Your Technique

Before learning how to design your study, it's important to have a brief introduction into behavioral and social science. The Behavioral Sciences include studies of learning, memory, perception, development, or linguistics using human or animal participants, including the effects of chemical or physical stress on these processes. Studies may focus on either normal or abnormal behavior. Social Science projects include experiments or surveys of attitudes, behaviors, or values of groups within a society, and/or the influences of a group on behavior, attitudes, and/or opinions. Projects in this area sometimes involve anthropology, archaeology, and sociology. Sociology is the scientific study of social interactions, at scales both small and large. Sociologists ask big questions, such as "How are societies maintained?" and "How do societies change?" If you're interested in the how's and why's of human behavior in groups, this section can help you get started.

Experimental Procedure

Collecting Data

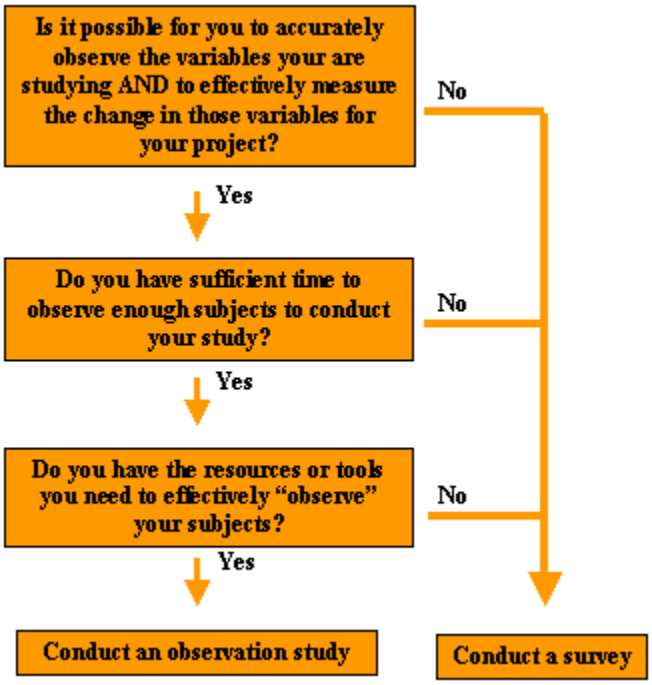
Most experiments designed to study sociology or human behavior require data collection from human subjects. This data can be collected either through **observation** studies or **questioning** the subjects directly. An observation study is one where the researcher simply "observes" the subjects, and has little or no interaction with the subjects while gathering the data. The questioning method of data collection involves direct interaction between the researcher and the subjects, through the use of interviews or surveys. There are pros and cons to each approach:

	Observation	Questioning
Pros	• Generally most effective means for studying young children who are unable to respond to questions • More convenient and less intrusive for subject • Captures an individual's genuine reactions	• Valuable for collecting information on unobservable variables such as feelings, motives, perceptions, attitudes, etc... • Usually less time consuming method for capturing sufficient data
Cons	• Limited to collecting data about visible characteristics or behavior • More time consuming to capture sufficient data for conclusions	• The questions, or the mere fact of being questioned, may influence a subject's responses.

Note: There are special considerations when designing an experiment involving human subjects. An Informed Consent Form is often required for every participant who is questioned or observed. In all cases, the experimental design must be approved prior to the commencement of experiments or surveys. Please refer to the ISEF rules for additional important requirements for studies involving human subjects: http://www.sciserv.org/isef/document/. You may find examples of the forms required for conducting experiments that involve human subjects in the appendix of this notebook.

Your Technique

If you are uncertain which technique is best for your project here is a quick guide to help you decide:



Your Assignment

To help ensure that you have chosen the best technique for your YSP project, please complete the "Which Technique Works Best for Your Project?" worksheet. **Please return to the YSP Coordinator by Friday, June 8, 2007**.

Which Technique is Best for Your Project?

Due Friday, June 8, 2007

Name: _____

1. Can you accurately observe the variables you are studying? What or who are the variables? (For more information on variables, see the section entitled "Variables".)

_____

_____

_____

2. Can you measure changes to the important variables using a number that represents a quantity such as a count, length, width, weight, voltage, time, etc.? Or, just as good, is your variable one that is simply present or not present? For example,

   - Lights ON in one trial, then lights OFF in another trial,
   - USE fertilizer in one trial, then DON'T USE fertilizer in another trail.

   How will you measure them?

_____

_____

_____

3. Do you have sufficient time to observe enough subjects to conduct your study? How much time do you think you will need? Explain.

_____

_____

_____

4. What resources or tools will you use or need to effectively observe your subjects? Describe how each resource/tool will assist you.

_____

_____

_____

5. Based on your answers to the above questions, which technique works best for you: Observation Study or Survey? (Circle one)

Sample Projects

Which Hand Is More Sensitive?

Sample Behavioral Science Project

Objectives / Goals

My project was to determine whether the sensitivity of a hand has any relation to whether it is the dominant hand.

Methods / Materials

Informed consent was obtained from 44 randomly selected people ranging in age from 8 to 67. Each person was asked to trace his/her hand palm side up on a piece of grid paper. The same was done for the other hand. Each person indicated whether they were left or right handed. A lamp and a racquet were positioned in a box so that the light shining through the racquet projected a grid pattern onto the subject's palm. The box prevented the subject from viewing his/her hand. Next, the subject's palm was lightly poked in three different places, using a different object (out of three)each time. The subject recorded the location and material of each touch on the grid paper on which s/he traced his/her palm. The subject then placed the other palm in the lamp box, undergoing the same procedure as the first palm.

Results

The right handed people had more sensitivity in their right hands, the left handed people in their left, but what I found was most interesting was that the left-handed people showed more sensitivity overall, providing the most correct responses.

Conclusions / Discussion

The dominant hand is more sensitive to touch than the other hand.

Is a Picture Really Worth a Thousand Words? The Effect of an Illustration on a First Grader's Listening Comprehension

Sample Behavioral Science Project

Objectives / Goals

The objective was to discover if first graders have better listening comprehension when viewing an illustration while listening to a story.

Methods / Materials

A short story, an illustration, and questions were created. One hundred two students were tested. Half were girls and half were boys. Half of the boys and girls were read the story without the picture, and the others viewed the illustration while listening to the story. All were questioned without the illustration. All were individually read the story and tested without distractions from the classroom. After testing all students available, data was calculated and results found.

Sample Projects

Results
Students who viewed the illustration while listening to the story answered four out of the five questions more precisely than students who did not see the illustration.

Conclusions / Discussion
First graders do have better listening comprehension when they view an illustration while listening to a story. First graders will remember more information if they have a visual aid.

A Box Office Disappointment: Why the Book is Always Better than the Movie
Sample Social Science Project

Objectives / Goals
Teachers are concerned about covering a large volume of curriculum in a short time. Since many students have trouble understanding what they read, some teachers and parents resort to showing videos. I believe that this practice may actually inhibit the higher-level language development necessary to understand complex books. The problem I investigated is the relationship of text to dialogue in films. My project determines the reading level of various trade books and the movies based on them.

Methods / Materials
The first 100-150 words for both trade books and the videos based on the same titles were translated and typed into a computer program. Readability formulas were applied to evaluate the language complexity children are exposed to when reading and when watching movies.

Results
An analysis revealed that regardless of the reading level of a book, the language complexity of the video is similar to primary reading material.

Conclusions / Discussion
Movie dialogue consists of simple sentences and vocabulary even when a screenplay is based on a high school or college level book. Therefore, it is important that students be exposed to written text as much as possible. If they are unable to independently access the material, adults should read the books to the children. Watching videos introduces children to the general plot, but fails to build reading comprehension skills. Students must be taught new vocabulary and understanding of complex sentence structure that they do not hear in conversation or in videos. Providing students with simplified children's versions of difficult books exposes them to a higher level of language than a video.

Sample Projects

If Einstein Had Watched More TV, Would We Have E=mTV?

Sample Social Science Project

Objectives / Goals

Our objective was to determine if there is a negative correlation between TV watching and grade point average amongst 6th, 7th, and 8th grade students.

Methods / Materials

We developed a survey to collect data about students' GPA and the hours of TV they watch per week. Four hundred forty-one 6th, 7th, and 8th grade students completed the survey. The breakdown by grade level was: 58 6th graders, 234 7th graders, and 149 8th graders. Based on the survey, we calculated the GPA for

each student who responded, and we entered each GPA into a spreadsheet for his or her grade level. Within each grade level, we grouped the individual GPAs into the corresponding groups of #hours of TV watched. These groups were: 0-1 hours, 2-3 hours, 4-5 hours, 6-8 hours, and 9+ hours of TV watched. Then, we calculated the mean GPA for each group, and graphed the results.

Results

In seventh grade, for 9+ hours of TV watching per week, the mean GPA was 2.22, the lowest GPA in that grade. By contrast, the 0-1 hours group had a mean GPA of 3.04. In eighth grade, the lowest mean GPA, 2.38, was associated with 9+ hours of TV per week. In comparison, the 0-1 hour group had a mean GPA of 3.07. Finally, in sixth grade, the lowest GPA, 2.83, was associated with watching TV for 6-8 hours per week, but the second lowest GPA, 3.08, was associated with watching 9+ hours of TV per week. By comparison, the mean GPA of those who watched 0-1 hours was 3.46. For both 7th and 8th grade students, as the amount of TV watched per week increased, the mean GPA decreased. Though the correlation was not as obvious for the 6th graders, they generally followed this trend, in that the lowest mean GPA was generated by those who watched many hours of TV per week.

Conclusions / Discussion

Our hypothesis appears to be correct in two of the three grades. For 7th and 8th graders, the more TV that they watched, the lower their grade point averages. For 6th graders, we saw the same relationship, except for the group that watched nine or more hours of TV per week. For that group, the grade point averages were higher than prediction

Your Design

Now that you have an idea of which type of study you will be conducting, you need to design your study. Each of these research techniques (questioning and observation) can be designed in a variety of ways depending on the objective of your study and the type of data you are trying to collect. Following are some features you should consider when designing your study:

Designing an Observation Study

There are many different ways to design an observation study, depending on the objective of your study, the type of data you are trying to collect, and the resources you have available for your study. Following are five different features that you should consider when designing the ideal observation study for your project:

Natural vs. Contrived Settings:

Conducting the study in a natural setting essentially means that you are simply observing your subjects in their "real life" environments. Because you have no way of influencing what your subjects are doing, this method can be time consuming to gather the information that you are specifically trying to obtain for your project. Alternatively, the data that is collected in a natural setting does have more accuracy in reflecting "real life" behavior rather than "contrived" behavior.

A contrived setting is one where the specific situation being studied is created by the observer. The contrived setting offers you, the observer, greater control over the gathering of data and specifically will enable you to gather the information more quickly and efficiently. However, it may be questionable as to whether or not the data collected does truly reflect a "real life" situation.

Disguised vs. Non-disguised Observation:

When subjects do not know they are being observed, this is called a disguised observation. Subjects in disguised observations tend to act more naturally and the data collected tends to reflect their true reactions. The primary concern with disguised observation is the ethical concern over recording behavioral information that would normally be private or not voluntarily revealed to a researcher. However, if you are simply observing a subject's behavior in a public setting then by definition, their behavior is no longer private.

When subjects know they are being observed, this is called a non-disguised observation. Using the non-disguised observation technique alone alleviates ethical concerns, however, since the subjects are aware that they are being watched, the advantages of using the observational technique are neutralized and a survey technique would be equally effective. There is one exception: the non-disguised approach offers the advantage of allowing the researcher to follow up the observations with a questionnaire in order to get deeper information about a subject's behavior.

Your Design

Human vs. Mechanical Observation:

Human observation is self explanatory, using human observers to collect data in the study. Mechanical observation involves using various types of machines to collect the data, which is then interpreted by researchers. With continuing improvements in technology, there are many "mechanical" ways of capturing data in observation studies; however, these new "gadgets" tend to be extremely expensive. The most commonly used and least expensive means of mechanically gathering data in an observation study is a video camera. A video camera offers a much more precise means of collecting data than what can simply be recorded by a human observer.

Direct vs. Indirect Observation:

Direct observations involve looking at the actual behavior or occurrence rather than a result of that occurrence, which would be an indirect observation. For example, if you were interested in seeing how much candy was purchased by a particular neighborhood, you could gather the information in one of the two following ways:

Direct observation: observe customers in a store and count how many bags of candy they purchase.
Indirect observation: look through trash cans on garbage day to see how many empty candy bags are in each trash bin

Indirect observation tends to be used when the data cannot be gathered through direct means, or when gathering the data through direct observation tends to be too expensive.

Structured vs. Non-structured Observation:

Structured observations are made when the data that is being collected can be organized into clear categories or groups so that the observer can record the data by simply marking off or checking a category on an observation form. Non-structured observations are not looking for specific facts or actions, but rather are capturing everything that occures. For example, if the US Postal Service were interested in knowing the gender and racial profile of the people that use a particular post office, they could post an observer at the front door and simply record the data as people entered the post office. This would be a structured observation, where the observer would simply be marking off boxes on an observation form. However, if the US Postal Service were interested in knowing the general level of satisfaction with service in a particular post office, they could post an observer in that office to capture more general data such as the length of the line during various times of day, the general change in customer demeanor as the line grows longer, the change in customer demeanor when there are one, two, or three windows open, etc....

Designing a Survey

The key to obtaining good data through a survey is to develop a good survey questionnaire. Whether you are conducting interviews or mailing out surveys, you will need to know how to design a good survey questionnaire.

Your Design

What is a survey questionnaire?

Survey questionnaires present a set of questions to a subject who with his/her responses will provide data to a researcher. On the surface, it seems a fairly simple task to write up a set of questions to collect information, but there are many pitfalls that should be avoided to develop a good survey questionnaire. We will focus here on describing some of the key elements in designing a survey questionnaire, and then highlighting some tips and tricks to for creating a good survey questionnaire.

Objectives

The key to developing a good survey questionnaire is to keep it short while ensuring that you capture all of the information that you need. This is not an easy task. Before you even begin to design your survey questionnaire, you should develop a set of objectives for your research and list out the information that you are trying to capture. This list of objectives and research goals will serve as your plan for the survey questionnaire.

Now that you know what you are looking for, you can begin to structure the questions that will help you capture the information. Once you have developed your survey questionnaire, you can use your objectives to go back through the questions and determine if each of the questions is providing you with information that you need. Any question that is not providing necessary information should be removed.

Types of Questions:

There are two different types of questions that can be used to collect information. The first is called a structured or fixed response question and the second is called non-structured or open question. It is important to understand when and how to use these questions when designing your survey.

Structured (fixed response)

Structured questions are questions that offer the respondent a closed set of responses from which to choose. Structured questions make data collection and analysis much simpler and they take less time to answer. Structured questions are best suited in the following situations: (1) when you have a thorough understanding of the responses so that you can appropriately develop the answer choices (2) when you are *not* trying to capture new ideas or thoughts from the respondent.

Your Design

Examples of Structured Questions

Do you have a driver's license? ( ) Yes ( ) No	Which subject do you enjoy the most at school? ( ) Math ( ) Science ( ) English ( ) Foreign Language ( ) History ( ) Government ( ) Art / Music ( ) Other	How many hours a day do you spend doing homework? ( ) 0 to 1 hour ( ) 2 to 3 hours ( ) 4 to 5 hours ( ) more than 5 hours

When writing the selection of responses for a structured question, you should make certain that the list covers *all possible alternatives* that the respondent might select AND that *each of the answers is unique* (ie they do not overlap). So for example, in the homework question above, we have included every option on the number of hours (from 0 to infinity). Also, you will notice that we were careful not to overlap the hours when defining the ranges by stating them as "0 to 1 hour" and "2 to 3 hours" rather than saying "0 to 1 hour" and "1 to 2 hours".

Sometimes, including general catch all responses (such as "Other", "Don't know", "None of the above", etc...) at the end of a list of answer choices will help to ensure that the data you are collecting will be accurate. In the school subject example above, you will notice that the last answer choice is "Other". Since the selection of non-required courses varies dramatically from school to school the option of "Other" helps to ensure that you are capturing the responses that do not fit into the broader subject areas already listed, rather than forcing respondents to select one of the other subject areas. Similarly, adding "Don't know" to a response list for a question that some of the respondents may not be capable of answering will help ensure you are collecting valid data. In general however, you want to use the "Don't know" option sparingly. You should try to ensure that your respondents are capable of answering the majority of the questions on your survey questionnaire.

You should also make sure that all of the answers are *relevant* to the question. Irrelevant responses may distract the respondent in addition to adding unnecessary length to your survey questionnaire. Consider the following change to the favorite school subject question.

Your Design

Example of a Bad Question With an Irrelevant Answer Choice

Which subject do you enjoy the most at school?
( ) Math
( ) Science
( ) English
( ) Foreign Language
( ) History
( ) Government
( ) Art / Music
( ) Football Practice
( ) Other

If we added a choice of "Football practice", we may find that football practice is someone's favorite "activity" at school, but it is not relevant to this particular question which asks "Which *subject* do you enjoy the most at school?"

Consistency is very important in writing the list of responses. All of the responses should be similar so that no single response stands out to the individual except the answer that is true for them. Consistency simply helps to ensure that you are not leading respondents to a particular answer by making that answer different from the others. It also makes it much easier for respondents to find the answer that is relevant to them. Here's an example using the homework question you have already seen above:

Example of a Bad Question with Inconsistent Answer Choices

How many hours a day do you spend doing homework?
( ) 0 to 1 hour
( ) 120 to 180 minutes
( ) 4 to 5 hours
( ) more than 5 hours

In this example, the second choice is exactly the same as what we had before, but it is listed in minutes rather than hours making it inconsistent with the other answer choices. Listing answer choices in this way is very confusing for the respondent and makes it more likely that they will provide you with incorrect information.

Sometimes you will be interested in obtaining a person's opinion on a topic, subject, product, event, etc.... To capture varying degrees of emotion about a subject, it is best to use either a rating or a ranking question. A rating question asks respondents to explain the degree with which they feel about a certain topic, subject, event, etc... For example:

Your Design

Example of a Rating Question

Please describe how you felt about the Homecoming Pep Rally.				
Unsatisfied (1)	Somewhat Satisfied (2)	Satisfied (3)	Very Satisfied (4)	Extremely Satisfied (5)

A ranking question asks respondents to explain how they feel about something by comparing it to other items in a list. For example:

Example of a Ranking Question

Please rank the following Homecoming activities in order of preference (starting with 1 for your favorite activity).

___Homecoming Pep Rally
___Homecoming Parade
___Homecoming Football Game
___Homecoming Dance

In general, if you are trying to get a respondent's opinion about something, it is best to have them do a rating rather than a ranking. A ranking asks respondents to list their responses in order of preference. This type of question leads you to an answer where the respondent is comparing one thing to another rather than giving you their feeling about each individual item. The disadvantage to a ranking is that if the respondent feels the same about two or more items, they are still forced to sort them into a ranking. The results of a ranking basically tell you which is the most preferred and which is the least preferred item on the list, but you do not know from a ranking if the respondent likes or dislikes any or all of the items on the list.

Non-structured (open-ended)

Non-structured questions, or open-ended questions, are questions where there is no list of answer choices from which to choose. Respondents are simply asked to write their response to a question. Here is an example:

Your Design

Example of a Non-structured Question

What do you like best about the Science Buddies Classroom Scientists Program?
_____
_____

It is best to use non-structured questions when you are exploring new ideas and you don't really know what to expect from the respondents. In some situations, you may have a partial list of answer choices, but you may still have some doubt or uncertainty about other possible responses. You can create a partially structured question such as the following:

Example of a Partially Structured Question

Why did you sign up for the Science Buddies Classroom Scientists Program (please select all that apply)?
( ) I really enjoy science
( ) My teacher asked me to sign up
( ) My teacher made me sign up
( ) My parents asked me to sign up
( ) I'm bored in science class & thought this would be fun
( ) I thought it would help me do a better project
( ) I thought it would help me win the Science Fair
( ) I thought having a Mentor to talk to would be fun
( ) I knew other students who were doing it
( ) Other _____

Open-ended questions let you get more insight into the respondents' thoughts and ideas about a subject. As we have already mentioned, open-ended questions are useful when you are trying to capture new ideas or information for which you have no basis to develop an all inclusive set of structured responses. The disadvantages to using open-ended questions is that it can be much more time consuming and difficult to analyze the data. In general you should try to minimize the number of open-ended questions in your survey questionnaire. If you find yourself designing a survey questionnaire where the majority of the questions are open-ended, then you may need to do more exploratory research to get a better foundation of knowledge for the subject you are researching.

Your Design

Tips to creating a good survey questionnaire:

Here are some tips and tricks to help you ensure you are developing a good survey questionnaire:

- **Clearly state your intentions with the research.**

  Many people are hesitant to answer questions about themselves and their opinions. If you are developing your survey for a YSP project, people will probably be more willing to help if you clearly state your intentions. At the top of your survey, write a brief statement explaining why you are collecting the information and reassure each respondent that the information is entirely anonymous. If you need to know specifics about a person, respect their privacy by identifying them as subject1, subject2, etc...

- **Include instructions with your survey questionnaire**

  What may seem obvious to you probably is not very obvious to someone else. To ensure that you collect valid survey results, make sure you include instructions on how to answer the survey questionnaire. There should probably be a short introductory set of instructions at the top of the survey questionnaire, and additional instructions for specific questions as needed.

  Your overall instructions may be something like:

  Please mark the appropriate box next to your answer choice with an "x" (X). Please answer all of the questions to the best of your ability.

- **Don't ask for personal information unless you need it.**

  Asking individuals to provide you with personal or demographic information (age, race, income level, etc...) may irritate some respondents and prevent them from completing your survey questionnaire. However, in many instances, this information is necessary for the research. If you need to ask for this type of information it is best to place the questions at the END of your survey questionnaire.

- **Keep the questions short and concise**

  The wording for survey questions should be short and concise. Each question should be clearly stated so that there is no misunderstanding about what is being asked. The best way to ensure your questions are well worded is to test them by having other people review and test your survey before you distribute it to the full sample.

Your Design

- **Ask only one question at a time (the double barreled question)**

  This is a very common mistake in survey questionnaires and one that will severely impact the results of your data. When you are writing a question, you must make sure that you are only asking one question at a time.

  Here is an example of a double-barreled question:

Bad Question: Double-barreled Question	Good Question
How have teachers and students at your school responded to the new 45-minute lunch period? ( ) Satisfied ( ) Unsatisfied	How have teachers at your school reacted to the new 45-minute lunch period? ( ) Satisfied ( ) Unsatisfied How have students at your school reacted to the new 45-minute lunch period? ( ) Satisfied ( ) Unsatisfied

  You notice that the double-barreled question is asking about teachers AND students. This means that a "satisfied" response could mean any of the following:

  Teachers are satisfied
  Students are satisfied
  Teachers and students are satisfied

  An "unsatisfied" response could mean any of the following:

  Teachers are unsatisfied
  Students are unsatisfied
  Teachers and students are unsatisfied

  Since the question was phrased in such an ambiguous way, you will not know what the respondent intended with their response unless you ask them, invalidating your data.

  To solve this problem, you simply need to break this question into two separate questions, as shown in the example above.

You will also notice that the two rephrased questions above are very similar and that the key word (which differentiates the two questions) has been underlined. This is a good technique to ensure that the respondents are reading the questions correctly when the structures are so similar.

- **Make sure the questions are unbiased**

When developing your survey questionnaire, you want to make certain that you are asking the questions in a neutral way, ie that you are not leading them toward a particular answer. This may seem simple, but when you are writing questions you will often find that the way you phrase the question may reflect your underlying opinion. Here is an example of a leading question:

Example of a Leading Question and How to Correct it

Bad Question: Leading	Good Question: Neutral
Do you think that the new cafeteria lunch menu offers a better variety of healthy foods than the old one? ( ) Yes ( ) No ( ) No Opinion	How do you feel about the new cafeteria lunch menu compared to the old one? ( ) The new menu offers a better variety of healthy foods ( ) The old menu offers a better variety of healthy foods ( ) The selections are similar ( ) No opinion

The leading question drives the respondent to the conclusion that the new menu is healthier than the old. A yes response to this question is the easiest, and many respondents may simply take the path that requires the least amount of thinking. The neutral question presents a better way to phrase this question by removing the bias.

- **Ask questions that can be answered by your subjects**

Make sure that the questions you are asking are questions that people will be able to answer. The most common mistake is to ask questions that most people simply cannot remember. Here is an example:

How much did you spend on school supplies last year?
( ) $0 - $10
( ) $11 - $20

( ) $21 - $30
( ) over $30

While this question appears to be perfectly acceptable, it is unlikely that many students will really remember how much they spent on school supplies. Most responses will probably be guesses rather than actual numbers, and many respondents may become frustrated trying to calculate in their heads how much they spent. If a guess is all that you are looking for, then simply rephrasing the question to the following will make it much easier for the respondent.

How much do you estimate you spent on school supplies in the last year?
( ) $0 - $10
( ) $11 - $20
( ) $21 - $30
( ) over $30

- **Order/group questions according to subject**

  If you have more than six questions in your questionnaire, then you should make an effort to organize your questions so the respondents can answer them as quickly as possible. A good way to organize the questions is to group them together by subject. This way your respondents can focus their thoughts and answer a series of questions around these thoughts.

- **Present the questions in a clean and organized layout**

  A clean layout will make it much simpler for people to respond to the questions and for you to collect the data. Make sure that your method for marking answers is well explained and that your answer boxes are consistent throughout the questionnaire. See the following a sample survey questionnaire in the next section.

- **Test the survey questionnaire**

  Once you have developed your survey questionnaire, you should conduct a small test (5 -10 people) to make sure that respondents clearly understand the questions you are asking and that you are capturing the information that you need for your study.

Your Design

Your Assignment

Please complete the "What are Your Objectives?" and Bibliography worksheets. Then, create your survey or design your observation study. The sample survey, entitled "2004 Advisory Survey", located in this workbook may provide greater assistance. You should also create the consent forms that you will have participants sign before they complete the survey. Example consent forms are located in the appendix of this notebook. **Please return to the YSP Coordinator by Friday, June 15, 2007**. Once your survey or observation study has been approved by your YSP mentor and coordinator, you may begin collecting data (i.e. asking questions or observing)!

What are Your Objectives?

Due Friday, June 15, 2007

Name: _____

6. What are the objectives or the questions that you are going to try to answer with your study?

7. What kind of information do you think you will need in order to accurately and effectively answer your questions?

8. Can you find at least 3 sources of written information on this topic? What are they? Briefly describe how information contained in each will assist you with your study. Please enter the appropriate information for each source on the Bibliography Worksheet.

Bibliography Worksheet

Due Friday, June 15, 2007

Name: ________________________________

Note: You won't fill in every item depending on the type of source.

This source is a: Book Magazine Newspaper Website Other______________________		
Author's Last Name	First Name	Middle Initial
Date Published	Title of Publication/Website	
Title of Article (periodicals, encyclopedia, websites)		
Place Published (books only)	Publisher (books only)	Editor (if applicable)
Edition (if applicable)	Volume Number (periodicals/encyclopedia)	Page Number(s)
Website is a Company Organization Government Newspaper/Magazine Other ___________________		
The URL is http:// (websites only)		Last Date of Access (websites only)

This source is a: Book Magazine Newspaper Website Other______________________		
Author's Last Name	First Name	Middle Initial
Date Published	Title of Publication/Website	
Title of Article (periodicals, encyclopedia, websites)		
Place Published (books only)	Publisher (books only)	Editor (if applicable)
Edition (if applicable)	Volume Number (periodicals/encyclopedia)	Page Number(s)
Website is a Company Organization Government Newspaper/Magazine Other ___________________		
The URL is http:// (websites only)		Last Date of Access (websites only)

This source is a: Book Magazine Newspaper Website Other______________________		
Author's Last Name	First Name	Middle Initial
Date Published	Title of Publication/Website	
Title of Article (periodicals, encyclopedia, websites)		
Place Published (books only)	Publisher (books only)	Editor (if applicable)
Edition (if applicable)	Volume Number (periodicals/encyclopedia)	Page Number(s)
Website is a Company Organization Government Newspaper/Magazine Other ___________________		
The URL is http:// (websites only)		Last Date of Access (websites only)

2004 Advisor Survey

Please answer the questions to the best of your ability, then click on the "Submit Survey" button at the bottom of the form. Please complete the survey one time only. If you have additional thoughts at another time, please email them to us separately. If a field is too small to hold your comments for a question, there is a "General Comments" question that has plenty of room.

We'll share with you the key results from this survey in our newsletter.

1. How would you characterize your overall experience in the Science Buddies program taking into account everything including the application process, training, communication with staff, the Command Center, and, of course, the actual work with your team?

   - ☐ Excellent
   - ☐ Very Good
   - ☐ Good
   - ☐ Fair
   - ☐ Poor

2. Why did you sign up for Science Buddies? (check all that apply)

   - ☐ I really enjoy science
   - ☐ I considered it a way to "give something back" to the community
   - ☐ I thought it would be fun
   - ☐ I enjoy working with and helping young people
   - ☐ I knew other people who were doing it
   - ☐ I wanted the opportunity to interact with professionals that had backgrounds in a field of interest to me

   Other _____

3. Would you participate in Science Buddies again?

   - ☐ Yes
   - ☐ No

4. Would you recommend Science Buddies to a friend?

   - ☐ Yes
   - ☐ No

5. Did you feel adequately prepared (trained) to help the students with their projects?

   - ☐ Yes
   - ☐ No, I needed more training on how to mentor someone
   - ☐ No, I needed more training on doing a science fair project
   - ☐ No, I needed more training on _____

6. Compared to your expectations before you began to work with your Investigator, how would you characterize the skill level of your Investigator (i.e., his or her ability to successfully complete the Science Buddies program)?

   - ☐ Above my expectations
   - ☐ About what I expected
   - ☐ Below what I expected
   - ☐ I didn't know what to expect

7. My Investigator (check all that apply):

   - ☐ Was an active participant
   - ☐ Was not an active participant
   - ☐ Was easy to communicate with
   - ☐ Was difficult to communicate with
   - ☐ Followed my suggestions
   - ☐ Did not follow my suggestions

   Other _____

8. In what part of the project do you feel you were able to offer the most help?

- ☐ Choosing a question
- ☐ Helping with research of the topic
- ☐ Designing the experiment
- ☐ Performing the experiment
- ☐ Analyzing the experimental results

9. How did you decide when to offer guidance to your Investigator about how to find an answer versus when to simply give the answer?

10. Do you feel that you were able to offer your Investigator all the help he or she needed?

- ☐ Yes
- ☐ No, because I didn't have enough knowledge of his subject area
- ☐ No, because I didn't have enough time
- ☐ No, because I couldn't actually see what he or she was doing
- ☐ Other

11. What parts of the Science Buddies Web Site did you use? (check all that apply)

- ☐ "Discussion Board" (the page where you talk to your teammates)
- ☐ "Assignment Folder" (the page with the timeline and the place to upload assignments)
- ☐ "Mentor/Advisor Forum" (the page where the staff posts daily answers to common Mentor and Advisor question as well as various program information)
- ☐ "Add/Edit Profile" (to post your picture and brief personal introduction)
- ☐ "Who's Online" (tells you whether any of your teammates are online right now)
- ☐ "How to Do a Science Fair Project" (which included separate pages for choosing a topic, researching a topic, variables, sample project, etc.)
- ☐ "Links" to science fair project ideas
- ☐ "Science Fair Gallery" (pictures of fairs)
- ☐ "About Us", "History & Mission", or "Sponsors"

12. How did you find the information on the Science Buddies Web Site? (check all that apply)

- ☐ Easy to understand
- ☐ Hard to understand
- ☐ It was easy to find what I wanted
- ☐ It was difficult to find what I wanted
- ☐ I didn't use it enough to say

Other _____

Variables

Erika Martinez (2006); Photo taken by Damilola Coker

Variables

Scientists use an experiment to search for **cause and effect** relationships in nature. In other words, they design an experiment so that changes to one item *cause* something else to vary in a predictable way.

These changing quantities are called **variables**, and an experiment usually has three kinds: independent, dependent, and controlled.

The **independent variable** is the one that is changed by the scientist. In an experiment there is only one independent variable.

As the scientist changes the independent variable, he or she observes what happens.

The **dependent variable** changes in response to the change the scientist makes to the independent variable. The new value of the dependent variable is *caused* by and *depends* on the value of the independent variable. For example, if you open a faucet (the independent variable), the quantity of water flowing (dependent variable) changes in response--the water flow increases. The number of dependent variables in an experiment varies, but there is often more than one.

Experiments also have **controlled variables**. Controlled variables are quantities that a scientist wants to remain constant, and he must observe them as carefully as the dependent variables. For example, if we want to measure how much water flow increases when we open a faucet, it is important to make sure that the water pressure (the controlled variable) is held constant. That's because both the water pressure and the opening of a faucet have an impact on how much water flows. If we change both of them at the same time, we can't be sure how much of the change in water flow is because of the faucet opening and how much because of the water pressure. Most experiments have more than one controlled variable. Some people refer to controlled variables as "constant variables."

Variables

Some Very Simple Examples of Variables

Question	Independent Variable	Dependent Variables	Controlled Variables	Comments
How much water flows through a faucet?	Water faucet opening (closed, ½ open, fully open)	Volume of water flowing measured in liters per minute	Water pressure (how much the water is "pushing")	A better measure of the independent variable would be to find area of the opening in the pipe in square centimeters.
How fast does a candle burn?	Time measured in minutes	Height of candle measure in centimeters	• Use same type of candle for every test • Wind – make sure there is none	In this case, time is what causes the dependent variable to change. The scientist simply starts the process, then observes and records data at regular intervals.
Does the fertilizer make a plant grow bigger?	Amount of fertilizer measured in grams	• Growth of the plant measured by its height • Growth of the plant measured by the number of leaves	• Same plants • Same soil • Same size pot • Same amount of water and light • Make measurements of growth at the same time	
Does an electric motor turn faster if you increase the voltage?	Voltage of the electricity supplied to the motor measured in volts	Speed of rotation measured in RPMs	• Same motor for every test • Same load on the motor	

Your Assignment

Complete the "Grading Yourself" section of this lesson. Type your variables (carefully labeling each of the three different types) and hypothesis on a Microsoft PowerPoint slide.

Variables

Grading Yourself

What Makes for Good Variables?	For Good Variables, You Should Answer "Yes" to Every Question
The independent variable is measurable?	Yes / No
You can change the independent variable during the experiment?	Yes / No
You have identified all relevant dependent variables, and they are all caused by and depend on the independent variable?	Yes / No
All dependent variable(s) are measurable?	Yes / No
You have identified all relevant controlled variables?	Yes / No
All controlled variables can be held constant during the experiment?	Yes / No

Data Analysis & Graph

Take some time to carefully review all of the data you have collected from your experiment. Use charts and graphs to help you organize the data and patterns. Did you get the results you had expected? What did you find out from your experiment?

Really think about what you have discovered and use your data to help you explain why you think certain things happened.

Calculations and Summarizing Data

Often, you will need to perform calculations on your raw data in order to get the results from which you will generate a conclusion. A spreadsheet program such as Microsoft Excel may be a good way to perform such calculations, and then later the spreadsheet can be used to display the results. Be sure to label the rows and columns--don't forget to include the **units of measurement** (grams, centimeters, liters, etc.).

You should have performed multiple trials of your experiment. Think about the best way to summarize your data. Do you want to calculate the average for each group of trials, or summarize the results in some other way? Or, is it better to display your data as individual data points?

Graphs

Graphs are often an excellent way to display your results. In fact, most good science fair projects have a graph.

Different types of graphs are appropriate for different experiments. These are just a few of the possible types of graph:

A **bar graph** might be appropriate for comparing different trials or different experimental groups. It is also may be a good choice if your independent variable is not numerical. (In Microsoft Excel, generate bar graphs by choosing chart types "Column" or "Bar.")

A **time-series plot** can be used if your dependent variable is numerical and your independent variable is time. (In Microsoft Excel, the "line graph" chart type generates a time series. By default, Excel simply puts a count on the x-axis. To generate a time series plot with your choice of x-axis units, make a separate data column that contains those units next to your dependent variable. Then choose the "XY (scatter)" chart type, with a sub-type that draws a line.)

An **xy-line graph** shows the relationship between your dependent and independent variables when both are numerical and the dependent variable is a function of the independent variable. (In Microsoft Excel, choose the "XY (scatter)" chart type, and then choose a sub-type that does draw a line.)

A **scatter plot** might be the proper graph if you're trying to show how two variables may be related to one another. (In Microsoft Excel, choose the "XY (scatter)" chart type, and then choose a sub-type that does not draw a line.)

Generally, you should place your independent variable on the x-axis of your graph and the dependent variable on the y-axis.

Be sure to label the axes of your graph--don't forget to include the **units of measurement** (grams, centimeters, liters, etc.).

Data Analysis & Graph

Your Assignment

Complete the "Grading Yourself" section of this lesson. Then, prepare your data analysis chart and plot graphs as appropriate in a spreadsheet program such as Microsoft Excel. Finally, import your information onto a Microsoft PowerPoint slide.

Grading Yourself

What Makes for a Good Data Analysis Chart?	For a Good Chart, You Should Answer "Yes" to Every Question
Is there sufficient data to know whether your hypothesis is correct?	Yes / No
Is your data accurate?	Yes / No
Have you summarized your data with an average, if appropriate?	Yes / No
Does your chart specify units of measurement for all data?	Yes / No
Have you verified that all calculations (if any) are correct?	Yes / No

What Makes for a Good Graph?	For a Good Graph, You Should Answer "Yes" to Every Question
Have you selected the appropriate graph type for the data you are displaying?	Yes / No
Does your graph have a title?	Yes / No
Have you placed the independent variable on the x-axis and the dependent variable on the y-axis?	Yes / No
Have you labeled the axes correctly and specified the units of measurement?	Yes / No
Does your graph have the proper scale (the appropriate high and low values on the axes)?	Yes / No
Is your data plotted correctly and clearly?	Yes / No