



Design and Conduct a Research Study in the Field of Exercise Physiology

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Grade Level:

High School

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Introduction:

This activity is designed to introduce students to the challenge, freedom, ownership and excitement of research. Instead of doing a prewritten laboratory activity, students will conduct their own research study from question to conclusion. This activity is appropriate for high school physiology, honors physiology and advanced biology classes. Early in the year, I share with my students a quote from Dr. Sue Hopkins with whom I worked this summer who said, "...the part I love about doing research is crunching the data, and finding out if your right. It's just like opening a Christmas present."

While many laboratory activities dictate what relationship will be studied, this activity will challenge students to develop their own question related to exercise and the human body and then design a study that will address their question. It is well established that when the student has ownership of their own learning, they will be much more involved and motivated to learn.

One of the many things that I took from the *Frontiers in Physiology Summer Research* experience was that my ability to contribute to the research relied upon my own grasp of the concepts being studied. I was very motivated to research and learn more about the topic. Another aspect of the research that I immediately noticed was the teamwork that was involved in the actual collection of data in this particular study. Numerous researchers with projects of their own would assist in the data collection with the knowledge that their colleagues would reciprocate. Therefore, this project will be designed such that students will be conducting their own research while at the same time, assisting their classmates in their studies either in the collection of data or acting as a subject.

Finally, the physiology students will have to write a research proposal requesting grant money in order to conduct their research. They will also need approval for research using human subjects. Their paper will outline very specifically the topic of their research, as well as their proposed procedures and expected outcomes- their hypothesis. This paper will be submitted prior to the onset of the student's study and they will only be able to begin when they have received the grant. With the approval of Dr. Sue Hopkins, this paper will be modeled after one such paper entitled "Application for Approval of Investigation Involving Human Subjects- UCSD School Of Medicine." Ideally the teacher should team with a researcher from a nearby research institute to evaluate the grant proposals, which will add to the authenticity of the research process.

The emphasis of the research project will be placed on the process of investigation rather than on the complexity or level of the research topic. In fact students will be encouraged to keep their research topics simple and direct.

Purpose:

To introduce students to the true process of scientific research. Students will design an experiment that investigates one relationship in the field of physiology and exercise.

Objectives:

Students will be able to:

- ask a question, develop a hypothesis, design an experiment to test their hypothesis.
- develop a method for collecting and analyzing data.
- use computers as a means of collecting and analyzing data.
- work in teams as a means of achieving goals.

Preparation:

Students will already be familiar with the cardiovascular system, respiratory system and measurements related to the physiological response to exercise including:

- heart rate (HR)
- blood pressure
- ventilation- (V_e)
- VO_2 max
- V_t – tidal volume
- methods of data analysis including graphing, standard deviation positive correlation and statistical significance
- use of Vernier graphical analysis program

In addition, the students will have completed labs using heart rate monitors, EKG sensors, pH probes and respiration monitors which will allow them to incorporate computer data collection and analysis into their research.

Leading up to the project, numerous examples of possible research topics will be given. For example:

- Testing the claims of the various energy bars that claim to improve performance.
- Studying the relationship between diet and exercise.
- Determining positive correlation between factors such as resting heart rate, blood pressure, vital capacity and performance.
 - Is there a link between reflex speed and running speed?

Safety:

All tests will be noninvasive and will not involve human blood in any way. Safety will be discussed as a class and all procedures must be approved before the onset of research. Students will sign a parent consent form to ensure the students do not participate in any activities that should be avoided due to physical conditions.

Duration:

This project will be introduced in the last six weeks and the students will be given four-five weeks to complete their study. Approximately 20% of the time spent will occur

during class time with the remaining 80% of the work being done out of class. As part of the project, students will do research at the local college and have literature to sight in their research study. Students will be encouraged to get the ideas for their research from the literature. (In a simplified form).

Procedure:

There will be three phases to the research assignment and project:

Phase 1

(1-1 ½ weeks)

Introduction to research project.

- Discussion and examples of possible topics for research (emphasis will be placed on creating a personal research topic). The students will be given multiple examples of possible topics and simplicity of topics will be stressed.
- Important issues of research including ethical reporting of results, single blind and double blind testing will be discussed.
- Ideally the project should include one or more library visits to research possible topics.
- Submitting research proposal. Must include specific outline of procedure (See students pages for format) Students will be reminded that procedures may be simple without penalty. Once again, the emphasis of the lab should be on the process of research not the topic.

Phase 2

(two weeks)

Identify subjects of research (Must have a minimum of five subjects)

Data collection

Phase 3

(one week)

Writing final research paper. This portion will be graded on quality of presentation as well as content.

The final paper will discuss the research question and conclusions with a discussion of possible further investigations (see handout 1).

Assessment:

In place of a final, the students will be turning in a final project with the results of their investigation in publishable format. The final project can be modeled after journal articles from the initial research phase. This paper should site all sources of reference.

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Student Guidelines

Purpose:

Students will be able to:

- conduct a research study based on the knowledge you have gained about the physiology of exercise.
- learn the processes of scientific research including grant writing, data collection, data analysis and summary of data in publishable journal form.

Materials:

Materials will vary depending on research but may include:

- heart rate monitor
- respiration monitor
- sphygmomanometers and stethoscope
- stopwatch
- EKG sensors
- calipers
- access to track, treadmill or steps
- school gym and gym equipment

Procedure:

There will be three phases to your research project:

Phase 1

Week 1

1. Develop a question related to exercise physiology, which can be studied using the available equipment listed in materials above. You may also choose a topic using other appropriate equipment provided by yourself for your study. Examples might include nutrition bars or various sports drinks.
2. Library visit to SDSU or UCSD to collect background information and research that may be useful to your topic (These sources must be cited in your paper.).
3. Write a research proposal requesting a grant for your research study following the guidelines given in *Application for Approval Of Investigation Involving Human Subjects* -attached form #1. Your research proposal will be reviewed by the grant approval committee. You must receive the grant and approval to conduct your research before you begin your study. Revisions may be necessary and will be outlined the committee.

Phase 2

Week 2-3

1. Identify subjects of research (Must have a minimum of five subjects).
2. **Research subjects must sign a consent form** (See –*Consent to Act as a Subject* form #2 attached)

3. Experiment/Data collection (Procedures and length will vary)

Phase 3

Week 4-5

1. Writing final research paper. This portion will be graded on quality of presentation as well as content.
2. Paper will discuss research question and conclusions with discussion of possible further investigations (see *Final Research Paper Guidelines*-attached form #3).

Grading: Total = 200 pts

50 points – Research proposal

50 points – Participation in a classmate's study (as subject or assisting in data collection)

100 points- Final Research Paper- See guidelines

Extra Credit will be given as appropriate for exceptional research topics and/or journal presentations.

Form #1

Application for Approval of Investigation Involving Human Subjects

Directions for writing application for research grant:

Follow the outline below in writing your grant proposal. You have also been given a sample application to help you in organizing your proposal. While each proposal will vary somewhat, try to include each major section in your proposal.

I. Introduction:

This section of your proposal should summarize the topic you intend to research. You might also discuss background information from which you are basing your research topic.

II. Purpose:

This section should discuss the goals of your research as well as why you feel it is beneficial to study this topic.

In this section you should include your hypothesis (what you expect the outcome will be). Be sure to support your hypothesis with clear reasoning for your expectations. This may include citing previous outcomes in a similar study or it may be a logical guess.

III. Materials

Include all necessary material. Be sure to include computers and related monitor (if being used).

Facilities

You should also describe the facilities where your research will take place (the school gym, physiology classroom, the school track)

Duration

Give the expected duration of your study.

IV. Research Design and Methods

In this section of your application, you should describe in detail the methods you will use to collect data. In other words, in this section you will write a procedure describing the conditions in which you will collect your data. Procedures may not include invasive procedures (causing harm to tissue), drawing of blood or potentially harmful conditions such as hypoxia (decreased atmospheric oxygen levels).

Once your procedures have been approved you must follow this procedure. If you wish to modify your procedure in any way, it must be cleared by the research supervisor (classroom teacher).

Your procedure should be written in such a way that a classmate would be able to conduct your experiment without any help from you. Be sure to make them clear and specific!

- Describe the subjects of your study.
- Describe potential risks to subjects- include reference to the informed consent forms (These will be mock forms. The advisory committee will ensure that there is insignificant risk. The risk to subjects will be no greater than that which is assumed as part of a PE class.)

VII. Request for Funding

In this section you may determine the appropriate grant that will cover expenses for the duration of the project, including equipment, payment to subjects, and your own salary.

Form # 2

**Consent to Act as a Human Subject
(sample)**

Name _____ Date _____

_____ and his/her colleagues are conducting a research study to give the scientific world a better understanding of _____.

The study will take about _____ hours in all, spread over approximately two weeks.

Participation in research is entirely voluntary. You may refuse to take part or withdraw at any time without jeopardy to any benefit which you are entitled to.

There will no direct benefit to you from participating in this study. The new knowledge gained, however, may be helpful to others in the future. A profile of your exercise capabilities will be given to you upon request.

Researchers records will be kept confidential.

_____ has explained this study to you and answered your questions. You have been given a copy of this consent document to keep and a copy of your consent will be kept on file.

You agree to participate.

Subject's signature _____

Age of subject _____ Date _____

Parent's signature _____ Date _____

(necessary only if subject is under 18 years of age)

Witness _____ Date _____

Guidelines for Final Research Investigation Write Up

The following is the format that should be followed in you research journal write up. You can also refer to the *Journal of Physiology*, which can be found at any college library, for samples of published research journals. Use these samples only for format and not as examples of the required length or complexity. There is no required length of this paper. The length should be sufficient to cover all relevant information.

Title

- | | |
|------------------------|---|
| I. Introduction | Copy from <i>Application for Funding</i> paper. |
| II. Methods | Copy from <i>Application for Funding</i> paper. |
| III. Results | Results should be presented clearly. Use data tables and graphs where appropriate. |
| IV. Discussion | This section is the conclusion section of your research. Be sure to clearly summarize your research results. You should also discuss whether or not your hypothesis was correct. |
| V. Follow Up | From the research you have done, write one to two paragraphs discussing possibilities for further research or testing either to confirm your positive results or test a revised hypothesis based on negative results. |
| VI. References | Site all references used in your research project. |