



# Intel STS 2012 Application

Bessinger

Gabriella

Last Name

First Name

10/24/1995

Biochemistry

Date of Birth

Category

Human Subjects: \_\_\_\_\_ Vertebrate Animals: \_\_\_\_\_

Human Tissue: \_\_\_\_\_ Animal Tissue: \_\_\_\_\_

## Project Title:

Heat Shock Protein 72: Effects on Illness and the Immune System

## Student Information

Bessinger	Gabriella	Jane	
Last Name	Full First Name	Full Middle Name	Alternate/Nickname
Adel	GA	USA	31620
City	State	Country	
Gender: Female	U.S. Citizen?: Y	Country of Birth: USA	

## High School Information

High School Name: Homeschool not listed

City: City not listed State: GA Country: USA

Missing/Corrected  
High School Information: ZZZZZZ  
Homeschool  
513 Wilkes Rd  
Adel, GA 31620

## Parent(s)/Guardian(s) Information:

Parent/Guardian Names: Mrs. Holly Bessinger Mr. Wayne Bessinger

## Most Influential Person

Who has been the single most influential person in the development of your scientific career?  
(Please select someone, and only one, with whom you have had personal contact.)

Title: Mrs. First Name: Holly Last Name: Bessinger

City: Adel State: GA Country: USA

What is this person's relationship to you? Mother

In what ways did this person influence you?

I found this science competition and my mother was the one that encouraged me to participate. I've always liked science so I thought it was a great idea. She also helped with gather some of the surveys I passed out.

## Current Coursework

In what classes are you currently enrolled?

Calculus	Research and Statistics	Advanced Writing
Advanced Chemistry w/ lab	Managing Life Issues	English 12

## Student Activities & Interests

What occupation do you hope to pursue?

Medical Doctor

Choice #1

Research Medical Doctor

Choice #2

Have you participated in any of the following?

\_\_\_\_\_ Science fair at your local or regional level

\_\_\_\_\_ Intel International Science and Engineering Fair (Intel ISEF) Finalist

Awards: \_\_\_\_\_

\_\_\_\_\_ Discovery Challenge (DCYSC)/SSP Middle School Program Finalist

\_\_\_\_\_ Science training program or summer institute:

\_\_\_\_\_ Other science competition(s):

## Extracurricular Activities & Interests

Please list the top 5 activities in which you have been involved during your high school career and offer a brief explanation of your involvement including the duration and/or any leadership role (e.g. athletics, Boy Scouts or Girl Scouts, school publications, music, clubs and student government).

Home school Group.

Running.

Babysitting.

Reading.

## Student Activities & Interests, Continued

How have you spent recent summers?

Last summer:

All last summer was spent doing my biochemistry research. This research made up the best summer I've spent in high school. Learning to run a 5k. Also studying calculus.

Two summers ago:

Babysitting for a friend. Studying Advanced Math (Pre-Calculus). Reading all the books I could lay my hands on mostly non-fiction chemistry, biology, biochemistry, mostly science related. Went to nursing camp, where I got CPR certified.

Three summers ago:

N/A

List any paid employment during the school year, with average hours per week.

None

List any volunteer work during the school year, with average hours per week.

None

List hobbies you are pursuing, if any.

Chemistry.

Explain your level of proficiency in foreign languages.

One year of high school Spanish.

## Student Activities & Interests, Continued

What subjects in high school have you liked most? Advanced math, calculus, and chemistry.

What course of study do you plan to pursue in college, graduate or professional school?

Chemistry/Pre-med

What would you like to be doing ten years from now? Why?

Be a practicing research medical doctor. Studying sickness and illness. Treating people.

List special recognitions, awards, honors and scholarships from both school and community, if any. Include national or international honors received during your high school career. Science-specific projects and competitions are addressed on the next page.

Academic (list up to 5):

None

Community (list up to 3):

None

Extracurricular (athletic, music, etc.) (list up to 3):

None

## Individual Projects & All Publications

List any individual research projects (not class projects) to which you have contributed during high school. A project does not need to have been submitted to a competition to be listed. If the project you are submitting to Intel STS has been entered in any other competitions, please list it below as Project 1.

1. 

Start Date	End Date	Supervising scientist/mentors (if any)
Project Title		
Competition/Awards (if any)		
2. 

Start Date	End Date	Supervising scientist/mentors (if any)
Project Title		
Competition/Awards (if any)		
3. 

Start Date	End Date	Supervising scientist/mentors (if any)
Project Title		
Competition/Awards (if any)		
4. 

Start Date	End Date	Supervising scientist/mentors (if any)
Project Title		
Competition/Awards (if any)		
5. 

Start Date	End Date	Supervising scientist/mentors (if any)
Project Title		
Competition/Awards (if any)		

**Publications:** List any scientific publications on which you are an author or co-author. List the name(s) of any coauthor(s). Indicate if a coauthor is a high school student.

## Team Science Projects

Research conducted as part of a student team project is not eligible for Intel STS. This includes any research or portion of research regardless of whether it has or will be submitted for competition or not. Even if you were a primary member of a team or conducted one portion of the research, it must still be considered a part of that team project. Please provide information on any team projects to which you have contributed.

1.	Start Date	End Date	Teammate Name(s)	Mentor Name(s)
Project Title				
Competition/Awards (if any)				
2.	Start Date	End Date	Teammate Name(s)	Mentor Name(s)
Project Title				
Competition/Awards (if any)				
3.	Start Date	End Date	Teammate Name(s)	Mentor Name(s)
Project Title				
Competition/Awards (if any)				
4.	Start Date	End Date	Teammate Name(s)	Mentor Name(s)
Project Title				
Competition/Awards (if any)				
5.	Start Date	End Date	Teammate Name(s)	Mentor Name(s)
Project Title				
Competition/Awards (if any)				

Explain how the research you are submitting with this application is different from these team projects. Be sure to address each aspect of your research—purpose, procedure, data, and conclusions.

## Intel STS Essay Questions

1. **Research Project "Layperson's Summary"** Summarize your project in layperson's terms, while maintaining scientific accuracy. Your explanation should provide easily understandable background, procedures, conclusions and relevance. The summary will aid readers, including evaluators, journalists and the public.

My research is a way to decrease and prevent sickness. This study surveyed 268 participants and found that regular exercise will decrease your chance of getting a cold. The heat shock protein 72 activated by exercise improves your immune response, decreasing the amount of sickness of the average person.

2. What inspired you to conduct this research project?

I'm interested in health and I wanted to invent a new way for an individual to prevent sickness on their own. A friend on my mothers has some serious health issues, but she exercised regularly and her health improved. I saw the connection with sickness, health issues and exercise. Seeing this I had to find the connection.

3. How has doing this research project helped you clarify your interest in science?

The research was really just the tip of the iceberg for me. I've loved science ever since I started high-school. This particular research is my best yet. I put all my time into this project knowing that one day this research will make a difference in someone's life. This research has inspired me to continue with science in college and beyond.

4. What benefits do you think your research will bring to the world? What additional steps, and by whom, might be needed for this benefit to be realized?

I think my research will benefit many individuals. It will take a lot more research and many years, but I believe this will reduce illness among many people.

## Intel STS Essay Questions, Continued

### 5. Your Promise as a Scientist, Mathematician or Engineer

Address through specific and concrete examples what characteristics you have that best demonstrate your affinity and aptitude for being a good scientist. What have you done that illustrates scientific attitude, curiosity, inventiveness, initiative? How does your experience suggest future success as a scientist, mathematician or engineer?

My experience is just that of curiosity and the want for my research to impact many people by preventing illness.



## Intel STS Essay Questions, Continued

### 6. Major Scientific Question of the Future

What is a major scientific question in your field whose answer you believe will have a significant impact on the world in the next 20 years, and why? Using examples from your own experience or research, explain how you might envision addressing the question over the next 20 years.

As I said, I want to make a difference in the medical community with my research. Finding preventative measures to prevent all sorts of illness among many people.

## Science Research Description

**1. Where was your experimentation/research conducted?**

Home, High School

**2. Who supervised the research?** Provide names, titles, and contact information for key people who supported the research. If you have personal ties to any of the key people (e.g. parent, relative, family friend), please indicate the nature of the relationship.

My mother, Holly Bessinger.

Address:

513 Wilkes Rd Adel, Ga 31620

Email: hollybessinger@gmail.com

Phone: 1-229-896-4001

**3. Please check all that apply to your research experience:**

- ☐ Applied to and was accepted into an established research program not connected to my high school
- ☐ Enrolled in a science research class
- ☐ Participated in research at my high school after school or on weekends
- ☐ Family member, friend, or family friend made or helped me make an initial connection that led to my acceptance into a research setting
- ☐ Teacher or school provided contacts or connections to scientists
- ☐ Identified and contacted a scientist independent of any support
- ☐ Read science journals, books, and/or magazines, and performed the research at my home or in the field without mentorship
- ☐ Other:

**4. How did you get the idea for your research?** Explain the development of your research design.

I made the connection of exercise and sickness from a person that had health issues resolved by exercise. From there it was looking up the past research relating to the subject.

**5. What was the duration of the research?** Explain the amount of time you spent on the research project that you have submitted.

Worked on it this summer. It was roughly 4 months of work, several hours a day.

## Science Research Description, Continued

6. If your research was conducted as part of a larger research project or group, explain how your work is independent of this larger laboratory project. If there were other high school students in the group, be specific about how your work was similar to other students vs. your independent work.

7. Please attribute the support you received to each area of the research process and highlight what you can claim as your own, original, unique contribution.

a. Developing/Initiating the purpose of the research

My mother got my in contact with the person that had the health issues. The person had health issues and exercised regularly and shows marked improved health.

I noticed there was a connection between exercise and sickness, resulting in the research.

b. Designing the procedures

I had no way of working at a university or in a lab with a mentor to help with this research. So, I devised a way around that by passing out some surveys to collect some of the research information I needed.

c. Implementing the procedure (including special techniques or the use of special equipment)

I makeup a 28 question survey to collect the data.

d. Gathering/Recording data

I passed out the surveys to regular exercisers and recorded the data to a Google spreadsheet.

## Science Research Description, Continued

e. Analyzing data

I then ran the data through the SPSS student statistical program.

f. Formulating conclusions

I then analyzed the data and the results are recorded in the research paper.

**8. Indicate any other substantive guidance received, as well as any prior research involvement or training that helped you in conducting your own work in this project.**

I read articles written by scientists on the same subject I was researching.

**9. Frequently Intel STS applicants do research that is similar to that of parents, mentors, relatives, friends, or other high school students. This is expected, since science is a cumulative process, each finding built on a previous one. The influence and assistance of those around you may be beyond the individual tasks included in the questions above.**

In order to recognize the independent research of student investigators, we need a clear picture of the evolution of your work and the aspects that are of your own design and execution. We would like to give you the opportunity to reassure the evaluation committee that while the above mentioned influences may exist, the work you have submitted is your own and not that of a parent, mentor, relative, friend, or any other person. Please write a statement in your own words explaining any research or person that has influenced your work outside of the individual tasks in the questions above. Provide as much supporting detail as possible. Failing to disclose similar or related research of which you are aware or failing to mention any person who has either closely or loosely guided you, and their relationship to you and your family, is a violation of your signed statement and would be grounds for disqualification from the Intel STS.

I did all the research myself. My mother encouraged this research. The only outside information was in articles that I read to gather relevant information.

## Human Research

**1. Does your project involve the use of human subjects?** N

(For projects using human subjects to obtain tissue or for data-only studies, please complete questions 2-3.)

Type of IRB: \_\_\_\_\_ Date of IRB Approval: \_\_\_\_\_

**2. Does your project involve the use of human tissue?** \_\_\_\_\_

a. What tissue/organs/parts were used and where were they obtained?

b. My tissue is exempt from IRB Review because it is:

If from an established cell or tissue culture, What tissue(s), organ(s), or part(s), or were used and where were they obtained? Include source and catalogue number.

c. If your project does require IRB approval, please provide the following information:

Type of IRB: \_\_\_\_\_ Date of IRB Approval: \_\_\_\_\_

**3. Does your project involve the use of human data?** Y

☒ I certify that I worked with de-identified data.

a. Explain how your data was obtained.

Passed out surveys to all the participants.

## Non-Human Vertebrate Animal Research

1. Does your project involve live non-human vertebrate animals in a behavioral or observational study? N

☒ I certify that this project involves only non-invasive and non-intrusive behavioral or observational research.

a. List the genus, species, common names of the animal(s) involved in the project:

b. Explain where the study was conducted:

i. Please provide any information on field permits, gaming licenses, or permissions that you or your mentor obtained for this research.

ii. If performed in a Registered Research Institution, please provide the following information:

Institution Name:

Title of study receiving IACUC approval:

IACUC Approval Number: \_\_\_\_\_ Date of IACUC approval: \_\_\_\_\_

c. Please provide a description of how animals were used in this research.

d. Did you have any physical contact with the animals? \_\_\_\_\_

☐ I certify that my only contact with the animal(s) was restricted to supervised handling and husbandry procedures that meet Institutional Animal Care and Use Committee standards at Registered Research institutions and which conform to federal regulations protecting animal well-being and researcher safety.

i. Please explain your interaction with the animals.

ii. Please provide a description of the training you received on working with vertebrate animals and the dates of training(s) (if any).

**2. Does your project involve the use of tissue obtained by a supervising scientist from live non-human vertebrate animals?**   N  

a. Please provide the following information about the supervising scientist's study:

i. Name of Registered Research Institution (and department, if any):

ii. Name, title, and contact information for supervising scientist:

iii. Title of the supervising scientist's study receiving (IACUC) approval:

iv. IACUC approval number: \_\_\_\_\_ v. Date of IACUC approval: \_\_\_\_\_

b. Please provide a brief description of the supervising scientist's study.:

i. List the genus, species, and common name of animal(s) involved in the project.

ii. How is your project related to this study?

iii. Did you have any physical contact with the animals?   N  

- ☐ I certify that my only contact with the animal(s) was restricted to supervised handling and husbandry procedures that meet Institutional Animal Care and Use Committee standards at Registered Research institutions and which conform to federal regulations protecting animal well-being and researcher safety.

Please explain your interaction with the animals.

Please provide a description of the training you received on working with vertebrate animals and the dates of training(s).

**3. Does your project involve non-human vertebrate animal tissue that is exempt from IACUC review?** \_\_\_\_\_

a. List the genus, species, common name and tissue(s) or organ(s) of the animal(s) involved in the project.

b. This tissue is exempt from IACUC review because it is:

Source and catalogue number (if applicable):



## MY SAT ONLINE SCORE REPORT

SAT TEST MAY 07, 2011

Gabriella Bessinger

PAGE 1 OF 10

## NOT AN OFFICIAL SCORE REPORT

## Summary of Results

Congratulations on taking the SAT Reasoning Test!

You're showing colleges that you are serious about getting an education. The SAT is one indicator of how ready you are to handle college-level work. The test measures what you learned in high school and how well you can apply that knowledge. Both skills are essential to doing well in high school and in college.

## CRITICAL READING: 460

## RANGE



When you take tests more than once, your scores may vary. This expected variation is considered your score range.

National Percentile: 35%

	TOTAL QUESTIONS	CORRECT ANSWERS	INCORRECT ANSWERS	OMITTED ANSWERS
--	-----------------	-----------------	-------------------	-----------------

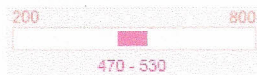
## CRITICAL READING

SENTENCE COMPLETION	19	10	9	0
PASSAGE-BASED READING	48	22	25	1
<b>TOTAL</b>	<b>67</b>	<b>32</b>	<b>34</b>	<b>1</b>

See page 3 for details on your critical reading score.

## MATHEMATICS: 500

## RANGE



When you take tests more than once, your scores may vary. This expected variation is considered your score range.

National Percentile: 45%

	TOTAL QUESTIONS	CORRECT ANSWERS	INCORRECT ANSWERS	OMITTED ANSWERS
--	-----------------	-----------------	-------------------	-----------------

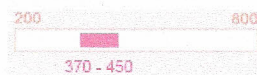
## MATHEMATICS

NUMBERS & OPERATIONS	12	7	5	0
ALGEBRA & FUNCTIONS	20	14	5	1
GEOMETRY & MEASUREMENT	15	6	9	0
DATA ANALYSIS, STATISTICS, & PROBABILITY	7	4	3	0
<b>TOTAL</b>	<b>54</b>	<b>31</b>	<b>22</b>	<b>1</b>

See page 4 for details on your mathematics score.

## WRITING: 410

## RANGE



When you take tests more than once, your scores may vary. This expected variation is considered your score range.

National Percentile: 22%

	TOTAL QUESTIONS	CORRECT ANSWERS	INCORRECT ANSWERS	OMITTED ANSWERS
--	-----------------	-----------------	-------------------	-----------------

## WRITING

IMPROVING SENTENCES	24	12	12	0
IDENTIFYING SENTENCE ERRORS	18	9	9	0
IMPROVING PARAGRAPHS	6	1	5	0
<b>MULTIPLE CHOICE TOTAL</b>	<b>48</b>	<b>22</b>	<b>26</b>	<b>0</b>
<b>ESSAY: 7</b>				

See page 5 for details on your writing score.  
On page 6, view the essay you wrote.

☐ See Glossary of Terms on page 10
A printout of this page will **not** be accepted by colleges as an official score report.



## Heat Shock Protein 72: Effects on Illness and the Immune System

Gabriella Bessinger

## Abstract

Is it possible to lessen the effect or eliminate sickness altogether? Heat shock proteins, when activated and released in the body during exercise, circulate through the body producing a positive immune affect, enhancing immune system function, thus enabling the body more capable of fighting infection. A study was conducted to determine the affects, if any, on one's ability to resist and combat infection. Specifically researched was the effect that Heat Shock Protein 72, a protein released during exercise, has on preventing the occurrence of illnesses from contagious pathogens. Two hundred and sixty-eight people of all ages were surveyed in this study; it was found that over 79.5% of exercisers had a lower sickness rate than the average non-exercising person. The effectiveness of heat shock proteins on the immune system to enhance resistance from infectious agents may prove to be a therapy for many, many things.

**Introduction:**

All around the USA people are concerned about the increasing illness rates among the people. All around us it's heard of in newspapers, websites, TV news and books. Scientists concerned are now researching for new ways to prevent and cure illness. The research done by Chubak et al. (2006) says that adults in the US have approximately 2-4 colds every year. Another source states 2-6 and more if you live or associate with young children (Richardson, 2003). Americans get around 1 billion colds per year (Hales, 2006). Due to the number of colds, the 25 million cold sufferers miss 20 billion days of work and have 22 billion absences at school (Hales, 2006). Decreased immunity is attributed to daily issues such as: lack of sleep and chronic stress promote illness in individuals (Straub, 2006). Less than 30% of individuals get the minimum required exercise associated with good health (Sharkey & Gaskil, 2006). Heat shock protein 72 activated by exercise will show improved immune function effecting illnesses by increasing immunity. Since the lack of exercise is linked to decreased immunity (Bertók & Chow, 2005), heat shock protein 72 released during exercise increases immunity. The paper was built on the research of many scientists researching the solution to this nationwide problem: lack of exercise causing decreased immunity.

In the cells of all living organisms, there is a highly conserved group of proteins called 'heat shock proteins' (Walsh, Koukoulas, Garnham, Moseley, Hargreaves, & Febbraio, 2001). The heat shock proteins were discovered in 1962 by Ferruccio Ritossa when he and his co-workers noticed odd patterns and an unusual gene expression in the polytene chromosomes of salivary glands in *Drosophila melanogaster* larva (Pockley, 2003). Since heat shock proteins are released from stressed cells, it is known that heat shock proteins function as immunological danger signals (Osterloh & Breloer, 2008). The term, heat shock, is inaccurate, since not only a

higher temperature, but oxidative stress exposure, nutritional deficiencies, ultraviolet irradiation, chemicals, ethanol, viral infection and ischaemia-reperfusion injury, causes the expression in these proteins (Pockley, 2003). The proteins are expressed in low concentrations when in the basal state (Walsh, Koukoulas, Garnham, Moseley, Hargreaves, & Febbraio, 2001). Lack of exercise strongly contributes to low concentrations of the proteins in the cells. Stresses such as ischemia, protein degradation, acidosis, free radical formation, increased temperature, hypoxia, increased cytosolic, endotoxemia, and reduced glucose availability, are all known to cause an increase in the heat shock protein count in some cell lines and tissues (Walsh, Koukoulas, Garnham, Moseley, Hargreaves, & Febbraio, 2001). An increase of the heat shock protein count has been known to be caused by exercise (Walsh, Koukoulas, Garnham, Moseley, Hargreaves, & Febbraio, 2001). The inactivated amounts of heat shock proteins in the body from lack of exercise are a cause of low immunity. Heat shock proteins in normal cells are at low levels or are isolated within a cell (Schlesinger, 1990). Exercise increases the locations and levels of heat shock proteins (Schlesinger, 1990), and spreads out the heat shock proteins, increasing the counts activated in the body. There has been speculation as to whether the immune response to these universal proteins allow for immune surveillance, an act of the immune system that completely removes damaged or abnormal cells from the body, not just the immediate protection from infections (Schlesinger, 1990). The immune response by the heat shock proteins helps explain the effects that occur in the immune system during and after exercise. There is evidence that suggests the heat shock protein 72, (or hsp72), is released during exercise (Walsh, Koukoulas, Garnham, Moseley, Hargreaves, & Febbraio, 2001).

(Walsh, Koukoulas, Garnham, Moseley, Hargreaves, & Febbraio, 2001) Stated,

“It is not surprising; therefore, that physical exercise has been demonstrated to increase Hsp72, the inducible form of the 70-kDa family of Hsp, in a variety of tissues in several mammalian species. Specifically, acute exercise up-regulates Hsp72 gene and protein expression in the heart, liver, brain, and skeletal muscle of rodents. In addition, increased gene and protein expression has also been observed in human skeletal system, in response to acute exercise” (p. 386).

Other researchers have demonstrated that heat shock proteins can stimulate cytokine production in immune cells. It has been suggested that heat shock proteins can be released from cells into the extracellular milieu to bind to membranes of other cells. Because exercise has been shown to produce positive, noticeable changes in immune function, an experiment was preformed. A small bit of Hsp72 was found in the serum of 2-6 subjects at rest. After 30-60 minutes of exercise, an increased amount of Hsp72 was detected in all subjects. (Walsh et al, 2001) Walsh et. al. demonstrated that exercise increased the Hsp72 circulation in the blood (p. 392).

Contributing to the immunity in many ways are the ‘white blood cells’ (Hoefnagels, 2012). All white blood cells each fall into one of five major categories of the immune system; neutrophils, eosinophils, basophils, lymphocytes and monocytes (Hoefnagels, 2012). Neutrophils and eosinophils are a sort of scavenger cells that ride around the blood stream and kill bacteria (Hoefnagels, 2012). Basophils trigger inflammation (Hoefnagels, 2012). Lymphocytes consist of three different types of white blood cells (Hoefnagels, 2012). B cells, T cells, and natural killer cells (Hoefnagels, 2012). Natural killer cells will kill infected cancer cells and infects virus cells (Hoefnagels, 2012). Monocytes produce macrophages (Hoefnagels, 2012). Some macrophages migrate though the body and other just settle in various tissues (Hoefnagels, 2012). Macrophages

engulf bacterium cells upon contact, eliminating them (Hoefnagels, 2012). The immune classification main subdivisions are innate defenses and adaptive immunity (Hoefnagels, 2012). Innate defenses are ready to kill any sort of foreign microbes on contact (Hoefnagels, 2012). Adaptive defenses remember previous invasions making the body immune to a second attract (Hoefnagels, 2012). This information is helpful in examining how heat shock proteins *really* affect the immune function.

Scientists have found an increase in the number of circulating white blood cells (leukocytosis) and lymphocytes (lymphocytosis) (Caren, 1991). It is very important that the leukocytes increase, because many of these cells, such as polymorphonuclear leukocytes, phagocytize foreign microbes (Caren, 1991). This is the start of this marvelous study, linking exercise to increased immune system function. This response shows that exercise indeed affects the immune response. Contributing to immunity in several ways are the small white blood cells called lymphocytes. (Caren, 1991). Caren states:

“Lymphocytes contribute to immunity in several ways. There are two main kinds of lymphocytes. B lymphocytes mature into antibody-producing plasma cells, whereas T lymphocytes, which mature in the thymus, mediate cell-mediated immunity. T lymphocytes secrete soluble hormones called lymphokines, which affect the efficiency of other types of cells, such as macrophages. Exercise-induced leukocytosis is usually due to an increase in two types of white blood cells, granulocytes and lymphocytes. Because exercise is good for the circulatory and muscular systems, one could ask whether it also is salutary for the immune system. Is the immune system already performing optimally, or could exercise make it better?”(p.410 )

The experiment performed in this paper was conducted to understand and verify the results of exercise on the immune system, focuses on the effects of heat shock proteins on immunity. Hypothesized is that the release and circulation of the heat shock protein 72, which is caused by regular exercise, plays an important role in fighting off infection.

### **Materials and Methods:**

#### **Subjects:**

268 subjects were used in this test. Only regular exercisers participated in this survey. Each subject was asked a set of questions (see Appendix A). The subjects varied from age 14 to age 83. A common factor among all the participants was that each participant is a member of Weight Watchers, a program designed to help people lose weight through good food choices and exercise. Participants in this study, all being apart of the Weight Watcher program, are strongly encouraged exercise on a regular basis, (30 minutes a day, 5 days a week).

#### **Experimental procedures:**

Google Document spreadsheets were used to create a survey. Researched were: what questions should be on such a survey? What questions should be on this particular survey? How many questions will be needed? All this had to be researched first. Finally, it was settled what questions would be put in the survey. Then each question was carefully written onto a Google spreadsheet. This test, or survey, consisted of 28 questions relating to exercise and health. Each of the first 100 surveys were printed out and administered at various Weight Watcher meetings. They were passed out at the end of each meeting and returned, whereupon the data was entered into the online spreadsheet. The last 169 surveys were administered to other Weight Watcher members online via Goggle Docs, where the data went directly to the spreadsheet. Employed by Weight Watchers, was a key supporter and made it possible to gather the needed information

from each member. A Biology professor also gave me some advice and tips that helped in the project creation.

**Statistical analysis:**

Once the data was collected, it was time for data analysis. The SPSS statistical program was used. Once data was input into the program, relevant information for the project was revealed. Each illustration, chart, or graph was created on the SPSS program. The data gathered was all run through the SPSS program to be analyzed.

**Results:**

The results of the survey were impressive. This survey, completed by 268 people, shows remarkable results that shed some light on the way heat shock proteins affect the immune system positively, providing better health and resulting in minimal colds. The results in illustration 1 show the amount of exercisers in comparison with the amount of exercise each participant performs on a regular basis. The percentage of people that have **not** been sick in the last six months, which was 51.9%, was significantly higher when compared to the 20.5% that got 2-10+ colds in the last six months. The other 27.2% only got sick once during that time. The combined percentage of people with a lower than average sickness rate is 79.5%, according to this study. Pictured in the pie graph (illustration 2) are these results showing the 79.5% of exercisers who were either not sick, or only sick once in the last 6 months. This percentage is much less than the national average. According to these results, people that exercised on a regular basis had less illness, than the average person. Each participant in the survey exercised regular basis. In this study, everyone stated the preferred form of exercise. All these exercises (see illustration 3) seem to have a positive impact on our susceptibility of getting colds. 19% of the exercisers just walked as their regular exercise. 48.6% `walked with a combination of one or more of these



other exercises (home video, running, elliptical, exercise bike, yoga, exercise class, lifting weights).

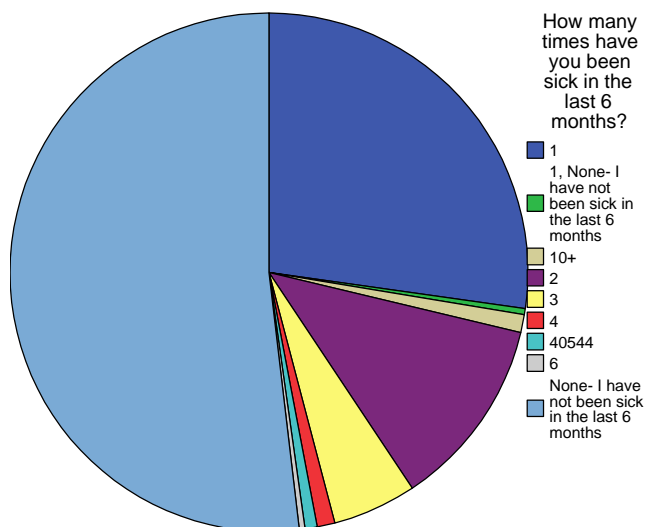
### Illustrations:

#### Illustration 1:

			Describe your daily physical activity in minutes?										Total
			0-15 minutes per day	0-15 minutes per day, 15-30 minutes per day	0-15 minutes per day, 15-30 minutes per day, 30-45 minutes per day	15-30 minutes per day	15-30 minutes per day, 30-45 minutes per day	30-45 minutes per day	30-45 minutes per day, 45-60 minutes per day	45-60 minutes per day	60+ minutes per day	0-15 minutes per day	
How many times have you been sick in the last 6 months?	1	Count	8	0	0	23	1	17	0	18	6	73	
		% of Total	3.0%	.0%	.0%	8.6%	.4%	6.3%	.0%	6.7%	2.2%	27.2%	
	1, None- I have not been sick in the last 6 months	Count	0	0	0	0	0	0	0	0	1	1	
		% of Total	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.4%	.4%	
	10+	Count	1	0	1	0	0	1	0	0	0	3	
		% of Total	.4%	.0%	.4%	.0%	.0%	.4%	.0%	.0%	.0%	1.1%	
	2	Count	7	0	0	8	1	6	0	5	5	32	
		% of Total	2.6%	.0%	.0%	3.0%	.4%	2.2%	.0%	1.9%	1.9%	11.9%	
	3	Count	2	0	0	4	0	5	1	1	1	14	
		% of Total	.7%	.0%	.0%	1.5%	.0%	1.9%	.4%	.4%	.4%	5.2%	
	4	Count	0	0	0	2	0	1	0	0	0	3	
		% of Total	.0%	.0%	.0%	.7%	.0%	.4%	.0%	.0%	.0%	1.1%	
	40544	Count	0	0	0	0	0	1	0	1	0	2	
		% of Total	.0%	.0%	.0%	.0%	.0%	.4%	.0%	.4%	.0%	.7%	
	6	Count	1	0	0	0	0	0	0	0	0	1	
		% of Total	.4%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.4%	
	None- I have not been sick in the last 6 months	Count	21	1	0	41	0	33	0	22	21	139	
		% of Total	7.8%	.4%	.0%	15.3%	.0%	12.3%	.0%	8.2%	7.8%	51.9%	
Total		Count	40	1	1	78	2	64	1	47	34	268	
		% of Total	14.9%	.4%	.4%	29.1%	.7%	23.9%	.4%	17.5%	12.7%	100.0%	

#### Illustration 2:

Pie graph: Exercisers have a very low sickness rate.

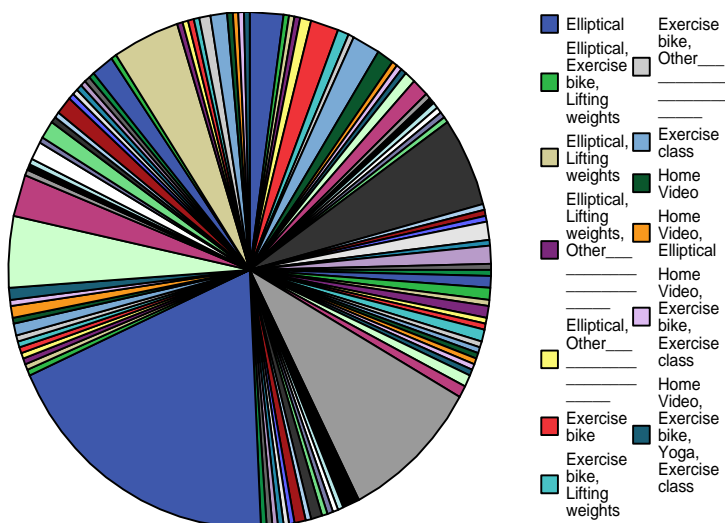


Note to Evaluator from SSP - You may request a color copy of this page from SSP Staff

### Illustration 3:

The many ways the people exercised.

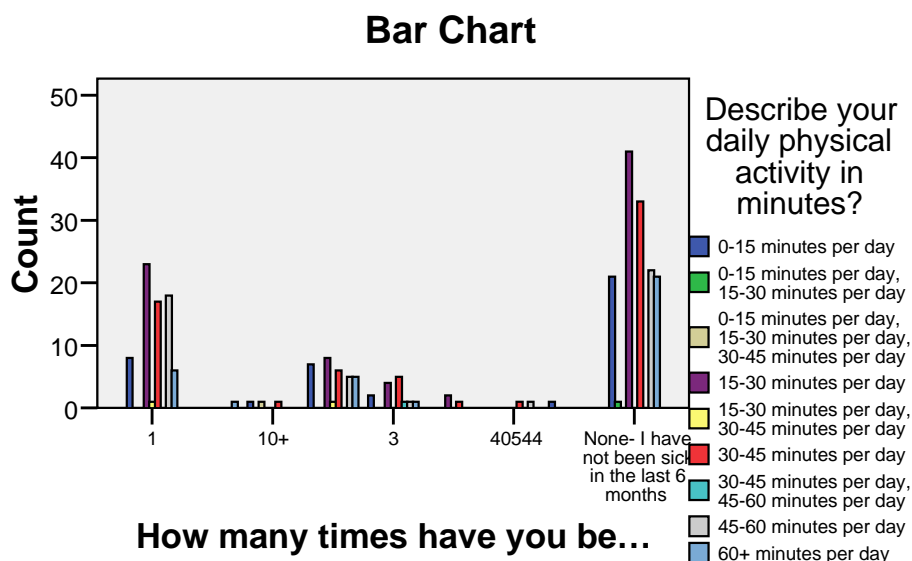
### How do you exercise?



Note to Evaluator from SSP - You may request a color copy of this page from SSP Staff

### Illustration 4:

Significant data from the survey.



Note to Evaluator from SSP - You may request a color copy of this page from SSP Staff

### Discussion:

This study is about heat shock proteins. Pockley (2003) said "Since evidence has emerged that heat shock proteins are present in, and can be released into, the extracellular environment in psychological conditions, and that these molecules can elicit a range of biological activities through interactions with specific cell surface receptors, their psychological function in this context should be reexamined." The research summarized here is yet another piece of evidence suggesting that heat shock proteins interact with our immune systems causing a beneficial immune response. Being investigated now is the capacity of the heat shock proteins of immunity to infectious agents (Pockley, 2003). Important of psychological and immunological process indicate the high degree to which heat shock proteins are very potent molecules (Pockley, 2003). In hopes of understanding how to harness the power of heat shock proteins, the enhanced understanding of the immunoregulatory mechanisms so we will have a way to treat human disease (Pockley, 2003). This study is just another layer of evidence demonstrating how the

human body can take heat shock proteins and turn them into a marvelous new way to treat disease. A high level of understanding of how the body works and how each cell, play an individual role in the immune response, releasing heat shock proteins. Scientists hope to have a complete understanding one day of how heat shock proteins enhance the body's immune function through the prevention and arrest of the illness. Some heat shock proteins have been reported to be the activators of the innate immune system (Tsan & Gao, 2009). This shows that heat shock proteins do indeed have a positive effect on the immune system. This effect is one reason to exercise, to help stay healthy. Also, several heat shock proteins have demonstrated modulate innate immune response (Osterloh & Breloer, 2008). It has been demonstrated in intensive studies of immune function that heat shock proteins immune stimulatory potential (Osterloh & Breloer, 2008). All this to say that there is a lot of evidence that supports the hypothesis, that exercise increases immunity thorough the stimulation of heat shock proteins. Also supporting this hypothesis are the findings that some of the cells and tissues in the body, such as leukocytes, heart, liver, and brain, have, in response to exercise, demonstrated an increase of Hsp72 expression (Walsh, Koukoulas, Garnham, Moseley, Hargreaves, & Febbraio, 2001). Assuming that heat shock proteins play a part in a positive immune response, by helping counteract illness, the increase in heat shock proteins will decrease the amount of illness in exercisers. Exercise (like walking for 30 minutes) each day may often result in leukocytosis, the affects that increase some kinds of lymphocytes (Caren, 1991). There is much evidence here of exercise increasing immune system response. Fewer infections occur in regular exercisers (Caren, 1991). The reduction of colds has been shown as a result of exercising (Chubak, et al., 2006). With all this evidence from other research, and from these results, it seems there is conclusive evidence that when heat shock proteins are stimulated by exercise, they will bring

about a positive and proactive immune system response. Many studies that have been referred to, have very similar findings to the study discussed today. Thus, the evidence that exercise can prevent the illness is legitimate. The people that participated in this study were uniquely different from participants in the discussed studies. This study looked at a group of individuals that have already decided that they will be a part of a group that wants to take charge of weight and health, partly by committing to exercise. That said, the results of this study, show that over 50% of the participants have not been sick in the last six months. Another 25% of have only been sick once in the last six months. That means over 75% of the people in this study have been sick one time or less in the past six months. Most of the people in this study (the rest trying to) regularly exercise from day to day.

### **Conclusions and Future Work:**

This is still inconclusive evidence, as there are many factors that could have played a part in the results shown in this study. The immune system is diverse and complicated. Further research into this subject would be a way to answer some questions, which as yet unanswered. Will the research presented today *really* be able to help the immune system? Will there be a way to have heat shock proteins on hand at hospitals and clinics as a form of treatment?

Further research could bring to light new ways to treat, and more importantly prevent illness. Experiments on the tissue and cells related to heat shock proteins need to be studied in a lab where more conclusive evidence can be found. There are many, many more questions that need to be asked, such as how long did that participants exercise before this study? Will just one day of exercise affect the way our immune systems work, or does it have to be an extended amount of time? Will there be a more positive or negative affect if intensity is increased? How

much exercise is too much? Can different exercise such as walking have a different affect compared to other forms of more strenuous exercise, such as running?

The beauty of science is the questions never end...one question answered gives birth to dozens more...

**Appendix A**

## Survey Questions

1. Male or Female?
2. Age?
3. Weight?
4. What is the most you can manage?
5. Describe you daily activity in minutes?
6. How many times have you been sick in the last 6 months?
7. How many servings of fruits and vegetables do you have each day?
8. How many calories do you consume daily?
9. How often do you sweat from exercising?
10. How sweaty are you after your workout?
11. How often do you work out?
12. Which on the following best describes you activity level at work?
13. How would you describe your workout?
14. Do you experience any soreness of the joints during or after exercise?
15. Do you feel you are at your ideal weight?
16. How would you rate you physical health compared with others you age?
17. How many times per year do you typically visit you doctor or healthcare provider?
18. How often do you eat breakfast in a typical week?
19. How many servings of whole grains do you eat per day?
20. How many servings of legumes do you eat per day?
21. Are you a vegetarian?

- 22. Do you run?
- 23. How do you feel after you have exercised?
- 24. How do you feel after eating fruits and vegetables?
- 25. How many servings of lean meat do you eat per day?
- 26. Where do you exercise?
- 27. How do you exercise?
- 28. When do you exercise?

**The original survey was not included due to size. This is NOT the original survey passed out.**



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