys traditionally have more access to these careers, boys may not need it pointed out that they possess attributes which would make them potentially good scientists. (p.16-18)

Even more research, reported by Moffat and Others (1992), includes a look at more variables that likely influence the gender difference, such as cooperative learning, competitive learning, student-centered learning, or teacher-centered leaning. The results of their research revealed that girls preferred cooperative, student-centered learning, and boys preferred competitive, teacher-centered learning. However, there is an influx of other research that shows “no significant gender effects for attitudes toward science” (George, 2006, p.573).

#### *Teacher Responsibilities & Requirements*

It is clearly known that teachers play a major, if not primary role in students' learning. “Research has shown that science teachers can have positive influences on student attitudes toward science... Teacher encouragement of science is found to have positive effects on student attitudes toward science as well as their attitudes about the utility of science” (George, 2006, p.574, 583). Students view their teachers as role models as well as knowledgeable people who they would like to make learning fun for

them. “The teacher and what the teacher presents as science is pivotal in maintaining student engagement in science” (Darby, 2005, p.425). George (2006) notes that:

Science educators, especially in the high schools, need to emphasize the practical applications of science so that students understand the importance of science as a major contributor to society. When students see the practical utility of science, they are more likely to become interested in science and pursue science-related careers. (p.586)

Thus, a science teacher’s influence is important in determining a student’s attitude toward science and achievement in the subject. Darby (2005) explains:

During their years of schooling, students develop perceptions about learning and teaching, including the ways in which teachers impact their learning experiences... That teaching is often seen by students in terms of style, personality and qualities... A teacher should be: enthusiastic, friendly, non-threatening, encouraging, understandable and attentive... Every action carried out or not carried out by teachers has significance for students. (p.425, 436-437, 440)

George (2006) also mentions that “teacher quality variables such as the academic preparation of the teacher in the specific field of science, science teaching practices, hands-on activities, cooperative learning, and student involvement in learning influence student attitudes” (p.2). Results of research conducted by Moffat and Others (1992) revealed that students in cooperative, student-centered classrooms had a more positive attitude towards science than those in the competitive, teacher-centered classrooms. Thus, it is clear that there are many factors the teachers hold that influence a child’s learning, attitude and engagement in science class.

In recent years, the call for recommended change and reform has required “teachers to rethink and fundamentally change [many] of their approaches to teaching science” (Yerrick et al., 2004, p.19). Research conducted by George (2006) found “students who perceive their teachers encouraging them to do more science courses and work hard on science are more likely to have positive attitudes” (p.583). Khoury and Voss (1985) describe how “teachers should support, encourage, and motivate students to do extra curricula work like reading science books, attending science lectures, watching science shows and developing science hobbies” (p.23). Getting students to engage in science outside of the classroom can help them to become more engaged within the classroom when learning new material. They can get excited about applying their new learning to out-of-class activities like Khoury and Voss suggested. As well, Darby (2005) notes the importance of teachers “providing students with a stimulating, challenging and fun experience [in] science... [within] a caring, supportive environment, so that learners can feel empowered...” (p.429 & 436). Therefore, it appears that not only influence, but encouragement is also important on having a positive effect on students and how they approach science.

In the student’s eyes, traditional lecture teaching is not the most fun aspect of education, but it is clearly an integral part of learning science. As much as science teachers would like to proficiently utilize hands-on learning, there is a lot of material to be covered in a short period of time (Litchfield, Mata, & Gray, 2007). “The amount of material that must be covered often does not allow for sufficient cognitive processing” (Litchfield et al., 2007, p.39). Teachers continuously struggle to balance lecture learning with activity-based learning in order to engage students. This can be a very difficult task



with all of the different learners in the classroom today. Some are visual learners, some are audio learners, and some are simply kinesthetic learners. It can be hard for a teacher to accommodate them all.

In order to give the students the best education imaginable “we need to ensure that those teaching science are equipped with the latest possible information to engage their students...that [students] are given the opportunities to explore the field using a variety of different methods and via a diverse range of sources” (Darben, 2009, p. 25, 28). If change or reform in the classroom is to take place, teachers will need to “rethink and fundamentally change some of their approaches to teaching science” (Yerrick et al., p.19). Today, I think many teachers are attempting new methods and are actually seeing results from them.

Kara and Yeşilyurt (2008) describe a teaching method called *Computer Assisted Instruction* (CAI), where the teacher utilizes computers to aid in teaching specific material. With technology becoming such a dominating form of communication in current years, students surely enjoy being able to use computers to learn material in their classrooms. The forms of CAI that are used include tutorials, web-based instructions, self-running simulations, drill-and-practice programs, and various edutainment software programs (Kara and Yeşilyurt, 2008). It will certainly take time to see results from computerized learning, but potentially help break free from the traditional lecture method that students tend to dislike.

Litchfield et al. (2007) suggests “splitting into small discussion groups, using references to solve problems, and finding alternative ways of expressing content” (p.34). Inquiry, direct observation, and hands-on labs are a few of the components that Ornstein

(2006) lists as being integral for a “good science class” (p.285). Regardless of the suggestions it is clear that “a challenge in any educational endeavor is finding ways to present abstract concepts to students in a manner that makes the ideas more concrete” (Kreiser & Hairston, 2007, p.6). By integrating new strategies and approaches to teaching, students will have more options to get engaged and can participate in learning that they enjoy.

Science can be a tricky subject for teachers, as many are restricted due to health and safety concerns (Darben, 2009). As well, school budgets and resource availability tend to be lacking for the science department, limiting what teachers can use for hands-on or experimental learning, which students enjoy the most. As Ornstein (2006) illustrates:

The problem [with achieving changes] is that education is funded by tax dollars and therefore is integrally tied with politics. Results are expected to be seen in a relatively short time and new leaders, whether administrators or politicians, want to be able to claim credit for successful efforts. Thus change is introduced too frequently in education, meaning too many innovations are being tried at the same time and few are ever given sufficient time to show their true influence. (p.296)

All of these limitations only hinder the efforts to incorporate different teaching methods and mechanisms even more. There is a struggle to balance what is needed with what is realistically and readily available, making the whole idea of engaging students just that much more difficult to achieve.

### *Active Learning*

There have been many suggestions of how to go about changing lesson delivery and learning experiences for students. Yerrick et al. (2004) suggest that “high-quality

science education must include active engagement in scientific investigations, an understanding of the nature of science, effective communication of science development of testable questions and experiments, and recognition of the relevance of science to everyday life” (p.19). Hollenbeck (2006) describes that there is clear need for:

- 1) Encouraging student initiation of ideas, greater participation in student learning, displays of leadership, and autonomy in planning and doing.
- 2) Encouraging students to expand and follow up on their ideas.
- 3) Using cooperative learning strategies that emphasize collaboration, respect for individuality, and the division of labor. (p.3)

“Despite the continued popularity of science-related documentaries and the explosion of science-themed drama in popular culture, young people are choosing not to engage in science education... Modern students no longer recognize the classroom as their sole source of scientific information” (Darben, 2009, p.24). Television and the Internet have provided a vast “array of alternatives to the traditional teacher-based delivery of scientific information” (2009, p.24). They have also helped to make science-based careers more interesting and exciting. Darben (2009) notes:

Successful science educators have moved away from the traditional model of textbook-based, teacher centered modes of delivery, which concentrated on the transmission of a set body of facts... We need to ensure that [students] are given opportunities to explore the field using a variety of different methods and via a diverse range of sources... We need to give young people an authentic hands-on scientific experience that has a definite connection to benefits in the real world. (p.24, 25, 28)

“Science learning must be taught in the scope of the human experience and understanding” (Hollenbeck, 2006, p.1). Students need to be learning and experiencing science based on their specific developmental level. “Students are expected to absorb verbal or symbolic information, whether it be from lectures, presentations, readings, or some other format void of an experiential framework” (Jelinek, 1998, p.5). If we are teaching students science information that cannot be related to their own daily activities, we cannot expect them to absorb the material we want them to learn. Jelinek (1998) recommends using an experiential learning program as follows:

1. Design conditions for transfer before the learning activities actually begin.
2. Create elements in the student’s learning environment similar to those elements likely to be found in future learning environments.
3. Provide students with the opportunities to practice the transfer of learning while still in the program.
4. Make the consequences of learning natural, not artificial.
5. Provide the means for students to internalize their own learning. (p.5)

“Everyday science assists students in making sense of the world in powerful ways, but is rarely viewed as valuable by science students” (Yerrick et al., 2004, p.18). Uitto et al. (2006) suggests “learning at zoos, botanical gardens, science parks, or research institutions may enhance pupils’ interests in learning more about [science] at school too” (p.128). Implementing inquiry-based learning, and allowing students to actively seek out information, places the learning emphasis solely on the students (Darben, 2009). Giving students a responsibility to develop their own learning helps to empower them and

increase their motivation, as well as heighten perceived relevance (Litchfield et al., 2007).

Reviewing the literature has revealed that there are many factors influencing the perception of science as a subject, as a career choice, its usefulness, and simply getting students engaged. It is clear that there is no easy way to go about any of the above mentioned factors, but continuing research will help create steps, leading toward more answers and possible solutions.

### **Research Questions**

With science being an incredibly fundamental element in understanding life, it is imperative that educational institutions highlight its importance. Clearly there is a growing concern with the increase in students' lack of interest and engagement in science subjects. This has prompted ongoing research and left many questions unanswered. This project focuses on some of those questions. I am interested in finding out what it is that students need in order to look forward to walking into their High School biology class. The primary research question which drives this project is: What do students need to get engaged in their science classes? Secondary questions include: If students had more options in their science classes, what would they choose to do for credit? What is it that they enjoy the most about their science courses? What aspects of the teacher and the teacher's methods are important influences on a student's attitude or engagement?

### **Methodology**

#### *Methodology and Rationale*

This research project focuses on the attitudes students have about and toward science, as well as what is needed to get them engaged in the subject. Because of the

nature of this study a qualitative research methodology is appropriate. Specifically, I utilized action research in a case study approach. Doing a case study entails collecting information from individuals or small groups of participants, and describing or interpreting the results, in order to understand everything that encompasses the matter at hand. By collecting information from various spectrums, we can come to a better understanding of why students tend to have negative attitudes toward science and what they need, in order to get excited for it and engaged in it.

### *Sample*

Participants for this case study included freshmen, sophomore, and junior high school students, as well as their science teachers. These participants included a variety of ethnic backgrounds, socioeconomic status, gender, and for teachers it also included length of teaching and teaching styles. By having access to this variety in participants, the data is more valid. This data is a collection of answers to surveys and interviews, along with observational information.

I observed, interviewed and surveyed twenty seven students and four science teachers to collect a variety of opinions and information. The students were from three different class periods, which also gave an idea of how students feel during a certain time of day. The teachers were from biology and chemistry science classes in order to get perspectives from the varying subject matter areas.

### *Instrumentation*

I began data collection by obtaining observational data, in the form of field notes. I observed the following: 1) How students interact in the classroom with their peers and with the teacher, 2) What parts of class time students appear to enjoy the most, and 3)

What assignments are done most efficiently and that tend to produce the best grades. By simple observation, I was able to obtain raw facts that helped to provide particular information about students in their natural environment.

Second, I set up semi-structured interviews with thirteen, out of the twenty seven students, and all four teachers. When interviewing the students, I looked at what they had to say about science, their attitude about it, and what they enjoyed most from their class(es). (Please reference Appendix A). I made sure students knew that their honest answers were important to the research and what they told me was confidential and they would not be penalized. For the teachers, I was particularly interested in what they thought their students enjoyed, what they have done differently to get students engaged, and what they think teachers, in general, can do to get students excited and interested about science. (Please see Appendix B). I reminded the teachers that the information they provided was confidential and no names were used when reporting the data. I believe that by finding out perspectives from the variety of students and teachers, I can aid in making the necessary changes in my science classes.

Last, I produced a survey for all of the twenty seven participating students to take. This survey included questions on interest in science classes, interest in science-related activities in school and out of school, interest in science careers, self-assessment, and confidence in their abilities to do science. (Please see Appendix C). The students were purposely asked not to write their name on the survey and to answer the questions honestly.

## *Analysis*

By using observational data, interviews and surveys, I was able to collect a plethora of information in order to answer my primary and secondary research questions. Utilizing and analyzing these three forms of qualitative data collection creates triangulation, which establishes credibility. Observational data can be one of the most important forms of data collection, and with the sample I used, I saw a variety of engagement, participation and attitudes. As a bias created from the majority of research, I had assumed I would see patterns of high engagement when science material included hands-on learning and a teacher that showed enthusiasm. This is what I did end up seeing.

Interviewing the students in a semi-structured manner allowed me to get answers to my questions as well as allowing the students to elaborate or talk about the things they felt were important or relevant. I believe the students were more honest with the anonymity and confidentiality that came with the survey; allowing concise and valid answers, as well as providing a back-up to what was recorded from the interviews.

## **Data**

### *Student Interviews*

In order to obtain detailed information on general opinions about science and what students enjoy in their science classes, I selected thirteen students out of the twenty seven who participated. I selected these students based on varying gender and ethnicity, as well as differing grades and class periods. Responses to the interview questions are displayed in Table 1, where the participants will be identified by using the numbers 1-13.



**Table 1***Student Interview Responses*

<b>QUESTION</b>	<b>STUDENT</b>	<b>RESPONSE</b>
1. Is science important to you? Why?	Student #1	Yes, because it is an easier subject for me. I can apply it to other things.
	Student #2	Kind of. I think learning about how things in life work, or are assembled.
	Student #3	Yes, because it is all around us.
	Student #4	Yes, because you can apply it to everyday life.
	Student #5	Yes, because you get to learn what keeps you living.
	Student #6	A little bit. It is useful for some things...I don't know.
	Student #7	Yes, because it determines a lot of how we function and how our environment works.
	Student #8	Yes, because we need more science people in America.
	Student #9	Yes, because it is used for everyday life and understanding our world.
	Student #10	Yeah, kind of. Useful for other subjects, or real life scenarios.
	Student #11	Yes, because it is interesting if you are influenced young.
	Student #12	Yeah, because if we didn't have science we wouldn't have explanations for things.
	Student #13	Sure. It relates to life.
2. Do you think boys or girls prefer science more? Why?	Student #1	Same. Different people like different things. I see more girls in my science classes.
	Student #2	Both. There are female and male scientists.
	Student #3	The same. I think they have equal interest and questions they want answered.
	Student #4	Same. I don't see any difference in preference.
	Student #5	Guys, because it is a nerdy subject and guys are nerdier.
	Student #6	Same. I think the engagement is the same.
	Student #7	Same. I think boys and girls have different preferences. Some girls prefer science or some guys prefer science.
	Student #8	Guys. They just understand it better.
	Student #9	The same, because I have never noticed a difference.
	Student #10	Same. My classmates engage the same.
	Student #11	Girls in high school.
	Student #12	Girls, because they are more interested and do better.
	Student #13	Boys. They participate more and seem more into it.
3. Do you enjoy learning about science?	Student #1	Yes, because I can apply it to other subjects.
	Student #2	Yeah, in general. There are a lot of facts to learn.
	Student #3	Yes, how everything works together, like people and the environment.
	Student #4	Yeah, I think it is very interesting and can use it with math.

Why or why not?	Student #5	More or less. It depends on the topic.
	Student #6	Sometimes. I think it is boring sometimes, but I like it sometimes too.
	Student #7	Yes, I think it is interesting and hands-on.
	Student #8	Yeah, some parts are tedious, other parts are fun.
	Student #9	Yes, because it is more visual and interesting.
	Student #10	Yeah, as much as learning in general. The things I can relate to.
	Student #11	Yeah, it's interactive and I like that.
	Student #12	Yes, because I can use it in my daily life.
	Student #13	Yes. I think it is interesting to learn about functions and complex concepts.
	4. What do you like most about your science classes?	Student #1
Student #2		I like doing labs the most.
Student #3		Lectures. They are more informative and the facts are laid out.
Student #4		I like it when we do activities.
Student #5		Activities. I learn more hands-on.
Student #6		I like labs the most. I really like using microscopes. Being able to see things hands-on makes an impact.
Student #7		I like lectures and the group activities.
Student #8		Group work is my favorite.
Student #9		Labs and lecture. I really like working in groups.
Student #10		I like the demonstrations and examples.
Student #11		Doing group work in labs.
Student #12		Labs are the most fun. I learn better with experience.
Student #13		I like my teachers. They have fun activities to do.
5. Have you enjoyed your science teachers? Why?	Student #1	Yeah, they make learning fun because we do lots of labs.
	Student #2	Yes, they are nice and energetic.
	Student #3	Not really in middle school, but in high school, yes. They seem more knowledgeable and helpful.
	Student #4	Yeah, I like it when they make jokes, it makes it more fun.
	Student #5	Yeah, mostly. They are usually nice and know a lot.
	Student #6	No. Everything is in a slideshow and they are not good about answering questions.
	Student #7	Yes. My teachers have all been very knowledgeable and make science fun.
	Student #8	Yeah, when they make it interesting.
	Student #9	Yes, they have all been very engaging.
	Student #10	Yeah, most of them. I don't like when they yell.
	Student #11	Yeah, I like when they do discussions in class and teach interesting facts.
	Student #12	Some more than others. Some don't make the connection.
	Student #13	Yes, they have all been very helpful.

6. Do you think science is useful? What for?	Student #1	Yeah, especially biology. You can apply it to your everyday life.
	Student #2	Yes, it is important to learn new, interesting things.
	Student #3	Yeah, it is important for understanding our future and stopping problems.
	Student #4	Yes, especially for learning disease and cures.
	Student #5	Yeah, for research and applying it to daily life.
	Student #6	Yes, unlike trigonometry. You can use things like evolution to understand life.
	Student #7	Yes, especially about our past and how it helps us to research and get insight to our future.
	Student #8	Yes, for understanding life and nature, which leads to technical advances.
	Student #9	Yeah, because then we can understand life.
	Student #10	I think it is useful for applying outside of class.
	Student #11	Yeah, it's good to learn the basics and then the detail.
	Student #12	Yes, because there is always something new, we will never know everything.
	Student #13	Yes, for research...but I wish we would learn more detail.
7. What is your favorite science subject or topic? Explain.	Student #1	Biology. I like learning about DNA specifically.
	Student #2	I liked Physics because we did so many labs.
	Student #3	Biology. I liked learning about Genetics and DNA.
	Student #4	Biology and Physics. They are the most interesting.
	Student #5	Biology, because it keeps things living.
	Student #6	Biology. I liked doing the plant labs and learning about photosynthesis.
	Student #7	Physics, because it incorporated math.
	Student #8	Biology. DNA was the most interesting.
	Student #9	Biology and Physics. You learn life information and the way things go together.
	Student #10	Biology. I like learning about the human body.
	Student #11	Biology for right now, but I am curious about chemistry.
	Student #12	Biology. Definitely not physics...too much math. I liked Natural Selection.
	Student #13	Physics, because I like math and it involves math.
8. Is science easy or hard for you? Why?	Student #1	Pretty easy. It's like math – a lot of memorization.
	Student #2	Easy. The concepts come easy to me.
	Student #3	Kind of easy. Lots of facts.
	Student #4	Really easy. I just understand the concepts easily.
	Student #5	Pretty easy. I think I pick up on the information easily.
	Student #6	Biology is easier, because it is about general things.
	Student #7	Easy. I am good at remembering facts.
	Student #8	Very easy. I just get it.
	Student #9	Easy. I understand it and just ask questions if I don't.
	Student #10	Easy, because there is no theory involved, it is logical.

	Student #11	It is easy because I understand it quickly.
	Student #12	Easy. The concepts are simple and straightforward.
	Student #13	Easy. Chemistry is the hardest.
9. What would you change about your science classes?	Student #1	More labs, they are more fun.
	Student #2	More labs, especially in biology.
	Student #3	More demonstrations and lectures.
	Student #4	I don't know. I don't have any ideas.
	Student #5	More hands-on activities. It is easier to learn that way.
	Student #6	Less lecture and more labs.
	Student #7	The time of day for class. Mornings are too hard.
	Student #8	More hands-on stuff.
	Student #9	More labs.
	Student #10	More explanations and checking for understanding.
	Student #11	More detail and hands-on activities.
	Student #12	More partner and group work.
	Student #13	More detail on certain topics.
10. Would you consider pursuing a science-related career? Which one?	Student #1	Maybe something in genetics.
	Student #2	Yes. I want to do marine biology.
	Student #3	I don't know yet. Maybe something with the environment.
	Student #4	Yes. Something in research, like saving habitats.
	Student #5	No, I want to be a film director.
	Student #6	Yeah, I want to be a dental hygienist.
	Student #7	Sure? Psychology I guess.
	Student #8	Yes, bio-engineering.
	Student #9	Definitely. I want to do medicine and research.
	Student #10	Maybe. I wish we had more of an explanation of what options there are in class.
	Student #11	Maybe. I like astronomy.
	Student #12	Probably. Research and psychology.
	Student #13	Yes. I would like physical engineering or biological research and development.

### *Teacher Interviews*

The interviews conducted on the teachers were done at varying times, during lunch breaks, tutorial, or even brief free moments. The teachers who participated varied in gender, subjects taught, and experience. I thought it important to collect information from the teachers as well, in order to understand their point of view of student engagement in science. They were presented with six questions and asked to give brief

answers. Responses to the interview questions are displayed in Table 2 below, where the participants will be identified by using the numbers 1-4.

**Table 2**

*Teacher Interview Responses*

<b>QUESTIONS</b>	<b>TEACHER</b>	<b>RESPONSE</b>
1. Do you think there is a decline in students pursuing education in science? If so, why?	Teacher #1	I don't think there has been a decline in pursuing education in science necessarily, because I think that the enrollment for science related careers has actually increased. However, I think that there has been a decline, in recent years, of students in high school that are not engaged in science as much.
	Teacher #2	Yes, I think there has been a decline because recent generations are becoming dependent on their parents, decreasing their academic drive in order to pursue challenging careers, such as science-related careers.
	Teacher #3	No, I think that because science is such a challenging subject, there will always be those that care to excel in the subject and those that do not care to challenge themselves, or their academic abilities. I see it as remaining pretty even.
	Teacher #4	Yes, I think there has been a decline and then an increase in students enrolling in technological education. That's where the market and the money is.
2. Do you think gender is a	Teacher #1	Not so much anymore. I

factor in students' attitudes toward science? How so?		think that males and females tend to feel the same about science.
	Teacher #2	I think that there are differences in different subjects. I have noticed that males tend to do better in my physics classes.
	Teacher #3	I think that students' attitudes just depend on how well they are understanding the material as well as how engaging the material is. My students really enjoy the labs.
	Teacher #4	I don't think gender has much to do with it. I think that it depends on what a student's peers think; If it's viewed as cool, they have a good attitude about it, and if it is not, then they tend to be pessimistic.
3. Do you feel like you have all the resources you need to teach science effectively? If you feel limited, what is limiting you? (i.e. resources, funding, support, training, etc...)	Teacher #1	Well, resources are always lacking somewhere in each subject. For the science department, we tend to be low on funding.
	Teacher #2	I feel limited by funding and resources. It isn't easy to develop a lot of physics labs that are actually interesting to the students, with such a limited budget.
	Teacher #3	I could always use more resources! My kiddos really love labs, so it would be nice to be able to get more funding for the fun hands-on activities that they really enjoy, and that I think they benefit from.
	Teacher #4	We never have enough money to allow the kids to do the really fun things. I think they would like

		Chemistry more if they had better labs.
4. Do you think that students view science as important and useful? Explain.	Teacher #1	Sure. I think that even if they aren't completely engaged or thrilled to be in class, they would agree that science is still important.
	Teacher #2	Definitely. I think they especially realize this when they learn things that they can apply outside of class.
	Teacher #3	I would say so. I can tell my students enjoy the things that they are learning when they ask questions that are outside the box; when they inquire about details that help them understand real life situations.
	Teacher #4	Sure. They recognize that science has to do with medicine, environment, technology, etc. So, I am sure they realize its usefulness.
5. What do you view as important in science learning? (i.e. hands-on experience, cooperative learning, etc...)	Teacher #1	I believe that it is all important. I think that learning the basics and how the world around us functions and continues to evolve helps students to understand themselves. Hands-on experience appears, to me, to be what really helps students to understand concepts.
	Teacher #2	I think that a little bit of everything is important in science education. It is good to have a mix of everything – lecture, group work, labs, homework, etc.
	Teacher #3	I think the hands-on group work and labs works really well. I notice my students



		understanding the material better when they can experience it firsthand.
	Teacher #4	My kids like the cooperative learning. I think they enjoy learning with their friends rather than listen to me blab all the time.
6. What do you think teachers can change to make science more exciting for students?	Teacher #1	Well, besides the lack of resources, teachers should focus on the individual needs of their students. Everyone learns differently, so it is important for teachers to adjust accordingly.
	Teacher #2	I believe that the lab work is most exciting for students, so I have tried to incorporate more lab work in my instruction, which I have noticed has helped to engage my students more.
	Teacher #3	I think that the hands-on learning helps students relate more to the material, which makes them more interested as well. We can't always do labs, but we can also do more group work which students also find more exciting...in my classes anyway.
	Teacher #4	My classes are exciting! I usually give my students options for learning certain material. I have those that enjoy group work and those that would rather read the text. I think that having that variety available helps students learn in their own way and able to excel by their chosen route.



### *Student Survey*

All twenty seven student participants were given the student survey. Twenty freshman, four sophomores and three juniors participated in the study. Eleven were males and sixteen were females. The surveys were distributed during class time, while the rest of the class was participating in group review for their biology final. The survey includes twenty statements designed to measure students' attitudes toward science. Students were given a response scale, with five choices, from which to respond to the statements, marking with a check or an "X" in the particular box with which they felt was most appropriate to them. The frequency of responses was calculated for each of the twenty statements, shown as a percentage, and can be seen in Table 3 below.

**Table 3**

### *Student Survey Results*

STATEMENT	RESPONSE SCALE #/27				
	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
I enjoy science classes.	1	2	5	14	5
I like to read books or texts about science.	3	5	7	11	1
I do not enjoy hands-on activities.	9	7	4	3	4
I prefer working independently on labs or projects instead of in groups.	6	9	4	4	4
I do not try to learn about science on my own.	5	7	2	10	3
I enjoy watching TV shows that deal with science.	0	3	5	12	7
Learning things in science is easy for me.	1	4	2	9	11
I do not enjoy doing labs in my science classes.	14	6	3	2	2
My teacher keeps me engaged in the science material.	0	3	7	11	6

I think science is useful.	1	0	3	9	14
I do not easily understand topics in science.	8	12	2	3	2
I look forward to going to my science classes.	1	4	6	10	6
I like to ask questions in class.	3	8	7	5	4
I feel overwhelmed in science classes.	12	9	5	1	0
I would or do belong to a science-related club,	8	3	12	2	2
My friends do not like science.	1	4	12	8	2
I am confident in my science abilities.	3	0	5	8	11
I am able to apply my science learning to real world experiences.	2	4	2	12	7
I often talk about science with my friends.	6	12	5	3	1
I would like to pursue a science career.	6	3	12	3	3

## Data Analysis

### *Student Interviews*

The information collected from the student interviews was slightly surprising. I assumed that the students would generally demonstrate a negative feeling about science and that it is not typically something they are interested in. I also expected many of them to say that they would not seek a science-related career. I was incorrect. Specifically, when asked if science was important and if they felt it was useful, almost all of the thirteen interviewees responded yes. The common reasoning was that it was important for understanding life and our surroundings and useful for research and new learning. This means that they are applying what they are learning to their environment outside of their science classes.

The second commonality that can be taken from the interview results is the fact that the majority of the students tend to enjoy the hands-on, group or lab work as a preferred way of learning. Out of the thirteen students interviewed, only two felt strongly about their preference to learn by lecture, or teacher oriented learning. These students noted that they enjoyed lectures more because “it is easier to memorize, because I am a note taker” and “they are more informative and the facts are laid out.” Those that chose labs, group work, or hands-on activities noted how this way of learning helped them to better grasp the concepts by being able to actually view or experience it. This was also seen when asked what they would change about their science classes, as the same students repeated the need for “more hands on activities, it is easier to learn that way” and “more labs, especially in biology.” It is pretty clear that students prefer these methods as a means of keeping them interested and excited about learning.

Last, students revealed that they have typically enjoyed all of their science teachers, one student noting that their teachers have “all been very knowledgeable and make science fun,” as well as an overall enjoyment of learning science in general. Again, with the previous research students have reported not enjoying their science classes, or their teachers, so I was surprised by these results. Only one student made the remark that they did not enjoy their science teachers because “everything is in a slideshow and they are not good about answering questions.” However, the majority of students noted they enjoyed their classes and teachers because “we do lots of labs,” “they make it interesting,” “think it is very interesting and hands-on,” “I can use it in my daily life,” and “they have all been very engaging.” This data collected shows that students demonstrate a positive outlook on their teachers, classes, and science in general.

### *Teacher Interviews*

I wanted to get a good variety of opinions from the science teachers, which is why I selected the four who taught different subjects and had varying lengths of experience teaching, as well as having both males and females. The data collected from the teacher interviews, however, was not surprising to me, as the student interviews were. I expected teachers to mention how a diminishing budget was limiting their abilities to teach the way they felt was most effective. This is exactly what each one of them mentioned or highlighted in their responses. These teachers have already noticed their students enjoy and tend to learn more from lab, group, and hands-on activities, which makes them desire the ability to do more of these things in their classrooms. Unfortunately funding for these methods of teaching have dwindled significantly along with the economic status of Washington State. Thus, without the available funds, teachers are limited on what activities they can do with their students, as a way of learning the material.

The teachers seemed to have varying opinions on whether or not they think there is a decline in students pursuing science education. Two said no, while the other two said yes, each of them having different reasons. One teacher noted “I don’t think there has been a decline in pursuing education in science necessarily, because I think that the enrollment for science related careers has actually increased. However, I think that there has been a decline, in recent years, of students in high school that are not engaged in science as much.” Another teacher blames the increase in technology careers. I would assume that each instructor has particular, personal experiences that are also creating their opinion and would need to be included in their specific examples.

Overall, the teachers seemed to agree that students felt that science was useful and that the cooperative, student-oriented learning were the best methods. They disclosed their feelings that their students appear to understand science is useful for understanding and applying to their daily lives. That the “hands-on experience...really helps students to understand concepts”, and “I notice my students understanding the material better when they can experience it firsthand.” It is clear that teachers concur that current students need to be active in their classrooms to be engaged, funding would help to increase these activities, and that students generally have a positive outlook about science.

#### *Student Survey*

I wanted to give the students a chance to be completely honest with their opinions and feelings about science, so I designed a survey for them to complete. I felt that they may not be as blunt or honest in the interview, and I also wanted to have more data than just what the thirteen student interviewees had provided. With the collection of the twenty seven completed surveys, the results appear to be consistent with what the student interviews also showed. Nineteen students reported that they enjoy science, they are confident in their science abilities, they are able to apply their science learning to real world experiences, and that they enjoy watching TV shows that deal with science. Twenty students checked that learning things in science is easy for them, the topics in science are easy, and that they enjoy doing labs in their science classes. Twenty five of the students agreed that science is useful, fourteen of them strongly agreeing. Overall, students tend to view science in a positive and engaging light in this particular high school.

## **Recommendations**

I certainly could have used more participants and more time to collect data. However, I think that the results from the research I was able to conduct does show a good sample of general attitudes about science in high school. Even though I was able to include students and teachers of different gender, ethnicity, age, experience, and socioeconomic status, it would benefit the research to look at schools in other states, other countries, and more severe socioeconomic statuses. I have a feeling these factors may influence student attitudes and I was not able to take a look at these in this study. As well, to interview students outside the current science classes could also be important. Not being in a current science class may lead to different feelings about past science classes and newer interests.

I would have liked to interview more teachers as well. Four teachers are not quite enough to get a great idea of the thoughts and opinions that are floating around regarding student engagement in science now-a-days. It would be interesting to interview a wider age and experience range. I think that this would definitely yield more varying responses to the interview questions.

It is obvious that there are many factors involved in students' attitudes toward science and how teachers are attempting to keep kids engaged. I do not know that there is one research project that would be able to cover and clearly reveal the best results, but it is imperative that teachers continue to strive to figure out what students need and how they can improve their methods and classrooms.

## **Conclusion**

This research set out to learn what students need to have positive attitudes about science and what teachers are doing to get students excited and engaged in science. Lecture and teacher-based instruction have been the means by which to convey information for learning for many years. However, in recent times, society has shifted and evolved, creating a change in the methods of teaching and learning, especially in science. With the advancement in new discoveries and variety of ways to display these facts and ideas, students have become more interactive with the content and want to experience the science firsthand. Current research clearly shows that students' attention is straying from the lecture learning and craving the hands-on laboratory activities. Being able to see the results, on their own accord; by their own doing, they can grasp the concepts better. If there is a way to increase the science budget in schools, teachers would be able to conduct more labs. The hands-on lab activities keep students engaged, increase their enthusiasm, and appears to be increasing their learning, as well as their attitude about science. It may be these simple steps that will help pave the way for students having positive attitudes toward science, increasing engagement, and even increasing the desire to pursue science related careers.

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## Appendices

### Appendix A

#### **SCIENCE ATTITUDE INTERVIEW**

Student

1. Is science important to you? Why?
2. Do you think boys or girls prefer science more? Why?
3. Do you enjoy learning about science? Why or why not?
4. What do you like most about your science classes?
5. Have you enjoyed your science teachers? Why?

6. Do you think science is useful? What for?

7. What is your favorite science subject or topic? Explain.

8. Is science easy or hard for you? Why?

9. What would you change about your science classes?

10. Would you consider pursuing a science-related career? Which one?

Appendix B

**SCIENCE ATTITUDE INTERVIEW**

Teacher

1. Do you think there is a decline in students pursuing education in science? If so, why?

2. Do you think gender is a factor in students' attitudes toward science? How so?

3. Do you feel like you have all the resources you need to teach science effectively? If you feel limited, what is limiting you? (i.e. resources, funding, support, training, etc...)

4. Do you think that students view science as important and useful? Explain.

5. What do you view as important in science learning? (i.e. hands-on experience, cooperative learning, etc...)

6. What do you think teachers can change to make science more exciting for students?

Appendix C

**SCIENCE STUDENT SURVEY**

GRADE:    ___ 9    ___ 10    ___ 11    ___ 12
GENDER:    MALE ___                  FEMALE ___
CLASS:

Please select the most appropriate response to each statement below:

STATEMENT	RESPONSE SCALE				
	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
I enjoy science classes.					
I like to read books or texts about science.					
I do not enjoy hands-on activities.					
I prefer working independently on labs or projects instead of in groups.					
I do not try to learn about science on my own.					
I enjoy watching TV shows that deal with science.					
Learning things in science is easy for me.					
I do not enjoy doing labs in my science classes.					
My teacher keeps me engaged in the science material.					
I think science is useful.					
I do not easily understand topics in science.					
I look forward to going to my science classes.					
I like to ask questions in class.					
I feel overwhelmed in science classes.					
I would or do belong to a science-related club.					

My friends do not like science.					
I am confident in my science abilities.					
I am able to apply my science learning to real world experiences.					
I often talk about science with my friends.					
I would like to pursue a science career.					