

Factors Which Determine Interest or Fear in Physics

A project submitted in partial fulfillment of the requirements
for the degree of Bachelor of Science with a concentration in
Physics from the College of William and Mary

By

John Laurence Mallory

Williamsburg, Virginia
May 2004

Table of contents

Abstract	Page 2
Introduction	Page 2
Methods	Page 4
Results	Page 6
Conclusion	Page 12
Appendix 1	Page 14
Appendix 2	Page 15
Appendix 3	Page 16

Abstract:

The purpose of this study is to identify specific factors-which either generate or perpetuate preconceived notions about physics. Through the use of surveys, 191 students identified their intrinsic response to physics and the factors which influenced their respective responses. The students who took part in the survey cited many different reasons for their interest in physics or their dislike of physics. The largest factor to encourage interest in physics was due to the influence of teachers and professors. However, the largest cause of an irrational dislike or fear of physics was induced by fellow classmates who would discuss the high level of difficulty involved with the subject matter. By possibly addressing these negative influences, more students could be given the chance to develop a genuine interest in physics.

Introduction:

We live in a world that is increasingly dependent on physics and fueled by breakthroughs in physics research. Technology continually advances, we are beginning to answer questions about the beginning and end of the universe, and we are discovering amazing things about the interaction of subatomic particles. Unfortunately, less and less students are studying physics, which is causing the general public to mitigate their understanding about scientific concepts. According to a 1984 study by the National Center for Education Statistics, only 3.9% of American ninth grade students will continue their education to get a bachelor degree in science, only .5% will go on to get a master degree, and only .2% will receive a Doctorate in a science-related discipline. How can we build taller buildings, create faster computers, or discover more accurate descriptions of the physical world around us if no one tries to familiarize themselves with science?

If we want a world with more advances in physics, we are going to need a world with more physicists to advance it. If we are going to encourage more students to study physics, we need to identify the influential factors which cause students to be either interested or disinterested in this discipline. According to a 1992 studyⁱ, students form opinions about physics in the early years of secondary school, and those beliefs become less favorable as students get older.

One reason that so many people have such a lack of familiarity with physics is the fact that very few people ever actually take a physics course. In the 1985-1986 school year, over 7000 (approximately 18%) of the high schools in the United States didn't offer a single physics course. Students simply decide not to enroll in physics classes and high schools are unable to offer courses that students will not take.

Another possibility for the small number of students enrolling in physics classes is the means by which most high schools arrange their science program. Many high schools have physics as the last level of science courses offered. Students who wish to take physics would usually have to wait until their senior year of high school. Many students would decide not to take physics in place of a less difficult elective and would simply not be in science long enough to take a physics course. This could also cause students to regard physics as the "most difficult science" since it requires so many other science courses before it. This negative perception of physics could be in place before the student even has a chance to decide whether or not he or she wants to take a physics course.

Another study from 2000 suggested that part of the problem lies with the nature of physicsⁱⁱ. Most other high school science courses rely on a large amount of memorization. Physics on the other hand deals more with quantitative skills and connections or relationships

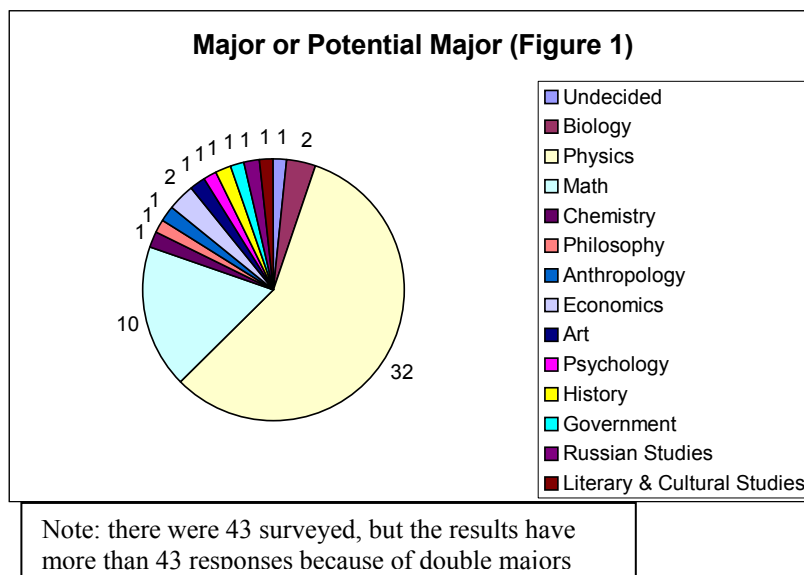
between concepts. Students who have done well in other science courses could possibly go into a physics course with same mentality that was previously successful. Those students could then become frustrated because the “methods” that worked for biology or chemistry do not work for physics.

Finally, many students do not take a physics course because they are admittedly worried about struggling with the class or even failing the class because of the extreme level of difficulty that they associate with physics. Why do they associate such a level of difficulty with a discipline that they may have never even studied? If the causes of such irrational fears can be identified and eliminated, more students will take the chance to enroll in a physics course.

Methods:

For the first part of the study, a survey with 5 open ended questions (see appendix 1) was given to 43 college students who were enrolled in a class that focuses on 20th century

developments in physics, called “Modern Physics.” Even though the class is required for students who wish to major in physics, many students in the class were not concentrating solely in physics. (See Figure 1)



This initial survey was meant to discover possible influential factors that cause interest or disinterest in physics among students who were voluntarily enrolled in a medium-level physics

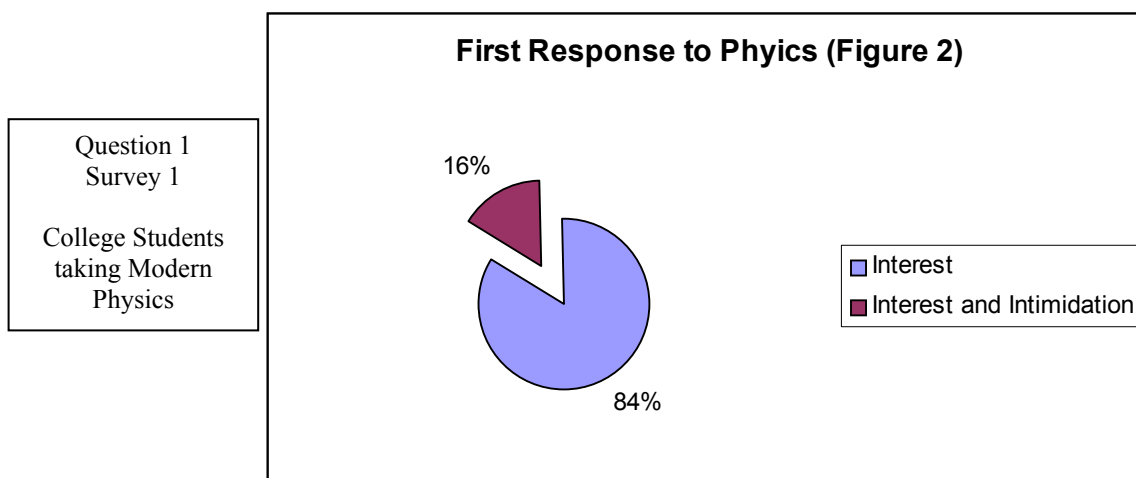
course. This type of student would most likely give honest sincere responses since they were being questioned about something in which they were interested.

After analyzing the data from the initial survey, a new survey was created. (See appendix 2) This survey consisted of different choices, which could be ranked. Each choice was based on the results of the initial survey, and this second survey was then given to 2 different groups of students. One group consisted of 50 college students who were enrolled in an introductory physics course that is required for other non-physics science majors. (A course that is required for biology majors, pre-medical students, etc). Another group consisted of 51 college students who were enrolled in a physics class called “Practical Physics”, which discusses the physical concepts that can be witnessed every day. This practical physics class was designed to give non-physics students an appreciation and understanding for underlying physical laws of nature, with a minimal amount of mathematics.

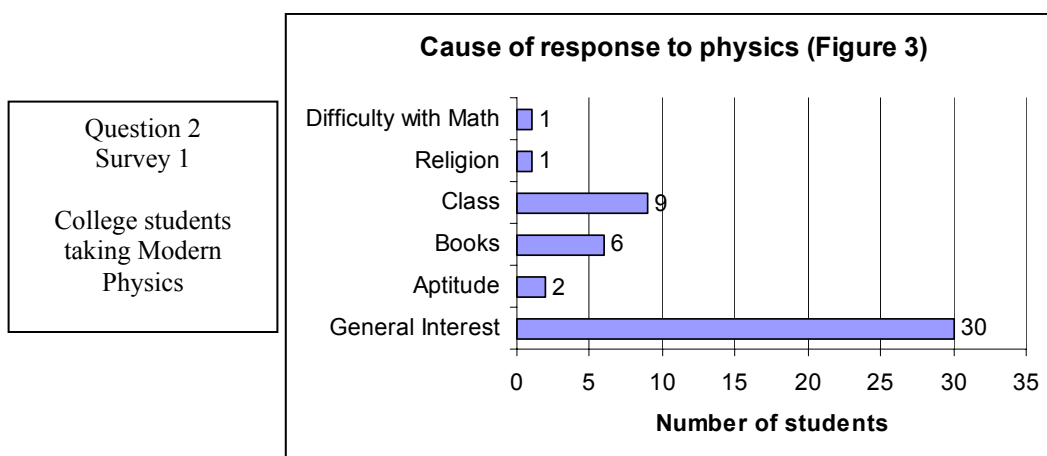
A slightly altered version of the survey was also given to two groups of high school students. (See appendix 3) First was an upper-level biology class consisting of older students (juniors and seniors). Only some of the students had actually taken physics, but all of them were familiar with the basic discipline of physics. Second, was a younger biology class consisting of high school sophomores. None of these students had ever taken physics, and many of them didn't even know what the word “physics” actually meant. The surveys were then collected and the data was analyzed.

Results:

Given the nature of the students who took the initial survey it was not surprising to find that the majority of their first reactions to physics indicated some large level of interest. However, some of the modern physics students admitted that their interest in physics was accompanied by some fear or intimidation for the difficulty of the concepts or the necessary math. (See Figure 2)

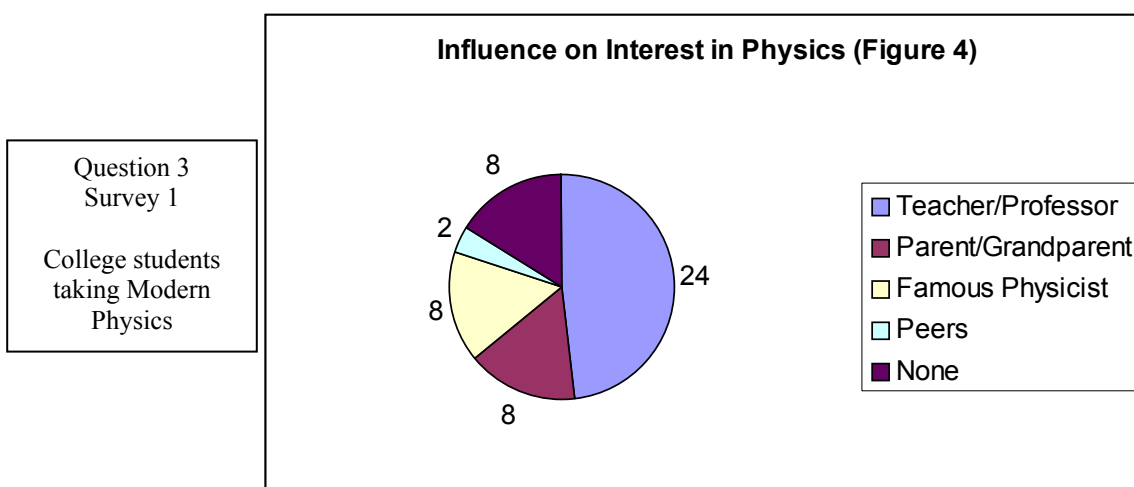


When the students were asked about the cause of their previous response, the majority of students said it was because of a general innate interest in physics. (See figure 3) Many students said that their interest in physics had been provoked by physics classes they had taken or



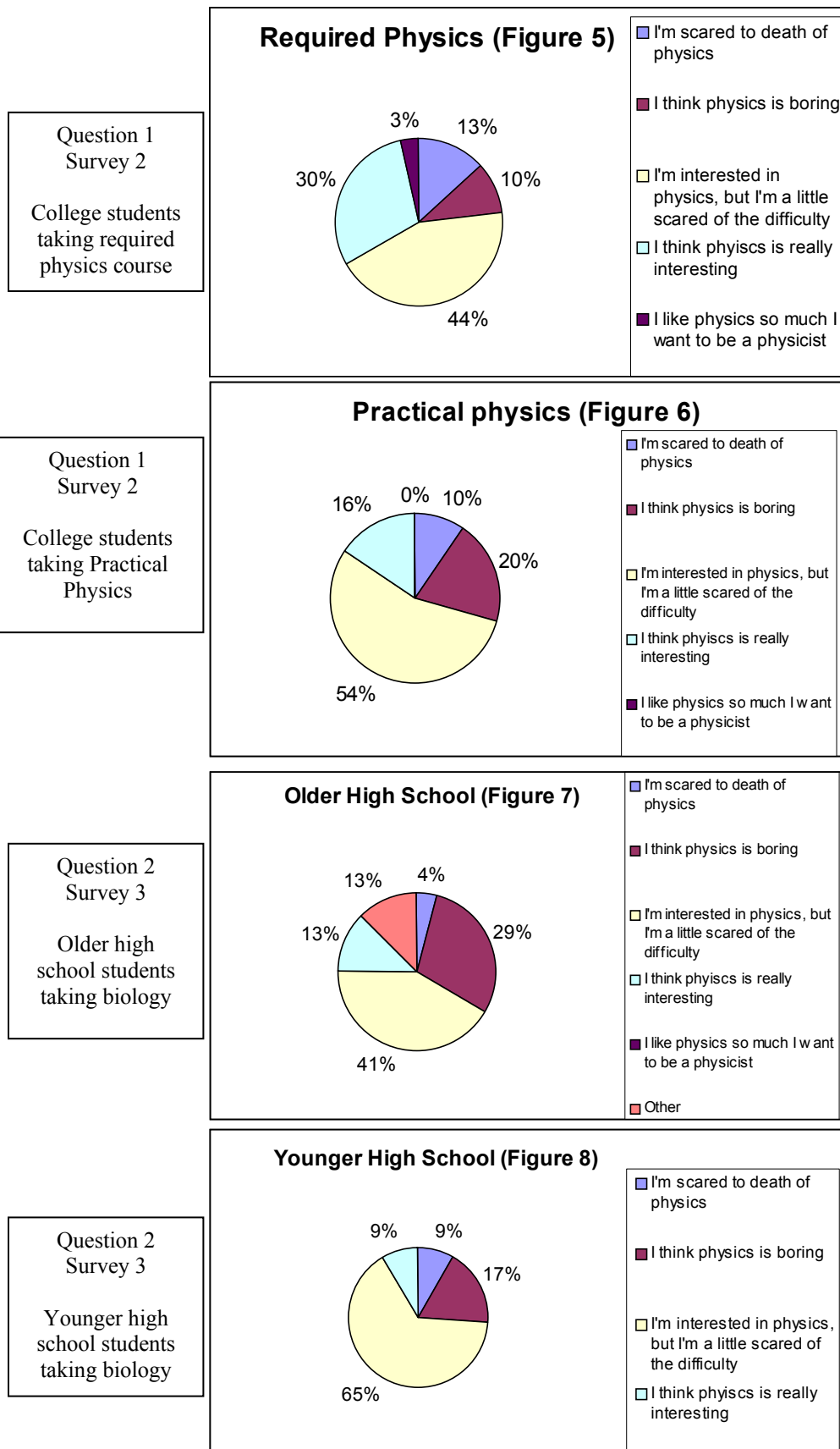
books they had read. Interestingly, one student enjoyed physics only because he found that it agreed with his Atheistic beliefs.

The initial survey found that the largest influence on a student's interest in physics was a specific physics teacher or physics professor. Students were equally influenced by family members, by the work of famous physicists, or by no particular reason. Interestingly, the smallest influence in a student's interest towards physics came from the student's peers. (See Figure 4)



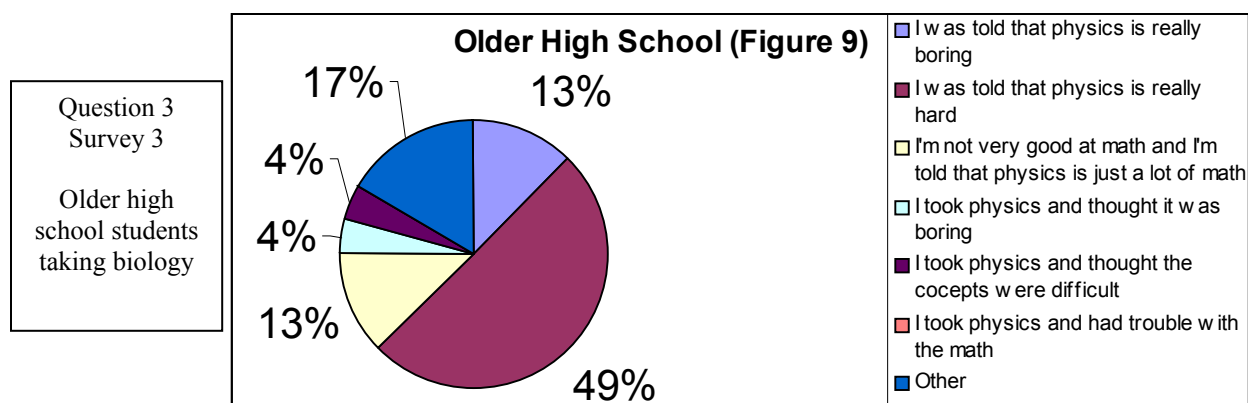
Every student indicated that they were enrolled in Modern Physics because of their interest in the material. Many of the students who intended on majoring in physics also stated that another reason for taking the class was because the class is required for a physics major.

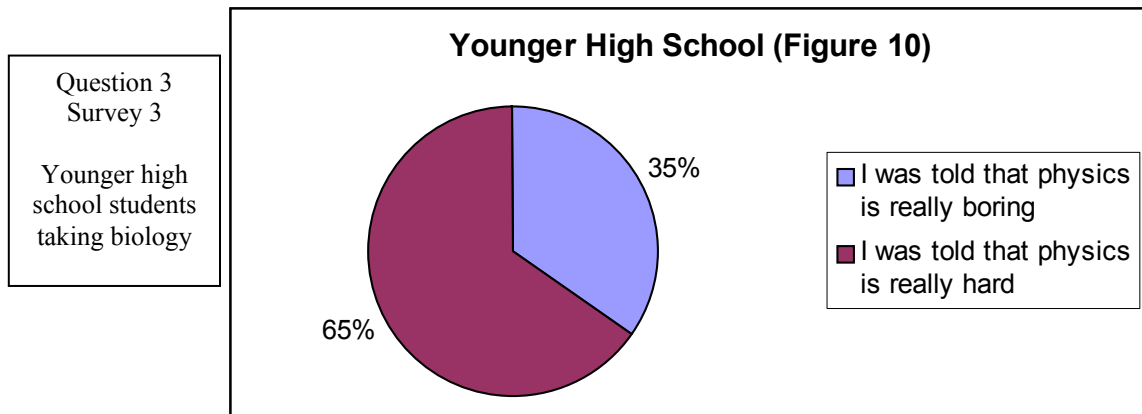
When the other 4 subsequent groups of students were surveyed, different factors that contribute to negative preconceived notions about physics became more apparent. In all 4 groups the largest percentage of students indicated that they were interested in physics, but intimidated or scared by the level of difficulty. (See figures 5-8)



Even though both the college students and the high school students shared a reserved interest in physics because of the perceived difficulty, they acquired this opinion because of different circumstances. The two groups of college students indicated that they perceived physics as a hard subject because they had actually enrolled in physics courses and had struggled with the material. Since this project intended to concentrate on the contributing factors of preconceived interest or disinterest in physics, the reactions of the surveyed high school students became the primary focus.

The majority of the high school students who had been surveyed had never taken a class on physics which means that very few of them had actually tested their preconceived difficulty in the subject. The high school students gave a variety of other reasons for their dislike of physics including a general dislike for science, having been told that physics is boring, a dislike for the only physics teacher in the school, and bad math skills. However, most students simply would not give physics a chance because they were told that physics is difficult. (see figures 9 and 10)

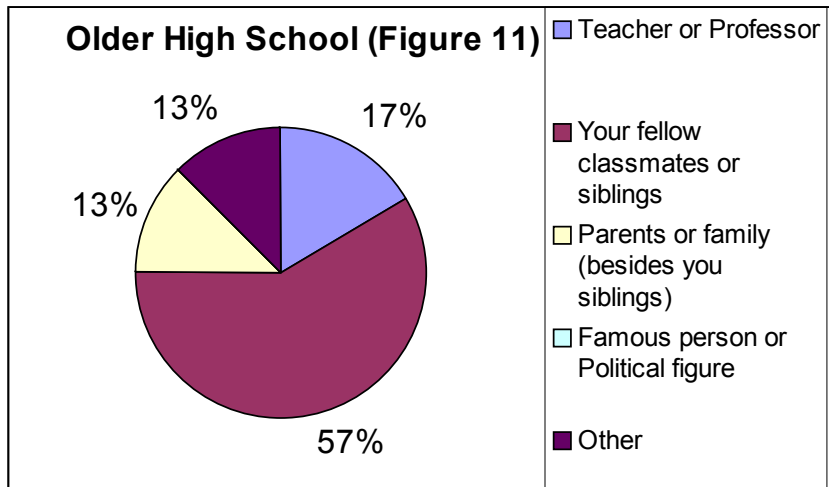




If students are being told about the high level of difficulty in physics, what is the source of all these negative comments? As it turns out, the vast majority of these students were told that physics is hard by their fellow classmates, siblings, and other members of their peer group. Some students indicated that their parents had dissuaded them from studying physics, some students were discouraged from taking physics classes due to physics teachers who had been described as “wretched”, and a few students cited other causes like the course guide which is supposed to help them select classes. However, the overwhelming influence on a negative opinion towards physics was the discouraging remarks from other members of a young person’s peer age group. (See figures 11 and 12)

Question 4
Survey 3

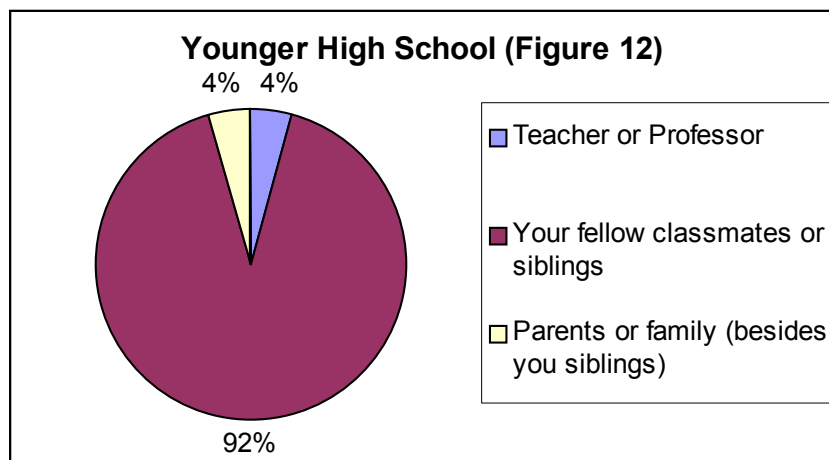
Older high school students taking biology



11

Question 4
Survey 3

Younger high school students taking biology



All four subsequent groups (college students taking the required physics course, college students taking the practical physics course, older high school students, and younger high school students) cited their teachers or professors as the overwhelming influence on any positive opinions that they had towards physics. This data in regards to most significant positive influence on physics agreed with the results from the preliminary surveys conducted on the students enrolled in the modern physics course.

Conclusion:

The first phase of this research intended to identify what factors positively influenced students who showed an interest in physics. It was initially discovered that teachers and professors have the single largest influence on students who show an interest in physics. Family members and famous physicists also had a strong amount of influence, but a student's peers had very little influence on that student's positive interest in physics. In the second phase of this project, it was discovered that student's peers had the most significant influence on a student's disinterest or dislike of physics. It was discovered that friends, classmates, and siblings would describe physics as overly difficult. Each group that was surveyed (college students taking physics because it's required for another science major, college students taking a concept based physics course which avoids lots of math, older high school students who had some familiarity with physics, and younger high school students who were completely unfamiliar with physics) indicated that members of their peer group had the most significant influence in disinterest in physics. This predisposed level of difficulty is what causes so many people to turn away from physics before they have even had the opportunity to enroll in a physics class. If we can find ways to dispel the rumors about how physics classes are excessively challenging, we'll give more people the chance to become more familiar with the world of physics and everything it can offer.

Every group that was studied identified teachers and professors as the largest source of positive encouragement toward physics. The only way to increase the amount of scientific literacy in our society is through the hard work of educators.

ⁱ Crawley, Frank E. "Causal Modeling of Secondary Science Students' Intentions to Enroll in Physics." Journal of Research in Science Teaching 29.6 (1992): 585-599

ⁱⁱ Williams, Karen. "Understanding, Communication Anxiety, and Gender in Physics: Taking the Fear Out of Physics Learning." Journal of College Science Teaching 30.4 (2000): 232-237

(Appendix 1)

Factors Which Determine Interest in Physics Questionnaire
John Mallory Senior Thesis

Name (Optional) _____

Gender _____

Age _____

Academic Year _____

Major or potential major _____

1. When you hear the word “physics”, how do you respond? (Interest, fear, etc.....)

2. Why do you feel this way? (Class you took, general interest, etc.....)

3. Did any person or group of people (teacher, fellow students, famous scientist, etc.....) influence how you feel about physics and if so how did they influence you? (Inspired by famous achievements, complained about difficulty, etc.....)

4. Did taking your first formal physics class change any of your perceptions of physics in a positive or negative way? If so, please mention the class and how it affected you.

5. Why are you taking this physics class? (Don't worry, Professor Reilly won't read this)

(Appendix 2)

Name(Optional) _____ Gender _____
 Academic Year _____ Major or potential major _____

Thank you for taking the time to answer this questionnaire. Please look at each question and rank your responses. (1 for the response that best describes you, 2 for the second closest response, etc)

- 1) When you hear the word “physics”, how do you respond?
 ___ a) I’m scared to death of physics.
 ___ b) I think physics is boring.
 ___ c) I’m interested in physics but I’m a little scared of the difficulty.
 ___ d) I think physics is really interesting.
 ___ e) I like physics so much, I want to be a physicist
 ___ f) Other _____
- 2) If you are scared of physics or dislike physics at all, why do you feel this way?
 ___ a) I was told that physics is really boring
 ___ b) I was told that physics is really hard
 ___ c) I’m not very good at math and I’m told that physics is just a lot of math.
 ___ d) I took physics and thought it was boring.
 ___ e) I took physics and thought the concepts were difficult
 ___ f) I took physics and had trouble with the math
 ___ g) Other _____
- 3) Who influenced this negative opinion in physics?
 ___ a) Teacher or Professor
 ___ b) Your fellow classmates or siblings
 ___ c) Parents or other family (besides your siblings)
 ___ d) Famous person or political figure (Names? _____)
 ___ e) Other _____
- 4) If you have a positive opinion toward physics at all, why do you feel this way?
 ___ a) I’ve enjoyed the physics classes I’ve taken
 ___ b) I’ve enjoyed participating in organized activities like science fairs
 ___ c) I currently have or used to have a science hobby (ex. Model rocketry)
 ___ d) I really enjoyed a book I read on physics (if so, which book? _____)
 ___ e) I’ve been inspired by trips to science museums or research facilities
 ___ f) Other _____
- 5) Who inspired this positive feeling in physics?
 ___ a) Teacher or Professor
 ___ b) Your fellow classmates or siblings
 ___ c) Parents or other family (besides your siblings)
 ___ d) Famous person or scientist (Names? _____)
 ___ e) Other _____
- 6) Did taking your first actual physics class change any of your perceptions about physics?
 ___ a) I had a negative opinion of physics before and after I took a physics class
 ___ b) I had a negative opinion of physics until I took a physics class
 ___ c) I had a positive opinion of physics until I took a physics class
 ___ d) I had a positive opinion of physics before and after I took a physics class

____ e) Other _____

(Appendix 3)

Name (Optional) _____ Gender _____

Age _____ Academic Year _____

Once in college, in what subjects do you want to major? _____

1) Have you ever taken a physics class?

Yes _____ No _____

Please look at each question and rank your responses. (1 for the response that best describes you, 2 for the second closest response, etc) If a response does not apply to you at all, just leave it blank.

2) When you hear the word “physics”, how do you respond?

- ____ a) I’m scared to death of physics.
 ____ b) I think physics is boring.
 ____ c) I’m interested in physics but I’m a little scared of the difficulty.
 ____ d) I think physics is really interesting.
 ____ e) I like physics so much, I want to be a physicist
 ____ f) Other _____

3) If you are scared of physics or dislike physics at all, why do you feel this way?

- ____ a) I was told that physics is really boring
 ____ b) I was told that physics is really hard
 ____ c) I’m not very good at math and I’m told that physics is just a lot of math.
 ____ d) I took physics and thought it was boring.
 ____ e) I took physics and thought the concepts were difficult
 ____ f) I took physics and had trouble with the math
 ____ g) Other _____

4) Who influenced this negative opinion in physics?

- ____ a) Teacher or Professor
 ____ b) Your fellow classmates or siblings
 ____ c) Parents or other family (besides your siblings)
 ____ d) Famous person or political figure (Names? _____)
 ____ e) Other _____

5) If you have a positive opinion toward physics at all, why do you feel this way?

- ____ a) I’ve enjoyed the physics classes I’ve taken
 ____ b) I’ve enjoyed participating in organized activities like science fairs
 ____ c) I currently have or used to have a science hobby (ex. Model rocketry)
 ____ d) I really enjoyed a book I read on physics (if so, which book? _____)
 ____ e) I’ve been inspired by trips to science museums or research facilities
 ____ f) Other _____

6) Who inspired this positive feeling in physics?

- ____ a) Teacher
 ____ b) Your fellow classmates or siblings
 ____ c) Parents or other family (besides your siblings)
 ____ d) Famous person or scientist (Names? _____)
 ____ e) Other _____