

# **The Survey Toolkit**

Resource Manual



Written and Photographs by:

Thomas E. Walsh Jr. PhD  
Middle School ELP Teacher

# The Survey Toolkit Resource Manual

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**Note of Appreciation** to the sixth grade students whose *TinkerPlots* projects have contributed in promoting learning about conducting survey research. A special appreciation is also given to Nolan and the contribution of his Energy Survey project, which has been valuable in supporting student and teacher understanding of concepts about the research process. Students and parents granted permission for placement of students' survey work questions, reports, hypotheses and graphs in *The Survey Toolkit Resource Manual*. In addition, I would like to thank educator Corey Andreasen for his editorial expertise and recommendations and support in writing the text.

**Castle Point Lighthouse**, New Zealand is located on the east coast of the North Island about 150 km from Palmerston North off the South Pacific Ocean seas.

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## Use of this Guide

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## Introduction

*The Survey Toolkit Resource Manual* was written for students and teachers to support and provide background reading and activities for *The Survey Toolkit Collecting Information, Analyzing Data, and Writing Reports* text. The manual is a collection of materials used by the author in his classrooms at the middle school. As a teacher you can decide how to most effectively use these materials, depending on your teaching style and scheduled classroom arrangement. The table of contents in the resource manual suggests where to integrate the activities from the guide with the main curriculum manual *The Survey Toolkit*.

The chapter readings provide the student with additional information about key concepts and vocabulary involved in conducting survey research. The Flesch-Kincaid grade level readability for the readings is approximately 10.5 or a lexile rating of 1025. I found the readings helpful for students in developing understanding of concepts and vocabulary terms prior to introducing a lesson. The appendix provides a vocabulary dictionary for students to record terms presented in the lessons, which may serve as a review prior to giving the post-assessment. Vocabulary pages for placement on a word wall are also included in the appendix.

Additional student activity pages to support instruction are provided in the appendix. A Factoid page for students to collect facts and record references when finding background information about their research questions may be helpful. A template form for developing a survey is also included, which may be necessary for some students to get them started in writing their survey. A TinkerPlot Data Completion Checklist I have found helpful for students, in conjunction with lesson 3.3, 3.4 and 3.5 to encourage critical examination of the survey data in various ways to generate a variety of graphs. The checklist also supports students to self assess graph development related to their research questions and hypotheses. The poster paper and peer review log for student peers and teachers to provide feedback about the survey research project is also included. The appendix activities are listed in the table of contents and suggest lessons in the main text *The Survey Toolkit* for ideas to integrate these resources.

On the following page a staff development plan is provided to inservice teachers using *The Survey Toolkit* curriculum. The staff development was written as a flexible plan for implementation based on the amount of time available for training teachers. Included with the plan are inservice summative and formative evaluation instruments. The formative could be used for ongoing feedback provided by participants, as needed, while the summative would evaluate the entire training experience.

# Staff Development Plan

## Topic and Activities

## Resources and Readings

### Part 1. Choosing Your Research Question

- |  |                                      |
|--|--------------------------------------|
| 1. Introduction to surveys* and the research process | ST Introduction and ST Lesson 1.1    |
| Optional assignment survey write and administer*     | ST Lesson 3.1*; STR Survey Template* |
| 2. Looking at survey data                            | ST Lesson 1.2; TP (NZ Data)          |
| 3. Planning and setting goals                        | ST Lesson 1.3                        |
| 4. Finding and summarizing information               | ST Lesson 1.4 & 1.5; STR pp. 1-6     |

### Part 2. Developing and Giving Your Survey

- |   |                              |
|---|------------------------------|
| 5. Writing survey questions                           | ST Lesson 2.1; STR pp. 7-16  |
| 6. Choosing a sample from a population                | ST Lesson 2.2; STR pp. 17-23 |
| 7. Writing a hypothesis                               | ST Lesson 2.3; STR pp. 24-25 |
| 8. Finishing and giving the survey                    | ST Lesson 2.4                |
| 9. Writing and giving a survey in cooperative groups* | MW                           |

### Part 3. Analyzing Your Survey Data

- |   |   |
|---|---|
| 9. Representing survey attributes and response rate | ST Lesson 3.1; Survey* or Data Set  |
| 10. Entering data into TinkerPlots                  | ST Lesson 3.2; Survey* or Data Set; TP w/Help - Movies TinkerPlotsBasic.mov |
| 11. Analyzing survey data with TinkerPlot graphs    | ST Lessons 3.3-3.5; STR pp. 26-36; TP                                       |

### Part 4. Sharing Your Results

- |  |   |
|--|---|
| 12. Writing your findings for a report or poster board | ST Lessons 4.1-4.4; STR pp. 37-40       |
| 13. Student evaluation and                             | ST Lesson 4.3 (Rubric); STR Assessment; |
| 14. Facilitator Evaluation                             | Staff Development Summative Evaluation  |
| 15. Implementation discussion and questions            | STR Appendix                            |

#### Resources Needed:

1. TinkerPlots Computer Program (TP) includes Data and Demos and Help (Movies)
2. *The Survey Toolkit Collecting Information, Analyzing Data and Writing Reports* (ST)
3. *The Survey Toolkit Resource Manual* (STR)
4. Microsoft Word Program (MW) or related word processing
5. Handouts: Student survey data set, formative and summative workshop evaluation

#### Optional Assignment\*:

Write and give a survey to a sample of 20 prior to topic 10 or use student survey and data set provided by instructor.

## Formative Staff Development Evaluation

Directions: If needed please complete and place in the container provided.

Name (optional): \_\_\_\_\_

Date \_\_\_\_\_ Session Name or # \_\_\_\_\_

What questions or ideas would you like to have addressed for the next session?

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## Staff Development Summative Evaluation

Name (optional): \_\_\_\_\_ Date \_\_\_\_\_  
 Title (✓): Faculty (teacher) \_\_\_\_\_ Administrator \_\_\_\_\_ Student \_\_\_\_\_ Other \_\_\_\_\_

**Directions:** The purpose of the evaluation is to examine the extent the inservice met your needs and to learn more about the effectiveness of the workshop elements. Please rate the following items by circling one number for each or rate NR (no response), and then answer the questions.  
 May this evaluation with your comments be written on published or unpublished text material in the future? Yes \_\_\_\_\_ No \_\_\_\_\_ May your name be included? Yes \_\_\_\_\_ No \_\_\_\_\_ If yes how? \_\_\_\_\_

	<b>Low</b>					<b>High</b>	
	1	2	3	4	5	NR	
1. Clarity of content and information	1	2	3	4	5	NR	
2. Usefulness of <i>The Survey Toolkit</i> text	1	2	3	4	5	NR	
3. Usefulness of <i>The Survey Toolkit Resource Manual</i>	1	2	3	4	5	NR	
4. Clarity in presenting the TinkerPlots software program	1	2	3	4	5	NR	
5. Usefulness of handouts (e.g., survey data set provided)	1	2	3	4	5	NR	
6. Sufficient practice using TinkerPlots software program	1	2	3	4	5	NR	
7. Help and assistance provided by facilitator	1	2	3	4	5	NR	
8. Learning environment and climate	1	2	3	4	5	NR	
9. Opportunity for interaction, participation and discussion	1	2	3	4	5	NR	
10. Differentiated learning strategies used and presented	1	2	3	4	5	NR	
11. Applicability and useful for your teaching assignment	1	2	3	4	5	NR	
10. Comfort learning and using statistical concepts and procedures	1	2	3	4	5	NR	
11. Likelihood of using text materials with your students	1	2	3	4	5	NR	
12. Plans to adopt and use TinkerPlots software with students	1	2	3	4	5	NR	
13. Feel comfortable to teach the survey research process	1	2	3	4	5	NR	
14. Pace of the workshop	1	2	3	4	5	NR	
15. Likelihood you would recommend this workshop to a colleague	1	2	3	4	5	NR	
16. Overall evaluation of workshop effectiveness	1	2	3	4	5	NR	
17. Do you have any implementation concerns on using the survey curriculum with students? If so, what are they? _____ (Use back page?)							
18. Comment on the workshop strengths, suggestions, recommended changes and/or provide additional ideas. _____ (Use back page?)							

**Thank you for your feedback!**

## Chapter 1. Finding Information and Planning the Survey to Answer Research Questions

There are various methods for finding information to answer research questions to accomplish your project goal. The most appropriate **methodology** or procedures for finding information will depend on your questions you want answered about a particular topic. The word “method” is found in the word methodology and means the way of doing something. One method is the **literature review** and the other is a **group survey**. Usually both methods will be used to answer research questions of interest. Finding information that already exists in the literature before giving a group survey is a good strategy. The information that already exists may not only answer some or all of your research questions, but also provide the background knowledge to write an effective survey. Some examples of research questions leading to the report topics selected by middle school students are show below in Table 1.

Table 1. Research Question Topic Ideas Selected by Middle School Students

Science and Technology	History and World Cultures
Aircraft	Ancient China
Aviation Progression	Ancient Egyptian Cultures
Alternative Fuels	Ancient Egyptian Gods and Goddesses
Astronomy	Ancient India
Constellations	Confucianism and Taoism
Earthquakes and Volcanoes	Easter Island
Flying Devices	Egyptian Mythology
Energy and Machines	Famous People of Medieval Times
Energy Sources (Forms)	Foods of the Renaissance
Green” Energy and Global Warming	Greek Mythology (Gods)
Hovercrafts and Segways	Greece
Inventions	Han Dynasty
Light Reflection and Sound Waves	Hinduism
Math and What People Like About It	History of the Renaissance
NASA: The Founding and Space Pilots	Medieval Music
Nanotechnology	Medieval Period and Castles
Natural Disasters	Medieval Siege Weapons and Castle Defenses
Physics: Work, Energy and Power	Roman Infantry
Planets and the Solar System	Rome
Rockets	Spartan’s Weapons
Simple Machines	Travel Destinations
Solar Energy	Tudor Dynasty
Space Exploration	
Styrofoam and the Environment	<b>Health, Psychology, and Nutrition</b>
Technology Advances	Brain and Hemispheres (Nervous System)
Virtual Reality Machines	Eyes and Vision (Ophthalmology)
Volcanoes	Handwriting Analysis
Weather	Healthy Choices
	How Color Affects People (Mood)
	Nutrition and Exercise

## Finding Information

The **literature review** method involves finding and reading information on a topic and then writing a paper or report. Major sources of information you find on your topic may be found in nonfiction books, reference books (e.g., encyclopedias), web sites, CD's, online reference services, newspapers, pamphlets or magazines. A review of the literature is important in not only answering your research questions, it provides information for a particular area of knowledge. After you have learned what others have done, it can provide the foundation for developing ideas to learn more and add to an area of knowledge.

Background research about your questions can be collected and written from different sources. It is important to record these facts in your own words and to not plagiarize information that has been already researched by others. Techniques to avoid copying and **plagiarism** include writing in your own words, summarizing or paraphrasing, and combining factual content. It is also important to write the reference from which the facts are collected. This is also necessary if pictures are collected and copied for use in a report. If you are finding information online or using the Internet it will be important to record the **bibliography** reference information before logging off the computer. Due to the fast changing nature of web sites, wikis and blogs, a site here today may be gone or under construction tomorrow.

Collecting information using notebook paper or using a Factoid form (ask you teacher about) may be helpful to record your facts. Once you collect the facts you can group the numbers together into categories to create paragraphs. Add an introduction and conclusion, along with your bibliography, and you will have a completed literature review report. Your teacher will have bibliography forms to use to assist in correctly writing the references. The information about **power notes**, presented in the next section, will also be helpful as another strategy to organize and collect report information.

## Power Notes for Organizing a Report

**Power notes** is another organizing structure for writing. Santa, Havens and Valdes (2004) report the outlining technique can be used for report writing skills. Power notes uses a system of number levels, like an outline, to organize information. An example is shown below relating to the literature research process:

1. Three components in the research report
  2. Bibliography cards
    3. Web sites
    3. Books
    3. Encyclopedias
    3. Online reference services

- 2. Developing the paragraphs
  - 3. Collect and write facts from source
  - 3. Group and categorize facts
  - 3. Develop topic sentences
  - 3. Write introduction and conclusion
- 2. Promote understanding
  - 3. Revise drafts
  - 3. Correct grammar and spelling
  - 3. Type final report
  - 3. Include graphics and pictures
  - 3. Cite references

The outline model using this procedure is:

- 1. Main topic level one
  - 2. Subtopic for level one
  - 2. Subtopic for level one
    - 3. Subtopic for level two
    - 3. Subtopic for level two
- 1. Main topic level one (Santa et al., 2004, 39)

Power notes are also useful for organizing information at various levels to develop and sequence the research report paragraphs for the body of the report. The first and last power notes (Power 1) can plan the introduction and conclusion paragraphs for the literature review report. Santa et. al., discuss the use of power notes as a method for organizing text in which the introductory paragraph contains the topics for each paragraph in the body (Power 1), and includes the thesis or controlling idea. The last concluding paragraph is a restatement of the thesis and main points (Power 1). These authors suggest introductory paragraphs should start with a lead (e.g., question, interesting fact, quote, or anecdote) to gain the reader's attention.

You may wish to consider using power notes as an organizational scheme for planning your literature review research report. It is especially helpful in selecting information to effectively write the introductory and conclusion paragraph for your research report.

## Research Report Guidelines

An example of a middle school student's research paper is helpful in writing a report to answer research questions and support later development of a survey. Evaluation guidelines are also necessary to support completing an effective research report. The steps in the writing process for the middle school students report is presented as follows. First, notes were taken to answer the research question. These notes were written without copying from the text source. The student combined or separated fact ideas from various sources, recorded ideas in their own words, and summarized information to avoid plagiarism. Some of these facts recorded were:

Topic: Alternative Fuels

- 1. Ethanol made by fermenting, then distilling starch and sugar crops - maize, sorghum, potatoes, wheat, sugar-cane, cornstalks, fruits and vegetable waste
- 2. Doesn't increase greenhouse effect and not a fossil fuel

3. Made from plant and renewable
  4. Blends can be used in all petroleum engines w/o modifications
  5. Biodegradable w/o harmful effects on the environment
  6. Ethanol blends can reduce
    - a. Emissions of hydrocarbons (major contributor to depletion of ozone layer)
    - b. Nitrogen oxide omissions up to 20 % (high level blends)
    - c. Carbon monoxide by 25-30% (according to US EPA) more than any other oxygenate
    - d. Harmful exhaust emissions and emissions of VOC's (Volatile Organic Compounds)
  7. Cut emissions of cancer-causing benzene and butadiene by more than 50%
  8. Fuel production = good local base industry for jobs and market for materials
- Other facts continued . . .

Next, the notes were grouped into paragraphs and typed into sentences. A main idea or topic sentence was added if the paragraph needed one. Third, the introduction and conclusion paragraph at the beginning and end of the report was added. The conclusion summarized what the paper was about. Fourth, the **bibliography** included at least two references at the end of the report. Below are the paper guidelines for the report.

1. **Report Content:** Clarity, introduction with conclusion, paragraphs develop with main ideas (topic sentences) and length (i.e., one or more pages including a bibliography)
2. **Report Mechanics:** Grammar and spelling check
3. **Report Format:** Font 11-point (e.g., Times) and single space to paste on poster board with bibliography including two or more references
4. **Optional: Picture:** Relevant to topic not part of report content or on a separate page. Remember to add to bibliography references if taken from book or website.

Figure 1 shows an example of a middle school student's report using his fact ideas on alternative fuels, which has been written into a final paper with a bibliography.

Figure 1. Sample Report Written by a Middle School Student

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**Alternative Fuels**

People are realizing fossil fuels such as oil will not last forever. The answer to this is alternative fuels. Many people are uneducated on alternative fuels. They don't know what their effects are or what it is. So they continue driving past the E85 pumps, pulling into the diesel ones. They don't know diesel is slowly, breaking down our world. They don't acknowledge the fact that glaciers are melting, and our atmosphere is deteriorating, is done partly by using diesel fuel. This is damaging our earth's environment.

Ethanol is a non fossil fuel that is made from plants, and doesn't increase greenhouse effects. It is completely renewable and is biodegradable without harmful effects on the environment. Blends of ethanol and gasoline can be used in all petroleum engines without modifications. Fermenting makes ethanols, then distilling starch and sugar crops like maze, sorghum, potatoes, wheat, sugarcane, cornstalks, fruit and vegetable waste.

Ethanol reduces many emissions that harm the health of humans and the earth. Pure ethanol as well as ethanol blends reduces emissions of cancer causing benzene and butadiene by more than fifty percent. It also reduces emissions of hydrocarbons, which is a major contributor to the depletion of the ozone layer. High-level ethanol blends reduce nitrogen oxide emissions up to twenty percent. Ethanol also reduces carbon monoxide by twenty-five to thirty-five percent, which is more than any other oxygenate, according to the U.S. Environmental Protection Agency (EPA). Ethanol also reduces emissions of volatile organic compounds, as well as other harmful exhaust emissions.

Ethanol is also appealing in the business field. Ethanol production plants are good locally based industry, because it provides local jobs and markets for materials. This means that it keeps money and investment in the community. These are two reasons why farming states in the United States and provinces in Canada back ethanol fuel production.

Biodiesel is a completely renewable fuel that can be made from common waste products such as used cooking oil and/or vegetable crops. Some of the fuel sources for biodiesel are: algae farms, vegetable

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## Chapter 2 Developing a Survey Questionnaire

### Writing Effective Survey Questions

The project began by identifying the research questions you wanted to investigate using a survey, along with writing a research goal. After collecting notes and writing a **literature review** or report, you are ready to write a survey. After you completed the literature review you may have changed your research questions based on the new information and interests developed from what you learned about the topic. The change in research questions may also affect the type of survey questions you want to ask.

When you are ready to write a group survey you will need to write your questionnaire or statements in a way that your sample understands. Each item question or statement written must be developed to answer research questions and support your goal statement. You will need to decide the types of questions to write along with considering a field test of the survey prior to giving it to your sample.

Many questions you write will either be closed or open form types. Questions written as a **closed form** only permits certain responses. An example of a closed form question would be a multiple choice or short answer response, such as these written by some students for their survey:

1. What is your favorite pharaoh or queen you would like to study and learn about?
  - A. Akhenaten: He was mainly famous for changing the religion of his country to worship one god: Atenaten was believed to be the sun disk, or the yellow spherical disk that we see during the day.
  - B. Cleopatra: She assumed the throne at the age of eighteen. She was married to her brother, Ptolemy and ruled alongside him. She married Marc Antony, and had twins, one boy and one girl. Later, she committed suicide by allowing a snake to bite her.
  - C. King Tut: He is known as “the boy king”, because he was only nine when he took the throne. King Tut accomplished next to nothing in his whole lifetime, and advisors did all his work for him. After a short reign of about ten years, King Tut died.
  - D. Ramses 11: He fought for land in Africa and Western Asia. He gained more territory in the land now known as Syria. Ramses II also made many lavish monuments in his life. He ruled for 67 years, making him the second longest ruling pharaoh in Egypt.
  - E. Hatshepsut: A female pharaoh often portrayed as a man. She believed she was the holy daughter of Amon, the sun god. She ruled as a regent to Thutmose III, and then took over the throne to rule herself. Thutmose III later conquered Hatshepsut.
  - F. Other (write on the line) \_\_\_\_\_
2. Would you prefer studying planets, stars, constellations, black holes more than chemistry or physics?
  - A. Yes
  - B. No

Closed form questions have categories of answer responses for the person to pick from. The other question type is the **open form (free response)**, in

which the subject makes any answers in their own words. Examples of these types of questions written by students are:

1. Name one or more types of Indian food.
2. Can you name three or more parts of the eye? If so, what are they?
3. What are three types of energy you know about?
4. What aspect of ancient Egypt is most interesting to you?
5. What are your three favorite inventions?

Questions written in the closed form are easier to later count and study when you analyze data using TinkerPlots and make basic statistics calculations on graphs. After writing the literature report to help in developing survey questions you may want to test your questions with some students. For example, one method for writing multiple-choice questions and selecting the best answer choices is to **field test** it as an open form question. You could ask a small number of people the question and then list the most frequent answers to give. Then you could change the question to a closed form based on the most frequent answer responses. Field-testing should have been used in one class when a group of students wrote a survey question as follows:

What is your favorite U.S. national park?

- A. Glacier
- B. Yellowstone
- C. Rocky Mountain
- D. Everglades
- E. Badlands
- F. Death Valley
- G. Other answer \_\_\_\_\_

After the group gave a survey to another class they found that some parks had few, if any answers. They later realized if they were to do the study again they would have selected other different national park answer choices. If the group had first asked the question in an open form to a test sample of students, without the answer categories, they could have selected the highest park choices and found more appropriate responses to ask for their actual test survey sample.

You may decide to write a combination of open and closed form types of question for a survey questionnaire to find out information. You may also decide that you want to find out someone's values (i.e., opinion, attitude or way they behave) about a particular idea or subject. A question dealing with one's values can be written as a **number rating scale**. A rating scale may be useful to answer one or more of your research questions that you are exploring for information. A rating scale is a question or statement written with a number of items in order to get an idea of someone's attitude. Examples of number rating scales written by students are:

**Directions: Circle the number which best describes your opinion or attitude about the subject.**

1. Do you like to eat Indian food?  
1                      2                      3                      4                      5  
(never)                      (sometimes)                      (often)
2. I think learning about the brain would be interesting.  
1                      2                      3                      4                      5  
(not true)                      (kind of)                      (very true)

A five-point scale is suggested here, but it could include a three-point scale or use of three faces (“yes” for smiling, “so-so” for a medium face and “no” for a sad face) when surveying younger children. You may also wish to use a longer point scale if you believe that the person’s attitude about a topic may be more spread out.

A variation of the number rating scale is the **Likert scale**, also used to measure attitudes or perceptions. It is similar to the rating scale except words (or abbreviated symbols) are used instead of numbers. Examples of the number rating scales changed to Likert scales are:

**Directions: Circle the letters which best describes your opinion or ideas about the subject.**

1. Do you like to eat Indian food?

SD	D	U	A	SA
(strongly disagree)	(disagree)	(undecided)	(agree)	(strongly agree)

2. I think learning about the brain would be interesting.

SD	D	U	A	SA
(strongly disagree)	(disagree)	(undecided)	(agree)	(strongly agree)

Both the number rating scale and Likert scale will allow you to find out someone’s values and ideas about a topic using slightly different methods.

If you decide to use a number rating or Likert scale you should **field test** the question with a sample of people to see if they understand the item being asked, and if they have enough knowledge to make an opinion about this subject. The field test may also provide ideas for the type of scale to use. You may wish to write your attitude item as either a question or statement to improve meaning and understanding.

## **Guidelines for Writing Your Own Questions and Avoiding Bias**

Notebook paper first draft or a questionnaire template is helpful to get you started in writing a survey. While the survey template provides a guide and format for getting started, you will want to think about the most appropriate questions or statements that will be understood by the individual or sample group identified to respond. Some rules to follow in writing questions or statements are:

1. Think of a question or statement that makes sense and is written using correct grammar (e.g., watch for capitals, spelling and punctuation).
2. Make sure every word means exactly what you intend it to mean. For example, does feel, think and believe mean the same thing?
3. Explain specifics in clear detail to explain what you mean. For example, explain “people at risk” in detail to mean “children at risk for dropping out of school.”
4. Watch out for unclear use of big words or terms, which are difficult to understand.
5. Write questions which are not negative and may cause the person to answer in a way that is opposite of their real opinion. For example, isn’t alcohol abuse a problem at our school?
6. Be careful if using a “no opinion” category for subjects to answer if they are not familiar with a topic question. Sometimes people will answer or say an opinion if given this category as a choice.

7. Respect people's preference for what they prefer to be called and watch out for labels. Describe people by their nation or region of origin, like Chinese American or Mexican Americans. Some people of African race prefer to be called Black or African American.
8. Use gender when writing about men and women as groups. Use the word "sex" when writing questions having to do with biology or psychology behavior of people.
9. Write about people that recognize their participation in a personal way using more specific terms like participants, individuals, middle school students, children or respondents. Use only the words "subjects" and "sample" when writing statistics.
10. Be specific when using number ranges and avoid the use of "over" or "under." For example, for age ranges write "65-75" or "70-80" instead of "over 65."

Above are a few rules or guidelines to follow in writing questions that will help to accurately measure and find out what you intend to learn, and reduce the chance of an individual giving an inaccurate answer or opinion about a topic. An answer you do not expect from a question, which is affected by the way it is written is called **response bias**. It is very important that questions avoid bias or do not lead the participant to a particular answer. **Leading questions** give hints as to the type of answer you would most prefer and results in the person giving you an answer you want. Reducing question bias will result in surveying individuals to most accurately obtain the information you desire, and improve the validity of your questionnaire or form.

You may desire to not use a template form for writing questions to answer your research question of study. If this is the case, then remember to organize and lay out survey questions so they are easy to complete as possible. Make your questionnaire attractive and typed using a readable font size. Number the question items and pages, and use examples for question items that may be confusing or difficult to understand. It is also important to organize the questionnaire in a logical way so that similar or related questions are grouped together. Provide directions for completing the survey along with confidentiality information or option for the students to not answer the survey if they decide to not participate (see Figure 2). Finally, avoid the use of "questionnaire" or "checklist" on the form since these words may bias the results.

An important consideration is the length of the questionnaire and its affect on the person who is responding, observed or being interviewed. The length of a survey or interview to write may depend on the age of the participants. Younger children, with shorter attention spans, may be unable to complete longer surveys. Expert interviews or oral histories by seniors may require the questionnaire to be shorter in length also. Question items that are interesting and relate to what is being studied will increase the number of responses. If this happens Borg and Gall (1989) report that each page added to a questionnaire reduced the number of responses by only 0.5 percent.

How do you deal with surveys that are not completed by a certain number of participants? Borg and Gall report if more than 20 percent of the questionnaires are not answered, then it is very likely your findings could be changed from the missing group sample and could bias your results. If this happens these authors suggest you select a small number of subjects randomly

(e.g., draw names from a hat) and interview these people using your survey questionnaire to get the necessary information. It may be possible to interview these non-responding people over the phone or by e-mail.

**Field test** and piloting have been discussed as effective methods for survey questions. A **pretest** of your questions and statements before used in a group survey of your selected sample of participant(s) is an effective way to reduce bias in collecting information about your topic of study. For a pretest select an individual or small group of people who are similar from the actual sample who will answer the questions or statements. You can reduce the chance of bias by writing the same question in more than one way and then evaluate the consistency of answer responses given by each person. During the pretest reviews ask participants to repeat their understanding of the questions in their own words. Ask the reviewers for ideas for rewriting the questions or statements so that they are more meaningful. You may need to find out which items the reviewers do not feel comfortable answering. Finally, determine which questions or statements are unclear and need to be rewritten, or removed and not used at all in your survey. The field test experience is valuable to determine not only if the participants who answer your questions clearly understand the items, and that you are consistently getting the answers you want.

Some additional survey question considerations with examples are provided on the next page. There are many considerations and things to think about when writing questions and statements about your topic of study. The ideas for effectively writing question to reduce survey bias were collected from two sources (Borg and Gall, 1989 and American Psychological Association, 1996).

## Survey Question Techniques to Improve the Quality of Information Gathered

There are some other ideas to consider when writing your survey. Most of the time you will be asking some **personal profile** questions, which may include information about the person's age or gender, like I am female and 12 years old. Perhaps you may want to find out the hobbies or possessions the person owns to determine interest. A personal profile question may ask for example, do you have a telescope? Always be careful not to ask inappropriate **personal profile questions** about some topics like religion, race or participation in risky behaviors (e.g., alcohol or drug use).

Most questions you will ask are **opinion** type. For example, I like to read and learn about medieval castles. An opinion question can give meaningful information especially if the question is refined and asked again or by writing additional questions about the topic. You can also quantitatively **define subjective words**, such as "like," "interest," "preference," "greatest," "best" and "most important" to improve opinion questions. For example, define the greatest invention in ancient China as:

- Inventions that are mentioned in five references found.

- Inventions still used outside of China.
- Inventions that have led to other inventions.

Another technique is to quantitatively change subjective opinion questions to an **objective questions**. Some examples are:

1. Do you have (or wish you had) a telescope?
2. Have you visited a planetarium or space exhibit or checked out a library book about astronomy?
3. Would you choose a TV program about astronomy over mystery, adventure, or animal program?
4. Here are five fields of interest: biology, history, astronomy, cooking, and engineering. When you order them in your mind, is astronomy in the top two?
5. Can you name three or more stars or constellations?

There are three quantifiable clues for asking questions about “interest” and “**preference**” for a topic, and these include the amount of time, money and interest they have in something. Examples of **time-spent** questions to determine interest are:

1. How much time do you spend reading books on space or watching programs?
2. Do you participate in plays or outings about ancient India?

Examples of **money spent** to find out about preferences are:

1. How much money have you spent on technology devices?
2. Do you eat at Chinese restaurants and how often do you go?

**Interest** is measurable when relevant to real life today, for example:

1. What is more important to you and your family – space travel or health research?
2. What percent of taxes should be spent on science research?
3. What strategies do you think are most effective to keep kids away from drugs?
4. What do you think is the most-used illegal drug in the United States?
5. Here are five main ideas of Hinduism (add five ideas). On a scale of 1 to 5, how close are they to what you believe in?
6. What has the most effect on modern clothing styles:
  - A. Ancient or traditional style
  - B. Available materials
  - C. Cost
  - E. Gender roles and occupations
  - F. Ideas about modesty and appropriateness
  - G. Other answer \_\_\_\_\_

Another opinion question writing technique is to turn general “yes” and “no” questions into multiple-choice questions. For example, are you interested in medieval entertainment (answer yes or no)? You can change this into a multiple-choice question like:

1. What grabs your interest most about medieval culture – technology, entertainment, clothing, food or armed conflicts?
2. Can you name five entertainments that would have been practiced in the Middle Ages?

As you are now aware, there are many techniques and strategies for improving opinion type survey questions.

Another consideration is to determine if you have interest in the topic or your research question may suggest asking survey questions to find out how much a person knows about a topic. You may want to write some **factual**

**questions** to find out the amount of information a person knows. These factual questions can be written in closed or open form to determine if students are knowledgeable about the topic. Students write factual questions to find out how much peers know about their subject of interest. Some question examples are:

1. How fast do you think light moves per second?
2. What is the closest star to the earth?
  - A. Vega
  - B. Canopus
  - C. Sirius
  - D. Arcturus
  - E. Kigil Kentaurus

You will want to discuss with your teacher if factual questions, which could be answered from a reliable source (e.g., web site or book) is useful. It is more appropriate to change a factual question so it relates to people, for example:

- Which Indian fact is most interesting to study?
- A. Education - Literacy changed from 14% to more than 70%
  - B. President - The current Indian president is Sikh
  - C. Christianity religion - Is the third largest religion in India
  - D. Food - A daily meal has rice and this flat bread
  - E. Family Values - Parents and disciple are very strict in India
  - F. Hindu religion - There are over 80% Hindu's in India

While you probably do not want your entire survey to have factual question, otherwise you would have a test, some may be necessary to answer your research questions of interest.

Many types of questions can be easily written after the literature review report or collection of factual information has been researched. Refer to the Survey on Alternative Fuels (see Figure 2) written by a middle school student showing a good example of different types of survey questions.

Some other question and survey ideas include using the survey form template to begin to develop and set up a variety of question types. You may also consider surveying another population instead of a **convenience sample** (e.g., like a classroom), to help disaggregate data or provide more variety of information and knowledge about the topic. For example, consider another sample group or interviewing individuals including grandparents, business leaders, teachers, or adults to disaggregate data more than just using gender and age.

## Survey Evaluation Research

**Survey evaluation** research can involve collecting data about a particular program. It is used to make a judgment about the worth of a particular activity. You may wish to evaluate how effective a new or existing program is meeting the needs of a group of people. Examples of programs to evaluate are:

1. How effective is student council?
2. How do students feel about the new after school soccer program?
3. Is quality food and service being provided by the lunch program?
4. Is study hall useful for students?

The methodology for evaluating a program involves questioning a sample of people who are involved in the program, called the **stakeholders**. The programs can be effectively evaluated by surveying all members of the group or randomly selecting members, belonging to larger groups, to complete a questionnaire you have developed. Another method for evaluating a program is to make individual interviews of the stakeholders involved in a program using your survey. Additional information or documents about the program being evaluated may be available (e.g., bookkeeping records) and worth collecting to provide further insight into the effectiveness of a program.

The particular method for questioning or surveying a program to evaluate will depend on the most appropriate research procedure you select for evaluation research. You may decide to interview using survey program stakeholders. Remember to seek permission from individuals responding to your survey.

## **Planning an Interview**

An **expert interview** is a research method that collects information directly from one or more people based on their oral feedback. It involves asking questions of a person(s) similar to those found on a survey or questionnaire. A major advantage of an expert interview is the ability to ask the interviewee follow-up questions for learning more details and specifics about your questions of interest, or to provide greater clarity and understanding about the meaning of their ideas. The expert interviewed is someone who has knowledge and accurate factual information about your research questions, or can provide an oral history of information for planning historical research. You may wish to use an audio recorder to provide more accurate collecting of information during the interview period.

An interview survey given by an entire group may be an alternative to group survey. Interviews using similar surveys can then be collected and used with TinkerPlots to analyze findings and make comparisons of a variety of responses from knowledgeable experts or stakeholders.

## **Questions to Discuss in Cooperative Groups**

1. Describe the difference between open and closed form questions, and the advantages and disadvantages of each?
2. How are statements written for a number rating or Likert scale different than those written for an observation form?
3. Explain how field-testing or piloting survey questions can reduce response bias.
4. Name some other ways to reduce bias when writing questions and statements for finding information.
5. Describe some other question writing techniques to improve the quality of information gathered?
6. When may factual questions be appropriate for a survey?

7. How is evaluation research different than giving a survey to a sample of people who are not stakeholders? What are the similarities in developing a survey?
8. What additional information may be useful to collect when conducting evaluation research?
9. How is survey and evaluation research alike and different?
10. What questions or concerns do you have about the process or steps in developing and giving a survey to your sample of subjects? What type of research do you want to do?

Figure 2. Survey Written by a Middle School Student

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**Survey on Alternative Fuels**

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**Directions:** Do NOT put your name on the survey. Please complete the survey by making a circle around the ONE best answer or writing answers in the blank(s). Answer the questions with the level of openness you would use in a class discussion. I would like to find out your interest and knowledge in learning about this topic.

**Confidentiality:** Students and teachers will see your answers. The results will be shared on a poster board in the media center. Although your name will not be associated with your survey answers, your privacy and anonymity cannot be guaranteed. If you decide while taking the survey that you do not want to participate, please put an X in the top right corner of the survey, and your survey answers will not be kept. **Thank you for taking my survey!**

1. What grade are you in school? \_\_\_\_\_
2. How old are you? \_\_\_\_\_
3. Are you Male or Female?
  - A. Male
  - B. Female
4. Have you heard about alternative fuels before?
  - A. Yes
  - B. No
5. Which alternative fuel would you like to learn more about?
  - A. Ethanol
  - B. Biodiesel
  - C. Hydrogen
  - D. Electricity
  - E. Solar
  - F. Wind
  - G. Geothermal
  - H. Nuclear
6. Alternative fuels should be used instead of nonrenewable oil, if it is more expensive.
 

1	2	3	4	5
Not agree		Maybe		Definitely
7. Do you think the world should use alternative fuels for transportation?
  - A. Yes
  - B. No
  - C. I don't know
8. Have you been in an alternative fuel vehicle (e.g., runs on E85, battery or hybrid)?
  - A. Yes
  - B. No
  - C. I don't know

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Figure 2. Survey Written by a Middle School Student (continued)

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9. Which alternative fuel do you think will benefit society the most?
- A. Ethanol
  - B. Biodiesel
  - C. Hydrogen
  - D. Electricity
  - E. Geothermal
  - F. Nuclear
  - G. Wind
  - H. Solar
10. The health of the earth is deteriorating.
- |            |   |           |   |             |
|------------|---|-----------|---|-------------|
| 1          | 2 | 3         | 4 | 5           |
| (Not true) |   | (Kind of) |   | (Very true) |
11. Are you interested in learning about alternative fuels?
- |            |   |           |   |             |
|------------|---|-----------|---|-------------|
| 1          | 2 | 3         | 4 | 5           |
| (Not true) |   | (Kind of) |   | (Very true) |
12. What would you like to learn about alternative fuels? \_\_\_\_\_
13. Which transportation vehicle do you think is the most important for using alternative fuels?
- A. Airplane
  - B. Boat
  - C. Car
  - D. Other vehicle (write-in) \_\_\_\_\_
14. Which alternative fuel do you think the government should spend the most money on?
- A. Ethanol
  - B. Biodiesel
  - C. Hydrogen
  - D. Electricity
  - E. Wind
  - F. Solar
  - G. Geothermal
  - H. Nuclear
15. Would you spend more money on alternative fuels than traditional gasoline?
- A. Yes
  - B. No
16. How much extra money would you spend on alternative fuels per fill-up?
- A. \$0.00
  - B. \$0.01 - 2.00
  - C. \$2.01 - 4.00
  - D. \$4.01 - \$6.00
  - E. Other (write-in) \_\_\_\_\_
17. We are running out of oil in the world?
- |            |   |         |   |             |
|------------|---|---------|---|-------------|
| 1          | 2 | 3       | 4 | 5           |
| (Not true) |   | (Maybe) |   | (Very true) |
18. Would you invest in alternative fuel production plants?
- A. Yes
  - B. No
19. What alternative fuel do you know the most about? \_\_\_\_\_
20. Do you think we should have a primary fuel source or a variety?
- A. One primary fuel source
  - B. Two primary fuels sources
  - C. One primary fuel and other secondary fuel sources
  - D. Use a variety of fuel sources
-

## Chapter 3 Selecting a Sample from a Population

After completing the survey it will be time to consider how to select the best strategy and appropriate group or individuals to participate in your study. If you conducted a literature review you may have developed some ideas about who to involve in your research plans. Who you select will depend on your particular type of research tool or methodology for gathering information. A survey study will require a sample or group of people selected to answer questions or statements. A survey study may require experts or identified **stakeholders**, and you may need to select a specific sample of individuals to answer your questions.

If you need to select a group of people you want to not only find the best people to provide answers to your research questions, and the most **representative** or similar to the target population from which they are drawn. To explain this more clearly we need to think about the terms sample and target population. For example, if you wrote a survey and wanted to give it to all the students in a school this would be the target population of people. Target population is explained as follows:

**Target Population:** The complete set of subjects who have common characteristics. For example, all the students at a school building makes up the population of different samples. A sample of three, four, and five year old children make up the population at a Day Care Center. A soccer team is a sample, which is part of a population of all the soccer teams in a town.

The **target population** is defined as the complete set of people having some common characteristic. For example, to be a part of the population of students in a school you would have to be a certain age. Unfortunately, it may not be practical to give a survey to an entire school population, because of the time and cost. Therefore, we have to select a sample of people to involve in our study. A sample is explained as follows:

**Sample:** The subjects or people who participate in a survey those are a group of a population of people. For example, all Native American students at a school are a sample that fills out a survey. Another example are students who are between the age of 10 to 12 at a school who complete a questionnaire.

A **sample** is defined as any subset of the target population. The picture on the next page shows a sample of Maasai people who live on the Serengeti Africa plains. The Maasai sample came from the target population of people from Loongoku village in Tanzania, Africa. While it may not be practical to survey an entire population, because of time and cost, sometimes researchers do this to get the most accurate results. This may happen when an interest survey is given to an entire school or student council elections are held. In these cases the survey is not sampling a subset of people from a total population, and we have a census. A **census** is when information is collected from the entire population. You may have heard of government agencies conducting a census to find the population of a city or country.



A sample of Maasai from a population of 175 people from Loongoku Village in Tanzania, Africa.

Because we want to gather data and information to generalize or apply to a population, it will be most important to find and select the most appropriate sample. **Sampling** means selecting a sample of subjects from a defined target population that **represents** that population. If sampling is done properly, then the information learned from a small sample of people can be generalized to the population. This is valuable because the information gathered or learned can be used for making decisions that can affect the larger population. Surveys and studies that use appropriate strategies for selecting samples can use accurately collected information for guiding decisions on the type of products to make, direct experiments used to evaluate the safety and effects of medical treatments, or advise candidates on the most appropriate campaign strategy.

In order to accurately **generalize** your findings to the population will depend if the sample of people selected is **representative** of the population from which they are taken. It is **representative** if the sample has been drawn in a way that makes it probable that the sample is similar in characteristics to the target population. For example, if your research problem is to determine if students feel bullied at school and you give a survey to one classroom (i.e., the sample) for an entire building (i.e., the target population) can you generalize your findings that bullying is a problem or not a problem at this school? Since you surveyed only one classroom, it may not be representative of the entire school and would not allow you to generalize your findings. This particular class may be different due to other reasons (e.g., passive younger aged students or gender differences). The “bully study” is an example of a selected sample which shows **variation** or error in one direction in which the sample will be different from the target population. Because of this the “bully study” can only make limited **generalizations** for the findings and report “Bullying is (or is not) a problem in the third grade class at Northwood School.”

In order to broaden and generalize your findings to the target population there are techniques to properly select a portion of the population, called your **sample**, as representing the target population. Before selecting a technique you will need to determine the **sample size** or the number of people to participate in your study. For example, if you e-mail questionnaires to 25 adults your sample size is 25. The size you decide for your sample will depend on your research goal and tool selected for your study. Other considerations to keep in mind when selecting a sample and determining its size, is reducing the possibility for error or bias to occur.

**Sampling error** has to do with the size of the sample selected from the target population. Sampling error increases as the size of the sample becomes smaller. The general rule to follow is survey the largest sample as possible. Given this rule, you will have to decide on a sample size you can handle, which is limited by the amount of time and expenses. Sometimes small samples are preferable for studies involving interviews or observation of small numbers of people. The number of people who respond is your **sample size** (i.e., the number of people asked to participate), may be affected by the type of research or methodology selected for your study. Particular research topics (e.g., athletic sports, medieval history or instrumental music) may improve or decrease the number of people who respond to questions you may ask. The number of people who decide to participate or not in your study will determine the number of respondents for a sample. For example, you contact 25 people to complete a survey and only 20 decide to respond to your questionnaire. In this case your sample size is 25 with a reported **participation (response rate)**, the percent of respondents that responded, of 20/25 or 80 percent. Even though everyone may not respond to a questionnaire, you still need to report the original number of people contacted and asked to do a survey as your sample size, and report the number of respondents in your research results.

Another factor in selecting people is sampling bias. **Sampling bias** is when there are differences between the characteristics of a sample and population from which the sample is taken. Sampling bias is reduced when you select your sample following the techniques and strategies given using **randomization**, or selecting a sample randomly. For example, if you randomly select three-sixth grade classrooms to give a survey, from a population of 14 classrooms, it is highly probable that the classrooms may represent the 14 section of sixth grade classrooms. These students may have a better chance of showing a representative sample of all sixth graders drawn from a target population that show a particular characteristic (e.g. classrooms have a high number of international and diverse students). Remember having a randomly selected sample will allow you to broaden your findings and generalize beyond the sample to the target population.

There are different techniques to properly select a sample for your research study. The method you select will depend on your research question, and depend on the particular survey questions given for participants to



A convenience sample of math students at Shighitini Secondary School in Tanzania, Africa.

answer. Each method will determine limited or broad generalizations you will be able to make when reporting the results and findings.

One type of sample is a **convenience sample**, in which the researcher or surveyor asks a group that is easy and available to participate. For example, you may want to know how students in your school feel about restricting lunch period, so you survey students in your class. Another example of a convenience sample is when you ask students their opinions about an issue and they respond by calling or using e-mail. A small convenience sample may be used when interviewing a small number of people to gather information, or knowledgeable experts in a particular field (e.g., history of a community). A convenience sample can be a useful method for gathering and learning information; however it is restricted in reporting findings and generalizations limited to the selected convenience sample size. Another sampling technique with restricted generalizations when reporting, but sometimes useful for some research questions, are a judgment sample. In a **judgment sample** an expert picks the sample based on the knowledge of a group. For example, a teacher may select knowledgeable students involved in a special activity, club or recommend staff members to survey in a particular content area (e.g., history or science faculty).

There are other techniques available to allow you to broaden your findings and generalizations beyond the sample to the target population. Three of these methods will be discussed and include systematic, cluster and random sampling.

One technique for selecting a sample is systematic sampling. **Systematic sampling** can be used if the members of a defined target population have been already placed on a list. This list could include a computer school database, phone directory or census directory.



A potential cluster sample group on pilgrimage learning about the history of the Isle of Iona in Scotland.

Follow these procedures for using systematic random sampling:

1. Count the total population number on the list (e.g., 500).
2. Divide the population by the number needed for the sample (e.g.,  $500/25 = 20$ ). This means you will ask every 20<sup>th</sup> person on the list.
3. Select a random number smaller than the division number answer found (e.g., 16).
4. Starting at that number select every 20<sup>th</sup> name from the list of the target population (e.g., name number 16, 36, 56, 76 and so on until 25 names have been selected).

Systematic sampling uses randomization (i.e., sample selection is made by using number patterns or units), but each person in the population is not chosen independently. This means once the first subject has been selected, all the other people in the sample are automatically determined.

**Cluster sampling** is another sampling method for selecting a group from a target population. It is used when it is preferable to select groups of people, than to pick individuals from a target population. For example, maybe you want to survey a neighborhood or district to find out their opinion about an issue. Using this sampling technique you could select 20 blocks at random and survey everyone on those blocks. A **random sample** is one in which each person in the target population has an equal chance of being selected for your study. For example, if our target school population has 75 students, we could randomly select 15 students for our sample by giving each person a number, placing the number in an envelope and selecting 15 numbers. An alternative method would be to assign numbers to a school list (e.g., directory), place numbers in a container and then draw the number needed for the most appropriate sample size.

The best method, which allows you to broaden your findings and generalizations to the target population, is **random sampling**. This can be more complicated and difficult if you select a random sample from a larger population. For example, sampling from a national population happens when surveys are given about public opinion polls. For your research study random

sampling can become more manageable and easier to achieve since in many cases your target population will be smaller (e.g., a middle school). **Simple random sampling** is one procedure to select your sample in which all the names of the target population are placed in a hat and drawn until you reach the desired number of your sample. For example, if you draw names of all the students at a school and select 25 out of a box you have a simple random sample. A version of simple random sampling is **stratified sampling** in which you divide the sample into strata on one characteristic (e.g., grade level or age) and choose random samples from each stratum.

You have learned some techniques and strategies for selecting a sample from a target population. It is now time to think about an appropriate sampling technique to answer your research questions. You may need to decide on a strategy for randomly selecting a sample to represent the target population. It may be important that your sample represents the population and/or most accurately provides the information you want to learn and discover. You may also need to consider the type of sample selected may be determined by the amount of time available to survey participants or you may be unable to obtain target population data from which to select a sample (e.g., current list of all students who participate in after school clubs). Frequently students use a convenience sample (e.g., classroom of students) to give their survey because of limiting time factors.

## Summary Power Notes Outline

The article reading is summarized into **power notes** to assist in organizing and understanding the major ideas in selecting a representative research sample. The power note outline was written to facilitate discussion ideas to help students select an appropriate representative research sample to survey.

### Outline on Selecting a Representative Research Sample

1. Group levels (large to small):
  2. Census: An entire population (e.g., city)
  2. Target population: Complete set of people having a common characteristic (e.g., city school district soccer teams)
  2. Sample: Subset of subjects that represent the target population (e.g., soccer players aged 8)
1. Sampling considerations for selecting to a sample to strengthen research findings impact
  2. Sampling: Select subjects to create a sample representing the target population
  2. Sampling appropriate techniques important to select a sample that represents the target population so that:
    3. Findings can be generalized (e.g., A majority of eight year olds reported poor sportsmanship is a problem in the school district soccer program.)
    3. Reduce sampling bias: Allows researcher to accurately generalize findings beyond the sample to the target population

1. Sampling techniques to generalize findings and reduce bias is supported by selecting a sample randomly from the target population and include these strategies:
  2. Simple random sampling: Drawing names (e.g., out of a hat) of the desired number of people for your sample from the entire target population names placed in a container
  2. Stratified sampling: The sample is randomly selected after being divided into strata based on a characteristic (e.g., age)
  2. Systematic sampling: Use a list defining the target population (e.g., school data base or directory) and selecting every  $n^{\text{th}}$  name off the list (e.g., every 20<sup>th</sup> person listed)
  2. Cluster sampling: randomly select naturally occurring groups from the target population to survey (e.g., randomly select five students from each classroom at a middle school)
1. Conditions that restrict survey findings and do not permit to generalize finding beyond the sample to the target population:
  2. Convenience sample: Survey a group readily available (e.g., classroom of sixth graders)
  2. Judgment sample: An expert picks the sample based on the knowledge of a group
  2. Sampling error (variation): The size of the sample selected from the target population is small due to participants not willing or available to complete a survey
    3. Sample size: The number of people asked to complete a survey
    3. Participation (response rate): The number of people selected who complete a survey

Power notes are used as an organizational scheme for summarizing information at different levels.

### Questions to Discuss in Cooperative Groups

1. How is a sample related to the target population?
2. What is the difference between random sampling and a census?
3. Explain the difference between a random, systematic, cluster, judgment, stratified and convenience sample. Which sampling technique allows you to generalize your findings beyond your selected sample? Why?
4. Name some sources of sampling bias and ways to reduce error.
5. What would be the most appropriate sample and sampling technique for your survey research? Do you anticipate any sources of bias, error or limitations using this selected sample? Are there any other sample options or sampling techniques for consideration?
6. How does survey participation (response rate) affect your findings?

## Chapter 4 Writing and Evaluating a Research Hypothesis

The **hypothesis** is a researcher's predicted explanation or opinion about the results of the study based on their research question about the topic being investigated. The hypothesis should give a predicted student answer to a survey question. The hypothesis predicts how a sample of people will answer a questionnaire, or complete an evaluation survey.

The hypothesis is written for research involving making predictions about a sample of people with respect to a target population and outcome for a comparative study. This type of research with sampling usually occurs with survey studies or questionnaire given to evaluate opinions and evaluate program effectiveness.

It is not uncommon to write more than one hypothesis predicting several outcomes before you use the research tool to gather data. Moore (1983) presents four ideas to think about when writing and evaluating your hypothesis to be effective. The first consideration is that the hypothesis is written as briefly and clearly as possible, such as the following:

Significant differences will be found between male and female students in selecting their favorite kind of wild animal.

Another idea to remember is that the hypothesis is written as a statement showing a relationship between two attributes. In the previous hypothesis we have two attributes being compared, which could include a personal profile (e.g., age or gender) with a survey question (e.g., suggesting favorite or preference). A third consideration is that the hypothesis is testable and workable as it relates to your research question. This means the hypothesis has to do with your topic being researched, and that the two attributes written in the hypothesis can be tested.

Another consideration suggested is that the hypothesis be supported by literature review information (i.e., taken from a theory or model), researched or personal experience. Moore reports the first step in writing a hypothesis is usually based on some intuition, experience or thought we have had. The next step is a period of gathering information and reviewing research to support our hazy ideas. Step three is to clearly state the prediction and reasons behind our thinking. After making a review of the literature about your questions and research goal, support is provided for the hypothesis. Some examples of hypotheses written by students, which support the ideas suggested by Moore, are:

1. A majority of female students will report geometry math as their favorite school subject.
2. Students will have a favorable attitude toward how much they would like to travel to another country in Europe.
3. No significant differences will be found in student's preference toward different kinds of organic food.

The third hypothesis written above may be useful when using the words "no significant differences." This means that students will report about the same number of responses when asked a question about their favorite kind of

organic food. Significant differences suggest students will show answer preferences, or in this example select favorite kinds of organic food.

Another thought about the hypotheses is writing them in a way that will not result in statements showing bias or personal opinion. You want to write a hypothesis that is clear and free of personal bias, such as:

1. We will show and prove that geometry is a favorite school subject for females.
2. Our students have a better attitude than any in how much they like to travel to Europe.
3. Students won't care what kind of organic food they eat.

Biases in writing a hypothesis and predictions will only increase the chance of error in our study of interest, and possibly reduce the accuracy of our research gathering of collecting information.

## Evaluating Hypothesis Outcomes

After you finish analyzing and reviewing you data findings and TinkerPlot graphs you will be ready to reject or support (accept) your **hypothesis** prediction. To evaluate your hypothesis you will need to add the hypothesis with your findings statement. This is usually done in the following ways:

- I reject the hypothesis and found . . . A majority of students reported ...
- I fail to reject (support) the hypothesis and found . . . Students reported having . . .
- Significant differences (or no significant differences) were found in . . .

Therefore, I reject (or fail to reject) the hypothesis that . . .

After some thinking and practice students become successful in writing their hypothesis outcomes. Some examples written by students are as follows:

1. I fail to reject the hypothesis because graph 7 shows that most students (n=10) picked Yellow Stars more then Red Dwarfs and Blue Giants (graph 7) as the most common in the solar system.
2. I fail to reject my hypothesis because a majority of the people selected Buddhism (n=11) rather than Hinduism, Islam, or Jainism (n=9) as the religion students know most about (graph 3).
3. I reject this hypothesis because seven out of eleven girls reported having heard medieval style music before.
4. I reject my hypothesis since eleven out of twenty people couldn't report the main cause of pinkeye (graph 14).
5. I fail to reject the hypothesis that students think the brain is interesting. Graphs 7 show that a majority (n=70%) thinks it is interesting.

After some thinking and practice students become successful in evaluating and writing their hypothesis outcomes.

## Questions to Discuss in Cooperative Groups

1. In your own words, what is a research hypothesis?
2. What does “significant differences” and “no significant differences” mean written as a hypothesis statement?
3. Brainstorm at least two workable hypotheses to share and evaluate with your classmates or in cooperative small groups. Use the words “significant differences” in one of your hypotheses.

## Chapter 5 Understanding TinkerPlot Data and Graph Statistics

Now that you have your data of information entered on Data Cards, shown in the Case Table, and typed in Text boxes you are ready to begin to study the **statistics** about the sample of people who participated in your study. Statistics is used to describe and summarize all the scores or information data. Statistics allows you to find out more about your survey data, and helps explain the results and answers of information collected. The TinkerPlots program allows you to easily show on the graphs some descriptive statistics results, such as raw scores, percent, mean, mode, median, range and score variability (e.g., display a box or hat plot).

### Types of Measurement Scales

Before you make TinkerPlot graphs using attributes on your data cards to effectively display statistics, it is important to learn and understand the differences between attribute and variable measurement scales. In other words before comparing attributes using TinkerPlots it will be necessary to understand the type of measurement scale you are working with and assigning variable names. This will help you understand your data graphs and make comparisons between attributes, which are meaningful for presenting valuable information to answer your research questions.

As discussed earlier, you will explore the relationship between two attributes when making your TinkerPlot graphs. The one attribute is an **explanatory attribute** with different levels and the other is a **response attribute**, which shows a score or number value. For example, if a survey question asked boys and girls to select their favorite hobby among five possible choices, you could create two attribute names one called “gender,” to show boys and girls, and the other called “favoritehobby” to show the answer choices on each data card. In this example “gender” would be the explanatory attribute and “favoritehobby” would be the response attribute, because “gender” shows two levels and “favoritehobby” gives the number value of choices. We would find making a TinkerPlots graph showing the relationship between these two attributes to, hopefully, provide some meaningful comparison information. By selecting one explanatory attribute with another response attribute you can gather some meaningful scores and data including finding the number of responses (frequencies), percentages and learning which item(s) was selected the most often (i.e., mode scores).

If you know the measurement scale for the attributes in your research study, then the guesswork and hassles over which ones to use and compare can be minimized. This will also be helpful when using a meaningful created graph for providing other statistics information. Another way to look at explanatory and response attributes is making the distinction by assigning a similar name for the numerical and categorical variable. A **categorical variable** is a measurement that shows the categories or levels of an attribute. For example, you could assign a number or symbol (i.e., letter or word) to show

the categories of gender, like “f or 1” for females and “m or 2” for males when entering values for the attribute name. Another category example would be assigning a number or symbol value to a question response for how much you like or dislike something. In this example, “L or 1” for like and “DL or 2” for dislike could be category values for the attribute names. Remember, the numerals given to an attribute only show the category each subject is in and can’t use mathematical operations (e.g., added, subtracted, multiplied or divided) to get a value. **Numerical variables** are a measurement that uses numbers to show relative position (i.e., order), and equal units or intervals. Examples of numerical variables are:

1. The class-rank of students with score from least favorite soccer team rankings of 1 to highest scores of 10.
2. Attributes show years A.D. (e.g., 1985) and Fahrenheit temperature.

Attributes show time, weight, distance, height and Kelvin temperature.

Numerical variables differ from categorical variables in that the numbers take a particular position, separate the order of the group or show quantity or amount. Many times these numbers can be added, subtracted, multiplied or divided to get a value; while categorical variables usually show the category each subject is in and may not permit use of mathematical operations. If numerical variables show position on a scale (e.g., rate from one to six), then additional statistics information can be collected. For example, a survey question using a rating scale may ask students, “How interested would you be in traveling to China?” This question and scale is numerical showing intervals, which allows the researcher to calculate or show on TinkerPlot graph statistics averages or mean.

Knowing the measurement scale for the variables you create using TinkerPlots, along with understanding the difference between explanatory (categorical) and response (numerical) attributes, will be helpful in making meaningful graph comparisons. This will ultimately lead to selecting the most appropriate descriptive statistical procedure to explore your survey data and report the findings.

## Understanding and Showing Data Sample Counts

A **statistic** is a number calculated from the data. A good place to begin your study of data statistics is to find information about the sample of people drawn from the target population. As you begin to construct TinkerPlot graphs you will want to display and report **frequency, proportion and percentage** of a subgroup that were in your sample. These terms are explained as follows:

$$f = \text{head count}$$

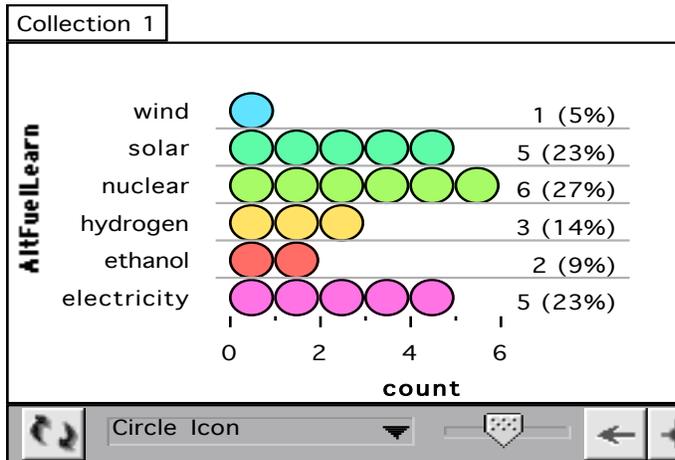
**Frequency (*f*):** the number of subjects in a particular category subgroup (for example: the number of girls in a classroom).

$$p = \frac{\text{subgroup}}{\text{total group}}$$

**Proportion (*p*):** the ratio of a subgroup to the total group, recorded as a decimal from 0.0 to 1.0.

$$\% = p \times 100$$

Figure 3. Counts and Percentages of Student Interest in Learning about Alternative Fuels



**Percentage (%)**: the proportion of a subgroup to the total group, recorded as a value from 0% to 100%.

You will find the frequencies and percentages of a subgroup that participated in your study using TinkerPlot graphs to show these basic statistics. You can simply use the TinkerPlot program tool button to display the frequency by pressing the **n** button and/or selecting the **%** button. An example of a graph showing frequencies with displayed percentages is shown in Figure 3.

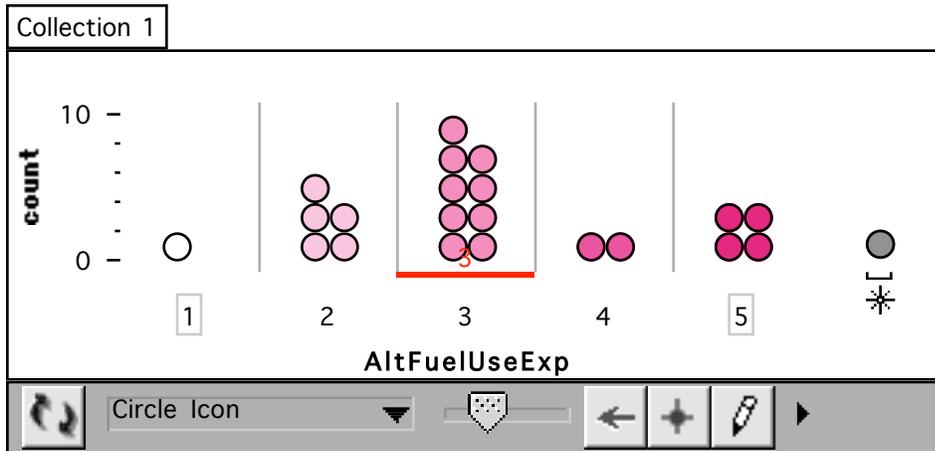
### Understanding and Showing Basic Statistics

As TinkerPlot categorical and numerical attributes are selected to create graphs, you may want to show on the graphs and report the mode, median and mean. Depending on the type of attribute, you can display these basic statistics values with the TinkerPlot program. You will discover these basic statistics can only be shown on your graphs for numerical attributes. The mode score could be shown for categorical attributes by showing the frequency of scores, using the **n** button, and then selecting the highest “n value score” as the mode.

The **mode** is helpful statistic when examining frequency scores of your data. The mode is the most frequently occurring score in a group. You will be finding the most frequent response for your TinkerPlot graphs. The mode is useful in describing the distribution of the data or the location of a “hump” or cluster of scores in the numerical data.

To display the mode on a graph select the small black triangle (next to the blue triangle), which is called Average Options. Pull down the window and select Show Mode and Show Numeric Value(s). This will display a line on your graph with the mode value(s) shown as a whole number. See Figure 4 as an example of a graph showing a mode score.

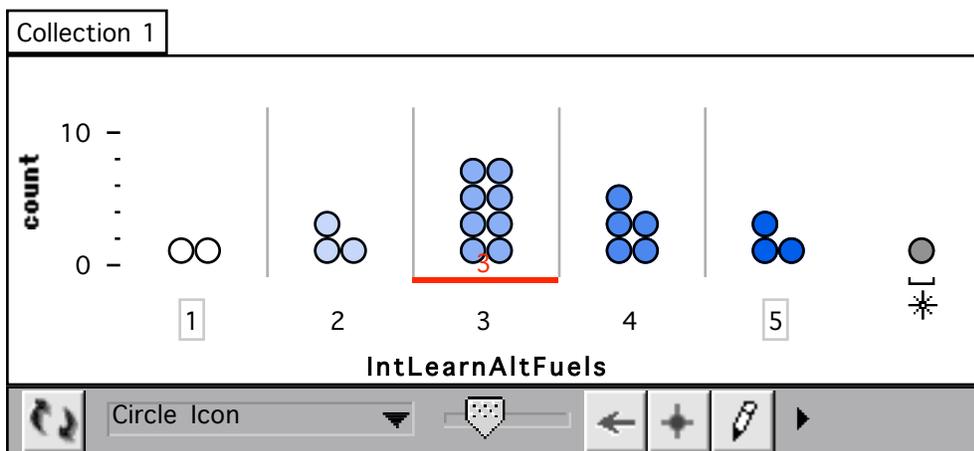
Figure 4. Mode Value Showing Student Interest in Using Alternative Fuels if More Expensive



The **median** is another helpful math statistic when examining frequency scores of your data. The median is the midpoint (middle) of a group of scores ranked from lowest to highest (or highest to lowest). If you have an even number of scores, or two middle scores, find the mean or average of the two. Median is another statistics measure to look at the central tendency of survey scores. The median has the advantage of not being effected by extreme scores in a distribution of scores. The median is the value that divides the data set into two equal parts.

To display the median on a graph click on the menu bar the red up side down “T” (Averages is written below it) to view the line showing the mode values on the Plot. Select the small black triangle (next to the blue triangle), which is called Average Options. Pull down the window and select Show Median and Show Numeric Value(s). This will display a line on your graph with the median value shown as a whole number and a decimal. Figure 5 shows a graph with a displayed median value.

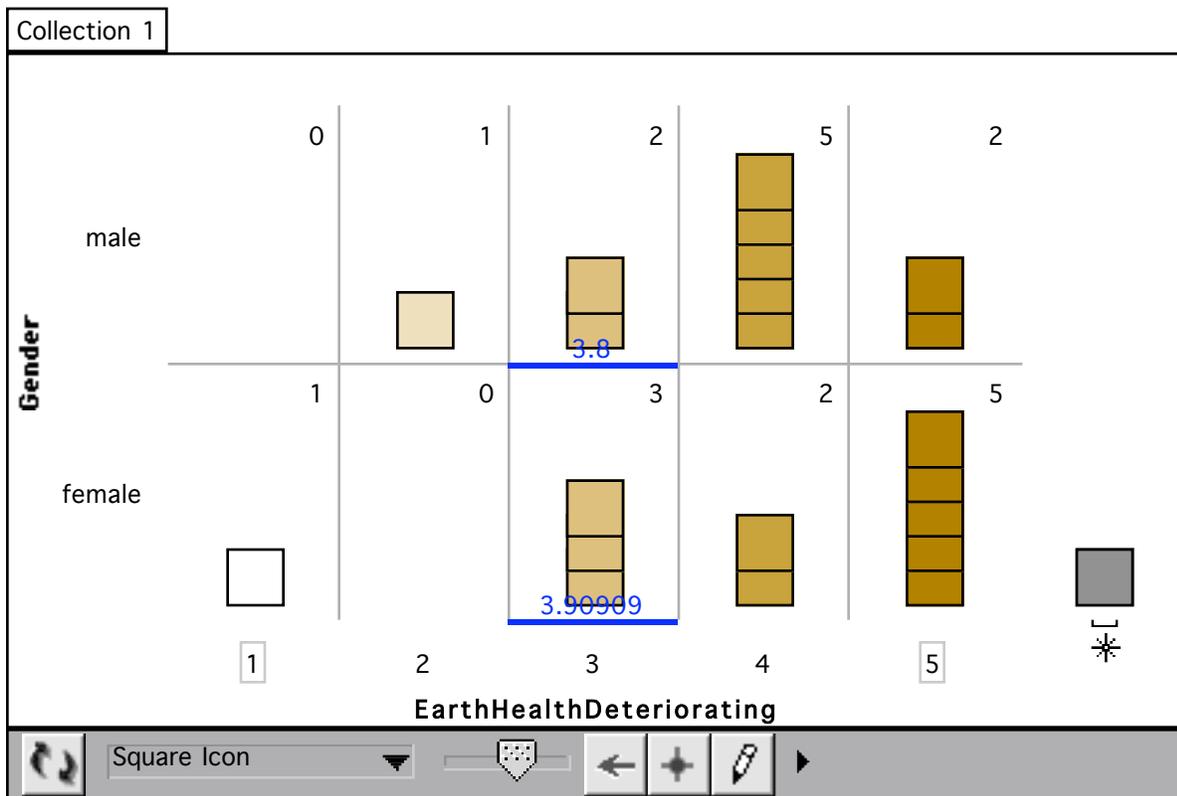
Figure 5. Median Value Showing Student Interest in Studying Alternative Fuels



An important statistic is the **mean**. It is one way of indicating the center of a set of data. You will find the mean values for a set of numbers shown on your TinkerPlots graph. You will display the location of the mean on a graph. The mean is the average of a group of scores. The mean is often called the average, however the average does not necessarily refer to the mean. The mean is one type of average. When you summarize using mean you lose some information about the original data. By knowing a central tendency statistic (e.g., the mean score of a group), you can gain a “typical” or “average” performance for a set of data.

To display and report the mean value for a TinkerPlots graph select on the menu bar and click the blue triangle (Averages is written below it) to view the line showing the mean values on the plot. You can then select the small black triangle (next to the blue triangle), which is called Average Options. Pull down the window and select Show Numeric Value(s). This will record on your graph actual mean values shown as a whole number and decimal. A graph with a displayed mean value is shown in Figure 6.

Figure 6. Graph With Mean Values Showing Student Views by Gender Rating the Health of the Earth as Deteriorating



## Questions to Discuss in Cooperative Group

1. What type of survey data can you show the mode score?
2. Which graph would be the most appropriate to find the mode scores for your survey project?
3. Is it possible to have any tie score for a question? Does a tie scores appear as one or two “humps” in a data set? What does this tell you about your data and distribution? Does this statistic provide information about your research question of study?
4. What if a graph selected will not display the mode value or score? What does this tell you about your attributes or data?
5. What type of graphed survey data is most appropriate for showing the median?
6. How is the mode different from the median score?
7. What does the median score tell you about the data and distribution?
8. Does the median provide information about your research question of study?
9. What if the scores were more “clumped” together or spread out on a TinkerPlots graph, how would this effect the median score?
10. What if a graph selected will not display the median value or score? What does this tell you about your attributes or data?
11. How does the mean help to explain your survey findings and explain survey questions results?
12. Will any of the data plot or graphs showing the mean, answer your research prediction or hypothesis for a survey question? If so, how was the hypothesis question answered?
13. What if a graph selected will not display a mean value? What does this tell you about the data?



The study of energy is a timely topic especially for cities growth and development like Auckland, New Zealand.

## Chapter 6 Understanding Data Variability on TinkerPlots Graphs

As you study your TinkerPlot data you will normally find variability in the scores shown on the graphs. It will be necessary to report this data variability, especially if the results answer the hypotheses or your research questions. Two methods for reporting variability are calculating the range and/or creating a hat or box plot. Both of these methods will be discussed as ways to gain better understanding to report your survey findings.

### The Range

The easiest method to explain variability in data, as shown on your TinkerPlots graphs, is to make a simple calculation of the range value. The **range** is the difference between the highest and lowest score of a group. The range measures the variability or spread of your survey question scores. A high range value score would indicate differences in question responses, while a lower score would suggest more evenly distributed answers to a survey question item. High range scores may suggest “significant differences” in a sample’s response to a question. Range scores can give an indication how much the sample likes or dislikes, or agrees or disagrees to an idea or question asked on the survey.

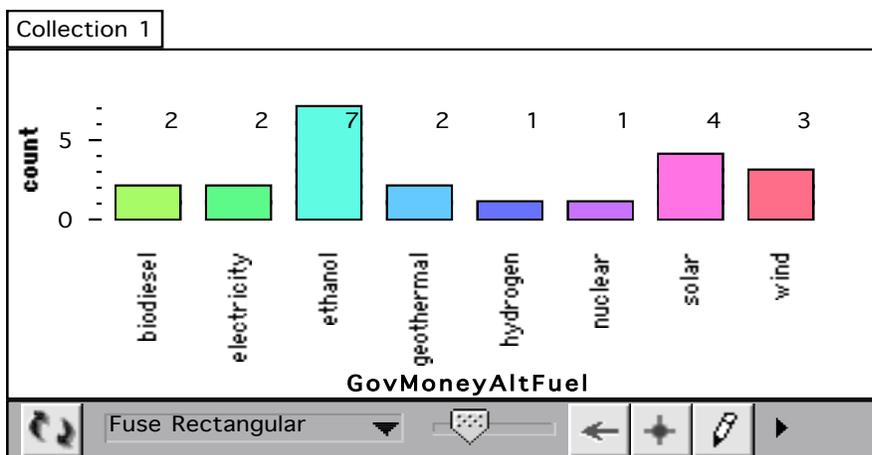
Range is the most basic measurement found by subtracting the highest score from the lowest score. You can find the range for one of your sets of TinkerPlots graphs by recording the highest and lowest score on the graph to find the range value. The simple formula for finding the range value is:

$$\text{Range} = X_{\text{Highest Score}} - X_{\text{Lowest Score}}$$

$$\text{Range} = \text{-----} - \text{-----}$$

After finding the range value or score you can then explain what it means indicating the amount of differences (i.e., agreement or disagreement) about a particular survey question item. Figure 7 shows a range value of  $7 - 1 = 6$ .

Figure 7. Student Variability on What Energy Government Should Spend Money



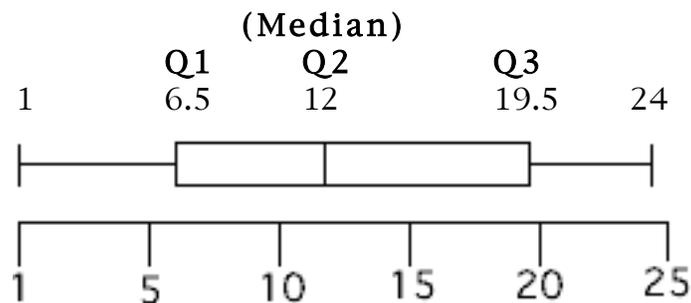
## Questions to Discuss in Cooperative Groups

1. What does the range value tell you about your data and survey question?
2. What if the range is calculated by more than one attribute (e.g., gender or age)? What could you learn about your data?
3. Explain what the range score means as it relates to your survey question data.
4. Will any of the data plot or graphs with a calculated range value, answer your research questions or hypotheses for a survey question? If so, how was the research questions or hypotheses answered?

## Showing Box Plots and Hat Plots With TinkerPlots

You can change data graphs easily into a box plot using the TinkerPlots program. A method to show variability, to compare different categories (sets) of data, is creating a **box plot** graph. The box plot shows the distribution of scores for a data set sample.

Before making a box plot graph it is important to understand what a box plot shows. A box plot visually shows the amount to which a group of scores spread out from the median, or mid-point of the data set. An example of a box plot showing a data set of number is shown as follows:



Graphic Source: The Shodor Education Foundation, Inc. (2004). *Box Plot Discussion*. March 16, 2004, <http://www.shodor.org/interactivate/discussions/boxplot.html>

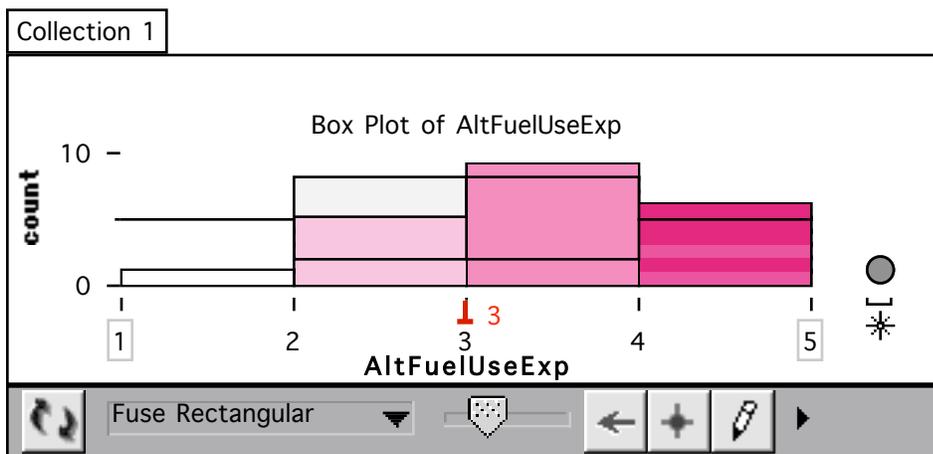
In the example Shodor (2004) reports each vertical line shows an important number in the data set. These lines show the regions and spread of scores about how people answered your questions or statements. The meaning and calculations for these lines are discussed using the example data set shown above. The first and last lines are drawn to show the lowest and highest data number values. The three vertical lines that make up the box show 25 %, 50 %, and 75 % of the way through the data list. The example shows the data set 1, 4, 9, 12, 16, 23 and 24. If we would calculate the **median** it would equal 12 or the 50 % Quartile 2 (Q2 is the median) region. The first **quartile** (Q1) or lower 25 % region is calculated by finding the median of the bottom half of the numbers. The Q1, which is the median of the bottom half of the numbers 1, 4, and 9 equals 4. The top third quartile is found by finding the median of the top half of numbers. The Q3 median of the numbers 16, 23, and 24 equals

19.5. Shodor’s example shows a clustered group of scores with **outliers**. This result in showing a high range value, therefore it is important to look at quartiles for a closer look and understanding of the data.

After the quartile calculations are made, then a rectangular box is drawn with horizontal lines connecting Q1 to Q3 going through the Q2 median score. The drawn box plot represents the difference between Q1 and Q3, and shows half of the people (sample) responses to an item (e.g., survey question). If a shorter rectangular box is shown then scores are grouped closer together in the quartile regions suggesting a similar distribution, while those that are spread out more widely in the graph (i.e., show a longer box shape) tell you that the sample of people who responded to a survey question differ in their responses (e.g., agree, disagree, like or dislike something). The surveyor may consider repeating their study of the group to see if they get similar results. For example, it may be necessary to ask different questions as to why the sample like or dislikes something (e.g., Why do some students prefer to study certain kinds of alternative energy sources?). When studying clusters of numerical data (i.e., scores that are on ordinal, interval or ratio scales) you need to look at the distribution of scores and study the shape, including outliers in the data set. **Outliers** are extreme scores represented by one or few responses. The center or location and spread give you an idea of respondents’ opinions about something. Mean and median were two ways to indicate the center for a data set of scores.

To display a box plot on your graph begin by clicking the black triangle next to the hat icon and select “Box Plot” in the pull down window. Note: the graph needs to be displayed as a Fuse Rectangular icon type to work. A title will then be displayed on the graph. Experiment and “play around with” these features of TinkerPlots and display other box plots of your data. See Figure 8 as an example of a graph showing a box plot, and explanation of results.

Figure 8. Box Plot Graph with Median Score



The spread of the box plot around the median suggest students differ in their interest and support for use of alternative fuels.

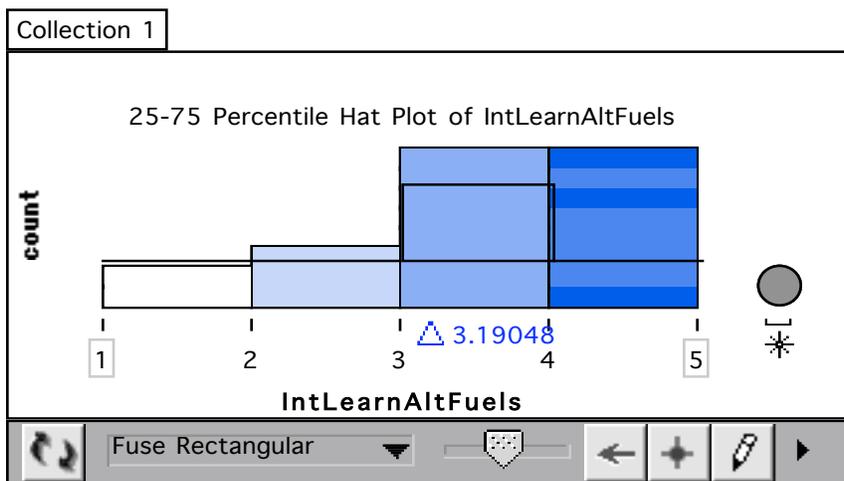
You can change data TinkerPlots graphs or box plots easily into a hat plot using the TinkerPlots program. Another method to show variability, to compare different categories (sets) of data, is creating a **hat plot** graph. The hat plot is another way to show the distribution of scores for a survey sampled.

Hat plots look like a hat that is divided into regions or sections, like the box plot. The hat plot is divided into three percentile or range sections. The central “crown” section of the hat is like the rectangular box region representing the spread or distribution of scores. The shorter hat “crown” shows similar responses, or suggests the sample of people tend to agree on how much they like or dislike something. Conversely, a longer hat “crown” shows a spread in distribution of scores and sample differences in their responses.

The hat plot also can show average or standard deviations. **Standard** or **average deviation** are measures of the amount to which a group of scores on average, are spread out (deviate) from the mean. If scores deviate, showing a lot of variability about a mean score, then the researcher may want to find out the reasons for the low and/or high scores. For example, why do some students differ so much in how much they like or dislike something? The researcher may want to survey the group again to find the answer. To find out more about using the TinkerPlots hat plot select Help from the top menu bar and view the contents menu. Select “Hat Plots” under the title “Working with Plots.”

To display a hat plot on your fused rectangular graph begin by clicking the black triangle next to the hat icon to select other hat options for viewing of the graph data. Graph titles will change to show the selected hat options including a Range Hat, Average Deviation Hat and Standard Deviation Hat. Experiment and “play around with” these features of TinkerPlots and display other hat plots of your data. See Figure 9 as an example of a graph showing a hat plot, and explanation of results.

Figure 9. Hat Plot Graph with Mean Score



The spread of the scores around the mean suggest students differ in their interest, with moderate support, in learning about alternative fuels.

## Questions to Discuss in Cooperative Groups

1. Explain the purpose of a box and hat plot, and how it provides further information about your survey data and information findings.
2. What does the interquartile range represent?
3. What are the similarities and differences between a hat and box plot?
4. Which measure of variability, the hat or box plot, would you prefer to use to study and report about the deviation of scores?
5. Looking at the box or box plot graph, what does this tell you about your data?
  - Were the quartile score regions close together showing a similar distribution or spread out far apart?
  - Did the sample of people answering an item (e.g., question) tend to agree or disagree in how much they liked or disliked something? How can you tell by the box plot graph?
  - How would these results affect your findings if you were going to change a survey question and sample a different group of people?



A view of the library at Ephesus near Kusadasi in Turkey showing evidence of a significant number of tourists, while other more remote archeological Greek sites had few visitors indicating a range or variability in tourism. This variability may be due to several factors including energy costs and greater distances for travel.

## Chapter 7 Writing About Your TinkerPlot Graphs and Findings

After finishing analyzing your findings and creating TinkerPlot graphs you will be ready to write the report to explain results from the research project. Be sure to include your most important results, findings, conclusion and recommendations for your survey study by reporting the TinkerPlot data shown for the graphs, table and text boxes. Some guidelines for writing your survey report for a research article or placing on a poster board is provided, to effectively share results with others.

Your report will include findings from the sample of people who responded to your survey, particularly the research questions to answer about the research topic. Other important findings selected as important and informative you will also want to include in the report. It will also be necessary to include in the report the results from your **hypothesis** predictions. Refer back to the chapter of this text on Writing and Evaluating a Research Hypothesis and the section on Evaluating Hypothesis Outcomes to provide help in writing your hypothesis evaluation statements.

Your teacher will provide the format and form for summarizing your research and writing the first draft. Examples of middle school students' reports are shown in Figure 10 and 11. As noted in this report it is important to write in complete sentences using necessary spelling and grammar rules, which can be checked using a word processing spelling and grammar tool. Some other general rules to follow regarding the use of numbers and strategies to report results and findings will be discussed in this chapter.

Figure 10. Research Report by a Student on Alternative Fuels

- 
1. Researcher: Student's name
  - PURPOSE
  2. Research question  
How do different alternative fuels benefit the environment?  
Are there significant opinions on or about alternative fuels?
  3. Research Goal:  
To learn about alternative fuels, but also to learn about what other peoples' opinions are. I also want to learn about alternative fuel sources and benefits for the economy.
  - BACKGROUND RESEARCH
  4. Summary of background research - See report copy
  5. Bibliography for background research - See report copy
  - SAMPLE
  6. Describe the sample and why you selected the sample  
There are ten males and twelve females. All of the survey participants are in 6<sup>th</sup> grade. The student ages are 10 eleven-year-olds and 12 twelve-year-olds.
  7. Population your conclusions should apply to  
The target population is Ames Middle School 6<sup>th</sup> grade students in Ms. Daniel's class.
  8. Sampling method and possible sources of bias  
I used a convenient sample, and a possible source of bias is the knowledge of increasing production of ethanol and biodiesel in Iowa, the state where the survey took place.
  9. The response rate was 22/24 or 92 percent.
  - METHOD
  10. Describe the survey. Explain how it was written and how you collected information from your sample.  
I researched various alternative fuels on the Internet and transferred some of that researched information into a report. Then from my facts and report, I wrote up questions relating to my research field. Most of the questions on the questionnaire inquired about the students' opinions.
-

## Figure 10. Research Report by a Student on Alternative Fuels (continued)

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11. Survey – See attached copy

### HYPOTHESES AND FINDINGS

12. First hypothesis statement

Students will report no significant differences in their opinions on various fuel source choices.

13. First hypothesis findings

My findings reject the hypothesis because the majority of the participants (n=12) answered a variety of fuel sources (graph 9).

14. Second hypothesis statement

There will be significant differences reported in alternative fuel(s) students want to learn more about.

15. Second hypothesis findings

My findings support my hypothesis because the participants' answers were widespread and diverse.

16. TinkerPlots – See graph printouts

17. Other important findings from the TinkerPlots graphs

If asked are you interested in learning about alternative fuels a majority of students (males mean 2.8 and females mean 3.6) were “kind of” interested in learning about alternative fuels (graph 2). A majority of students (n=11) were interested in learning more about solar and nuclear energy. It was also found that approximately 63 percent of the people surveyed responded to one of the free response questions about what would you like to learn about alternative fuels. Most people wanted to learn about how alternative fuels are made, work, quantity that can be made, and how they effect the environment.

When asked, do you think we should have a primary fuel source or a variety there were significant differences in the participants' taking the survey opinions on what kind of fuel source should be used (range = 11). Graph 5 shows of the 12 people said “yes” when asked if they would invest in an alternative fuel production plant, while 11 said they would spend extra money on alternative fuels per fill up. Graph 14 shows that of the six participants that “agreed” or “strongly agreed” that alternative fuel should be used instead of traditional gasoline, 66.6 percent said they'd spend \$0.01-6.00 on alternative fuels per fill up.

Finally, it was found the most common answers (mode = 4) were that people agree or strongly agree that the health of the earth is deteriorating (graph 3).

### MODIFICATIONS

18. Recommendations if the study is repeated

I would recommend to future surveyors to include several right and wrong questions that would test their knowledge on alternative fuels and on present day topics (i.e. 1. Do you know what President Bush said on alternative fuels in his state of the Union speech? 2. What is ethanol made from?) I would also survey a variety of populations (i.e., one class from grades 1-6, 6-12, several researchers, farmers, teachers, and adults).

### CONCLUSIONS

19. Concluding ideas about your research question

I found from my report different alternative fuels like ethanol, bio-diesel, hydrogen, wind and solar energy have benefits for the environment. From the survey it was learned that people had a variety of opinions and ideas on which alternative fuel they thought were the most beneficial, or wanted to learn more about.

### RECOMMENDATIONS

20. Recommendations for action based on your conclusions

Since there appears to be interest among students in studying and using alternative fuels, along with knowing about the energy problem, this study should be followed-up by interviewing students, teachers and administrators on how to put into practice the use of these alternative energy choices at our school. Is it possible to raise money to place solar panels or install a wind generator at our school?

### REFLECTION

21. What I learned by doing this project

I learned how some alternative fuels are made, and how alternative fuels affect the economy and environment. I also learned how to write a survey, use TinkerPlots and write the results and report the findings.

---

Figure 11. A Student Summary Report on Greece Today and Yesterday

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Research Summary

My research question was if Greece sounded interesting for people to study. The goal of my research was to find out about Greece and who was interested in it.

My sample was of my homeroom class; I chose that because of its convenience. The population my conclusions apply to is the sixth grade M team. My sampling method was to choose one of the M team classes or my homeroom. A possible source of bias was on the survey question about the favorite Goddess or God because of the amount of information given for each one was. The response rate of my sample was 100%, meaning that 100% of the people who were given the survey responded.

The survey asks about people's interests in Greek Gods and Goddesses, Olympics, government, and climate. I collected this information off of the Internet.

My first hypothesis was that there would be no significant difference in whether people want to Greece or not. I reject this hypothesis because many more people prefer to travel to Greece. My second hypothesis was that most males would select Zeus or Hades as oppose to most females who will select Apollo or Poseidon as the Goddess or God they are most interested in. I reject this hypothesis because most males selected Poseidon instead of Zeus or Hades, and females selected a wide variety of different ones.

I found that most students would rather race than fight (graph number 1). Graph number 2 shows that few people chose the Acropolis as the landmark in Greece they would like to go to. I found that the god most people were interested in was Poseidon (graph 3). In graph 5, I found no significant difference in what currency people thought belonged to Greece. A majority of people were, somewhat interested in Greek Gods and Goddesses (graph 7). Most people (n=11) thought that Greece received a normal amount of rain (graph 8). Fourteen people thought that Piraeus was not the capital of Greece (graph 9). A majority of the people's first interest was to study Greek mythology (graph 10). No significant differences were found whether people thought there were a certain number of seats in the Greek legislature.

If the study were to be repeated, I would include some people from every class on the M team, since some classes may have studied Greece and some may not have. I would change my hypothesis to one about Olympic sports.

I now conclude that some people knew quite a bit about Greece, and appear to have some amount of interest in the topic. Some people on the other hand know less about Greece and show little interest in studying Greece. Some people are just in between. So, there really isn't a significant difference in whether they are interested in Greece or not.

A recommendation would be to try surveying more people. I would make copies of the report I wrote and pass it out to those who took my survey so they can compare what they said to what's on the report.

I learned much about the Greek Gods and Goddesses, about the Greek culture and about Greek government. I found out that many people were somewhat interested in Greece. I learned a lot about Greek culture and life.

---

## General Number Rule

While usage varies usually you should spell out numbers that can be written in one or two words and use figures for other numbers (The Writing Lab and Owl at Purdue 2008). Typically figures are recorded to write numbers 10 and above (e.g., 13 years old) and words for numbers less than 10 (e.g., eight students). Exceptions to this rule applies when reporting data and findings using numbers which make comparisons, show mathematical or statistical use, and represent time. Examples of these exceptions are:

Mean = 4, 9 %, 3 of 21 surveys, the 6<sup>th</sup> group, 2 out of 8 responses, 7 subjects in the sample, 4 weeks ago, 6.5 of the time, and scored 4 on a 5-point scale.

This is a good rule to use for all of your writing. More examples and ideas are provided by the American Psychological Association (1996) publication.

## Ideas for Reporting Results and Findings

You will want to use a variety of methods to report results and findings. This will allow you to not only clearly and effectively report survey results, but explains findings in a variety of ways to avoid repetitions in your writing. The researcher usually writes the report using few pronouns (e.g., I found . . . or We learned . . .) when explaining information from the TinkerPlot data. Some examples of writing styles to effectively report information are:

- In the study on . . . it was found (mode = 6 or n = 15). . .
- The results of the study (median = 3) indicate . . .
- After surveying the class on . . . it was found that most students (mean = 4.5) want . . .
- The graph on . . . shows . . .
- Graph number . . . shows that . . .
- It was found . . . and this is displayed in graph number . . .
- The subjects tended to prefer (like or dislike) . . .
- Graph . . . and . . . show more students preferred (chose, selected). . .
- The sample included more girls (n=14) than boys (n=11) who took the survey.
- . . . participants in the sample were found to . . .
- . . . out of . . . students demonstrated they preferred . . .
- A majority (n=54%) reported (indicated) that . . .
- When comparing . . . (one attribute) and . . . (another attribute) it was found that . . .
- When studying (examining) . . . there is evidence . . .
- A positive attitude (or interest), as shown in graph number . . ., was found . . .
- Table . . . shows . . .
- A range of scores (range = 7) for question . . . suggests students (differ or do no differ) in . . .
- . . . subjects (n = 15) reported they . . .
- Other findings learned (from open-ended question responses on the survey) included . . .
- The hat plot (or box plot) displays the scores in graph . . . as spread out from a mean score of 4.2 suggesting students show significant differences (preferences or no preference) in . . .

Another rule to remember when writing research is to only write the findings and results and do not explain why you think or believe students answered questions the way they did. Save the “because and why” for the modifications, conclusions and recommendations part of the report.

Some examples of findings reported by middle school students about their survey topics are given as follows:

1. There were significant differences in younger peoples responses about attending an Indian wedding (n=21), while people over 20 years (n=8) showing interest in the event (graph 17).
2. Graph 8 shows that males have a range of 6 and females have a range of 8, which means that there are no significant differences between those wearing and not wearing glasses.
3. Most students (median = 4) think learning about the brain was/would be interesting (Graph 4).
4. The majority of students (median = 3) chose three or higher on the scale meaning they liked to study Egypt more than other ancient civilizations.

5. On graph 11, the majority (n=16) chooses middle to high degree of interest (3-5) for learning about Egypt.
6. It was found that 14/21 students want to study stars, planets, constellations, and black holes more than chemistry or physics.
7. Graphs 1 and 17 shows that most 12 year olds had pinkeye and most 12 year olds have worn glasses.
8. Graph 12 shows that the median for both 12 and 11 year olds was 3, which means most people, might want to travel to India.

Hopefully, these ideas can give you some different ways on how to report your results, without repeating or stating information in the same way. This will make your research report more interesting for others to read.

Writing the research report is not easy to do at first. It takes practice-getting use to this type of writing style. It is, however, an important final stage of the research process so that others can understand and learn from your survey project. Research also adds information to the field of knowledge, and provides direction and guidance for making decisions on important issues for guiding policy. Frequently your project can lead to similar future survey projects to support policy and guide decision-making. Someone may ask you if they can use your survey again on a different random sample or repeat your study by changing some of the survey questions. Who knows . . . your survey project may be effective in providing ideas for teachers and administrators to change school rules, add after school activities or clubs and support fund raising causes to help other people.



● Are you able to generalize your survey findings to the population, which the sample was selected?



Grade six student poster board projects on various survey topics to answer research questions of interest related to the curriculum.

## References\* and Suggested Readings

- \*American Psychological Association. (1996). *Publication Manual of the American Psychological Association*, Washington, D.C.
- \*Borg, Walter and Gall, Meredith. (1989). *Educational Research*. New York: Longman Inc.
- Garfield, Joan and Ahlgren, Andrew. (1988). Difficulties in Learning Basic Concepts in Probability and Statistics: Implications for Research. *Journal for Research in Mathematics Education* 19(1): 44-63.
- Hawkins, A., Jolliffe, F. and Glickman, L. (1992). *Teaching Statistical Concepts*. Harlow, England: Longman Group UK Limited.
- Hillocks, G. (1987). Synthesis of research on teaching writing, *Educational Leadership*, 44(8): 71-82.
- \*Hinkle, D., Wiersma, W. and Jurs, S. (1988). *Applied Statistics for the Behavioral Sciences*. Boston: Houghton Mifflin Co.
- Huff, Darrell. (1954). *How to Lie with Statistics*. New York: W. W. Norton and Company, Inc.
- Joyce, B., Calhoun, E. and Hopkins, D. (1999). *The New Structure of School Improvement: Inquiring Schools and Achieving Students*. Buckingham, Great Britain: Open University Press.
- Konold, C. (1989). Informal Conceptions of Probability. *Cognition and Instruction* 6: 59-98.
- Konold, C., Higgins, T., Russell, S. and Khalil K. (2004). *Data Seen Through Different Lenses*. Paper supported by the National Science Foundation, Amherst: University of Massachusetts
- Konold, C. (2005). *Exploring Data with TinkerPlots*. California: Key Curriculum Press.
- \*Moore, G. (1983). *Developing and Evaluating Educational Research*. Boston, Massachusetts: Little, Brown, and Co.
- Russell, Susan Jo. (1990). Issues in Training Teachers to Teach Statistics In the Elementary School; A World of Uncertainty. In A. Hawkins (Ed.), *Budapest, Hungary Proceedings of the International Statistical Institute Round Table Conference: Training Teachers to Teach Statistics* (pp. 59-71). Voorburg, Netherlands: International Statistical Institute.
- \*Santa, C. M., Havens, L. T., Valdes, B. (2004). *Creating Independence Through Student-owned Strategies (CRISS)*. Iowa: Kendall/Hunt Publishing Company.

Shaughnessy, J. M. (1992). Researchers in probability and statistics: reflections and directions. In Grouws, D. A. (Ed.). *Handbook of Research on Mathematics Teaching and Learning* (pp. 465-494), New York: Michigan Publishing Company.

\*The Shodor Education Foundation, Inc. (2004). *Box Plot Discussion*. March 16, 2004, <http://www.shodor.org/interactivate/discussions/boxplot.html>

Sprent, Peter. (1977). *Statistics in Action*. Great Britain: Penguin Books.

\*The Writing Lab and Owl at Purdue. (2007). *APA Formatting and Style Guide*. February 4, 2007, [http:// owl.english.purdue.edu/owl/resource/560/01/](http://owl.english.purdue.edu/owl/resource/560/01/)

# Appendix

# Resources

Name \_\_\_\_\_ Period \_\_\_\_\_

## TinkerPlots Movie and Data Set Review

**TinkerPlots Movie:** View TinkerPlotsBasics.mov located in the TinkerPlots Help folder to learn how to use the program.

**Data and Demos:** Open the Data and Demos folders and select one of the subject folders and file to study:

**Health:** Backpacks.tp or Body Measurements.tp or Reaction Times.tp

**Science and Nature:** Judging Weights.tp

**Social Studies:** Australian Students.tp or New Zealand Students.tp or US Students.tp

**Save** the selected subject files to your desktop:

1. Select file - Save as
2. Where: Desktop
2. Button: Save or press Return (Enter)

**Data Review:** Select one question from the subject file, construct graphs, and record other findings found from the data set.

Subject File Name \_\_\_\_\_

Question: \_\_\_\_\_

\_\_\_\_\_

Answer: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Other Graph Findings: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(Use the back of sheet if needed)

Name \_\_\_\_\_ Period \_\_\_\_\_

## Factoid About Research Question

- 1. Find useful facts
  - 2. Read information from Internet or text sources
  - 2. Record facts about your research question
  - 2. Write facts that will help to develop your survey
- 1. Write facts to avoid plagiarism
  - 2. Write facts in your own words
  - 2. Summarize or paraphrase information
  - 2. Combine factual content ideas
- 1. Recoding methods
  - 2. List ideas by numbers
  - 2. Record ideas as power notes or write an outline

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_
- 10. \_\_\_\_\_
- 11. \_\_\_\_\_
- 12. \_\_\_\_\_
- 13. \_\_\_\_\_
- 14. \_\_\_\_\_
- 15. \_\_\_\_\_
- 16. \_\_\_\_\_
- 17. \_\_\_\_\_
- 18. \_\_\_\_\_

Add paper for additional notes . . .

{Attach two or more bibliography cards.}



Name \_\_\_\_\_ Period \_\_\_\_\_

## Opinion and Knowledge Survey Template

**Researcher Directions:** Use the template and fill in the lines for your questions and ideas. Decide if you want to include knowledge type questions on your survey. Write extra question items in order to select the best for a two page typed survey. Attach notebook paper for additional question types, if needed.

**Survey Title:** \_\_\_\_\_

**Directions:** Do NOT put your name on the survey. Please complete the survey by making a circle around the ONE best answer or writing answers in the blank(s). Answer the questions with the level of openness you would use in a class discussion. I would like to find out your interest and knowledge in learning about this topic.

**Confidentiality:** Students and teachers will see your answers. The results will be shared on a poster board in the media center. Although your name will not be associated with your survey answers, your privacy and anonymity cannot be guaranteed. If you decide while taking the survey that you do not want to participate, please put an X in the top right corner of the survey, and your survey answers will not be kept.

**Thank you for taking my survey!**

### Part I. Student Info

1. What grade are you in school? \_\_\_\_\_
2. How old are you? \_\_\_\_\_
3. Are you a male or female? A. Male      B. Female

### Part II. Opinion Questions

1. \_\_\_\_\_  
\_\_\_\_\_ ?

- A. If yes, why? \_\_\_\_\_  
B. No

2. \_\_\_\_\_  
\_\_\_\_\_ ?

- A. If yes, explain. \_\_\_\_\_  
B. No

3. \_\_\_\_\_  
\_\_\_\_\_

- A. \_\_\_\_\_  
B. \_\_\_\_\_  
C. \_\_\_\_\_  
D. \_\_\_\_\_  
E. \_\_\_\_\_  
F. \_\_\_\_\_  
G. Other (write on the line) \_\_\_\_\_

4. \_\_\_\_\_  
\_\_\_\_\_

A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

E. \_\_\_\_\_

F. \_\_\_\_\_

G. Other (write on the line) \_\_\_\_\_

5. \_\_\_\_\_  
\_\_\_\_\_

1  
(Not true)

2

3  
(Kind of)

4

5  
(Very true)

6. \_\_\_\_\_  
\_\_\_\_\_

1  
(Never)

2

3  
(Sometimes)

4

5  
(Always)

7. \_\_\_\_\_  
\_\_\_\_\_

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

8. \_\_\_\_\_  
\_\_\_\_\_

9. \_\_\_\_\_  
\_\_\_\_\_

**(Add more paper if needed . . .)**

### Part III. Knowledge Questions

#### Short Response (Write the answer)

1. \_\_\_\_\_  
\_\_\_\_\_?

Answer \_\_\_\_\_

#### Completion (Underline the answer in the blank)

2. \_\_\_\_\_  
\_\_\_\_\_

#### Multiple-Choice (Circle the correct answer)

3. \_\_\_\_\_  
\_\_\_\_\_

A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

E. \_\_\_\_\_

4. \_\_\_\_\_  
\_\_\_\_\_

A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

E. \_\_\_\_\_

#### True-False Statements (Circle the correct answer T or F)

5. T F \_\_\_\_\_  
\_\_\_\_\_

6. T F \_\_\_\_\_  
\_\_\_\_\_

**Matching (Write the correct answers in the blanks – add extra answer choices)**

7. Write the correct letter answer in the blank.

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_

- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_
- D. \_\_\_\_\_
- E. \_\_\_\_\_
- F. \_\_\_\_\_
- G. \_\_\_\_\_
- H. \_\_\_\_\_

**Matching Order and Rank (Write the directions and correct answers in the blanks)**

8. Directions: \_\_\_\_\_  
\_\_\_\_\_

- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_
- D. \_\_\_\_\_
- E. \_\_\_\_\_

1st \_\_\_\_\_ 2nd \_\_\_\_\_ 3rd \_\_\_\_\_ 4th \_\_\_\_\_ 5th \_\_\_\_\_

KnowScore = \_\_\_\_\_ / \_\_\_\_\_  
KnowScore – The number of correct items divided by the total points possible

**(Add more paper if needed . . .)**

## Helpful Ideas for Creating *TinkerPlots* Data Cards Handout Supports Activity 3.1 in The Survey Toolkit

Inventions\_1
case 2 of 19 ◀▶

Attribute	Value	Unit
Grade	6	
Age	11	
Gender	Female	
Wanttoinvent	No	
Whatlwantoinv	None	
Learboutinven	2.0	
Usenewinven	Yes	
Favsone	Wii	
Favstwo	Handheld Comp	
Favsthree	Video games	
Favoldinven	Wii	
threeDvidcam	Yes	
Vidcamwhy	Important Eve...	
Movfloors	No	
Movfloorswhy	You could fall	
Ideas	No	
Ecoinv	No	
helpful1	Internet	
helpful2	iPad	
helpful3	iPod	
Time	0-5	
Arenewhelpful	Yes	
Meetinventor	Yes	
Whichinventor	Einstein	

### Attribute Dictionary

Grade - Level in school  
 Age - Years old  
 Gender - Male or female  
 Wanttoinvent - If they want to invent  
 Whatlwantoinv - What they want to invent  
 Learboutinven - How much they want to learn about inventions  
 Usenewinven - Use of newer inventions  
 Favsone - Their first favorite invention  
 Favstwo - Their second favorite invention  
 Favsthree - Their third favorite invention  
 Favoldinven - Their favorite old invention  
 Threedvidcam - If a 3-D video camera is useful  
 Vidcamwhy - Why a video camera is useful  
 Movfloors - If moving floors are useful  
 Movfloorswhy - Why moving floors are useful  
 Ideas - Their ideas for inventions  
 Ecoinv - Inventions that will help the environment  
 helpful1 - A helpful invention  
 helpful2 - A helpful invention  
 helpful3 - A helpful invention  
 Time - The amount of time in minutes they think about inventions  
 Arenewhelpful - If new inventions are helpful  
 Meetinventor - If they want to meet an inventor  
 Whichinventor - Which inventor they want to meet

The *TinkerPlots* data card, attribute dictionary and question examples show information from a grade six-student survey research project on inventions.

### 1<sup>st</sup> Data Card Attributes

1. Make an attribute to describe each question explaining what it means using short single word ideas or abbreviations.
2. If you have a matching knowledge question make one attribute to describe the score or number of correct answers (e.g., FamInvMatchSc - Match the name of the famous person with what they invented).
3. Add a knowledge attribute to report the number of correct answers the student surveyed could answer for all the questions given (e.g., InventKnowSc - The total number of correct answers for the knowledge questions on the survey).

## 2<sup>nd</sup> Data Card Values (Survey Answers)

1. Write answers in the same way for each survey case (i.e., do not use Y and y or m and male differently for the different survey cases).
2. Questions using rating scales type the number only and do not add words like “not true” or “somewhat” for values.

I would like to learn about inventions.

1                      2                      3                      4                      5  
 (Not true)                      (Somewhat)                      (Completely True)

3. For multiple-choice questions type the answers using a short set of words and do not record A, B, C, D, or E choices as values (e.g., enter TV, computer iPod, radio, car, movie theater, or the other answer written).

What is your favorite invention below?

- A. T.V.
- B. Computer
- C. iPod (any version or type)
- D. Radio
- E. Car (any kind)
- F. Movie Theater
- G. Other (write on the line)\_\_\_\_\_

## 3<sup>rd</sup> Table Display

1. Select the table button in *TinkerPlots* and drag open the display of attributes and values for all of your survey cases so the information is in view.
2. Review all values for similar spelling, capitalization, and common word usage when grouping together survey responses to your questions.

Inventions												
	Grade	Age	Gender	Wanttoin...	Whatlwa...	Learbout...	Usenewi...	Favsone	Favstwo	Favsthree	Favoldin...	th
1	6	12	Female	No	D	3.0	Yes	Person.rob...	Electriccar	Radiocon.h...	Computer	No
2	6	11	Female	No	None	2.0	Yes	Wii	Handheld C...	Video games	Wii	Yes
3	6	12	Female	No	E	1.0	Yes	Laptop	I-pod	Phone	Ipod	Yes
4	6	11	Female	Yes	E	5.0	No	Elec. tooth	Sham. WOW	Slap. Chap	Movie. The	No

## 4<sup>th</sup> Text Box Attribute Dictionary

1. Use the text box in *TinkerPlots* to make a dictionary describing each attribute and type what it means.
2. Look at your survey questions to write a meaning for each attribute (i.e., change the survey question to a short phrase to write the description).

## 5<sup>th</sup> Extra Text Box for Survey Questions Option

1. Open another text box in *TinkerPlots* and type your free response survey question.
2. Type a list of the survey answers for the question. Add a number after each answer for multiple similar responses.

Name \_\_\_\_\_ Period \_\_\_\_\_

## TinkerPlot Data Completion Checklist

✓ BOX WHEN COMPLETED

**GRAPHS:** Color key (locked) should be shown with number, percent, mode, or mean values when possible.

### Entering Data into TinkerPlots

✓	<b>Data Cards</b> - Surveys entered values
	<b>Text Boxes</b> - Open ended question results and “other” answers given
	<b>Text Box Dictionary</b> - Define attribute meanings
	<b>Case Table</b> - Display of all data to check data card entered values

### Categorical Attribute Graphs

Attribute Names: \_\_\_\_\_

	<b>Plot with Bins</b> or dividers showing counts ( <b>n</b> ) and/or percentages
	<b>Rectangle Graph</b> using square icons or fused rectangular icons
	<b>Circle Graph</b> with color key locked

### Quantitative Attribute Graphs

Attribute Names: \_\_\_\_\_

	<b>Rectangle Graph</b> using square icons or fused rectangular icons
	<b>Line Plot</b> with dividers and counts ( <b>n</b> ) or percents
	<b>Average Graph</b> showing mean score values

### Comparison Attribute Graphs (Categorical and Quantitative)

	<b>Binned Scatter Plot</b> showing boxed lines (e.g., attribute compared with ages)
	<b>Value bars Vertical or Horizontal</b> graph (e.g., drag attribute to plot and select another attribute for the key)
	<b>T - Graph</b> with two columns showing counts ( <b>n</b> ) and/or percents
	<b>Average Graph</b> showing mean comparing two attributes

### Other Graphs (Pick One or More)

	<b>Unique Graph</b> or different idea creating meaningful data understanding
	<b>Rectangle Graph</b> using square icons or fused rectangular icons showing average or mean score values
	<b>Hat or Box Plot Graph</b> using fuse rectangular

### Graphs Evaluation

	<b>&gt; 10 Graphs</b> - Have you created over 10 graphs altogether?
	<b>Hypothesis Graphs</b> - Do you have two graphs that show your two hypothesis predictions? If not, go back and make another graph(s).
	<b>Research Question Graphs</b> - Do your graphs help answer your research question? If not, make additional graphs(s).

### TinkerPlot Data Prepare to Print

	<b>Show Page Breaks</b> - Select from file menu bar
	<b>Arrange/Organize Data</b> - Move data cards, text boxes, graphs and case table so they display within the lines of the page breaks
	<b>Teacher Check</b> - Review with teacher completion and arrangement of data before printing

## Poster Paper Peer Review Log

**Feedback Wanted:** Please provide positive thoughts and constructive suggestions about the research project. Only write your **first name** and ideas on the peer review log. You may also include any questions you have about the project too. Use these questions to guide your comments:

1. Are the findings and results clear and easy to understand?
2. Do the graphs show the most important information from the survey?
3. Does the report provide support in writing the survey and are the survey questions appropriate?
4. Does the layout and presentation improve the appeal and interest in the survey topic?
5. Other ideas?

Name	Comments
1. _____	_____
_____	_____
2. _____	_____
_____	_____
3. _____	_____
_____	_____
4. _____	_____
_____	_____
5. _____	_____
_____	_____
6. _____	_____
_____	_____
7. _____	_____
_____	_____
8. _____	_____
_____	_____

9. \_\_\_\_\_

\_\_\_\_\_

10. \_\_\_\_\_

\_\_\_\_\_

11. \_\_\_\_\_

\_\_\_\_\_

12. \_\_\_\_\_

\_\_\_\_\_

13. \_\_\_\_\_

\_\_\_\_\_

14. \_\_\_\_\_

\_\_\_\_\_

15. \_\_\_\_\_

\_\_\_\_\_

16. \_\_\_\_\_

\_\_\_\_\_

17. \_\_\_\_\_

\_\_\_\_\_

18. \_\_\_\_\_

\_\_\_\_\_

**Thank-you for your comments!**



## Vocabulary Dictionary

### Part 1 New Vocabulary:

research question: \_\_\_\_\_

survey: \_\_\_\_\_

population: \_\_\_\_\_

sample: \_\_\_\_\_

hypothesis: \_\_\_\_\_

data: \_\_\_\_\_

attribute: \_\_\_\_\_

variable: \_\_\_\_\_

research goal: \_\_\_\_\_

bibliography: \_\_\_\_\_

bias: \_\_\_\_\_

plagiarism: \_\_\_\_\_

### Part 2 New Vocabulary

sampling: \_\_\_\_\_

convenience sampling: \_\_\_\_\_

random sampling: \_\_\_\_\_

systematic sampling: \_\_\_\_\_

stratified sampling: \_\_\_\_\_

judgment sampling: \_\_\_\_\_

cluster sampling: \_\_\_\_\_

volunteer sampling: \_\_\_\_\_

generalize: \_\_\_\_\_

sample size: \_\_\_\_\_

response rate: \_\_\_\_\_

census: \_\_\_\_\_

stratum: \_\_\_\_\_

prove (hypothesis support): \_\_\_\_\_

disprove (hypothesis reject): \_\_\_\_\_

privacy/private (anonymity/anonymous): \_\_\_\_\_

### **Part 3 New Vocabulary**

case: \_\_\_\_\_

value (apply to data and TinkerPlots): \_\_\_\_\_

response rate (calculated): \_\_\_\_\_

data card (apply to TinkerPlots): \_\_\_\_\_

case table (apply to TinkerPlots): \_\_\_\_\_

categorical: \_\_\_\_\_

quantitative: \_\_\_\_\_

count (frequency): \_\_\_\_\_

mode: \_\_\_\_\_

mean: \_\_\_\_\_

median: \_\_\_\_\_

line plot or dot plot: \_\_\_\_\_

shape, spread, range, outlier, center clump (apply to graphs): \_\_\_\_\_

\_\_\_\_\_

histogram: \_\_\_\_\_

value bars: \_\_\_\_\_

T-chart or T-graph: \_\_\_\_\_

binned scatter plot: \_\_\_\_\_

### **Part 4 New Vocabulary**

findings: \_\_\_\_\_

conclusions (in the context of doing a survey): \_\_\_\_\_

\_\_\_\_\_

## Vocabulary Dictionary

### Part 1 New Vocabulary:

**research question:** questions of interest to a student answered by a survey

**survey:** questionnaire to find answers to questions of interest

**population:** entire set of people you want to know about

**sample:** part of the population or subset selected for a survey

**hypothesis:** prediction how people will respond to the survey

**data:** set of numbers or observations with a context and drawn from a real sample or population

**attribute:** a characteristic of a person or thing

**variable:** another word for attribute

**research goal:** applying research questions to form a statement about survey objectives

**bibliography:** reference citation like a book or online source (e.g., URL web site)

**bias:** sources of information slanted toward one viewpoint or misrepresented

**plagiarism:** copying from a source

### Part 2 New Vocabulary

**sampling:** choosing a sample

**convenience sampling:** a survey given to a group easy to include (e.g., classroom)

**random sampling:** give a survey to a group chosen in a completely random way so each person has an equal chance of being selected (e.g., draw from a hat)

**systematic sampling:** survey group chosen in an orderly way (e.g., every 10<sup>th</sup> person selected in a directory)

**stratified sampling:** divide the population into strata based on one characteristic (e.g., grade level) and choose random samples from each stratum

**judgment sampling:** an expert picks the sample based on the knowledge of a group (e.g., student council)

**cluster sampling:** list of all clusters or groups and randomly select one or two groups (e.g., homerooms)

**volunteer sampling:** give a survey to anyone who wants to take it (e.g., online survey)

**generalize:** the amount or degree that results from the sample are true for the population

**sample size:** how many people are in your chosen sample

**response rate:** how many people chosen actually answer the survey

**census:** survey a whole population

**stratum:** sampling layers based on one characteristic in a population (e.g. age or grade level)

**prove** (hypothesis support): the hypothesis statement agrees with the survey findings

**disprove** (hypothesis reject): the hypothesis statement does not agree with the survey findings

**privacy/private (anonymity/anonymous):** the expectation some survey information will not be shared without permission and no one will know your answers belong to you

### Part 3 New Vocabulary

**case:** each student completing a survey

**value** (apply to data and TinkerPlots): a data card with all the answers applied to an attribute

**response rate (calculated):** the number who respond to the survey divided by the total number in the sample who tried the survey

**data card** (apply to TinkerPlots): survey case attributes and values entered into the TinkerPlots data base

case table (apply to TinkerPlots): table created from data cards displaying all survey entered data

**categorical:** the categories or level of an attribute, like gender, that form separate groups

**quantitative: attributes** take a particular position and order showing quantity or amount (e.g., position on a number rating scale) allowing statistical evaluation (e.g., find the mean)

**count** (frequency): the number of responses for a survey question

**mode:** the most frequently occurring score in a group

**mean:** the average of a group of scores indicating the center of a set of data

**median:** the midpoint or middle of a group of ranked scores

**line plot or dot plot:** TinkerPlot graph created by dragging icons to change a dot into a line plot graph with a scale

**shape, spread, range, outlier, center clump** (apply to graphs): refers to the TinkerPlot graphs appearance with a range of values and outliers (values beyond the range)

**histogram:** a TinkerPlot fused rectangular graph showing changes over time

**value bars:** a graph displayed with value bars

**T-chart or T-graph:** a graph with two columns

**binned scatter plot:** a plot with quantitative data that can show the location of averages

### Part 4 New Vocabulary

**findings:** specific facts students found from the survey results

**conclusions** (in the context of doing a survey): statement about the overall survey or research question

Survey Toolkit Vocabulary  
(Posting a Wall Chart)

Part 1 New Vocabulary:

Lesson 1.1

research  
question

Lesson 1.1

survey

Lesson 1.1

population

Lesson 1.1 (2.1)

sample

Lesson 1.1

hypothesis

Lesson 1.2

**data**

Lesson 1.2

**attribute**

Lesson 1.2

**variable**

Lesson 1.3

**research goal**

Lesson 1.4

**bibliography**

Lesson 1.4 (2.1)

**bias**

Lesson 1.4

# plagiarism

Part 2 New Vocabulary

Lesson 2.2

# sampling

Lesson 2.2

# convenience sampling

Lesson 2.2

# random sampling

Lesson 2.2

**systematic  
sampling**

Lesson 2.2

**stratified  
sampling**

Lesson 2.2

**judgment  
sampling**

Lesson 2.2

**cluster sampling**

Lesson 2.2

**volunteer  
sampling**

Lesson 2.2

**generalize**

Lesson 2.2

**sample size**

Lesson 2.2

**response rate**

Lesson 2.2

**census**

Lesson 2.2

# stratum

Lesson 2.3

# prove

 (hypothesis support)

Lesson 2.3

# disprove

 (hypothesis reject)

Lesson 2.4

# privacy (anonymity)

## Part 3 New Vocabulary

Lesson 3.1

# case

Lesson 3.1

**value**

Lesson 3.1

**response rate**

Lesson 3.2

**data card**

Lesson 3.2

**case table**

Lesson 3.3

**categorical**

Lesson 3.4

**quantitative**

Lesson 3.4

**count (frequency)**

Lesson 3.4

**mode**

Lesson 3.4

**mean**

Lesson 3.4

**median**

Lesson 3.4

**line or dot plot**

Lesson 3.4

**histogram**

Lesson 3.4

shape, spread,  
range, outlier,  
center clump

(apply to graphs)

Lesson 3.5

T-chart or  
T-graph

Lesson 3.5

value bars

Lesson 3.5

# binned scatter plot

Part 4 New Vocabulary

Lesson 4.1

# findings

Lesson 4.1

# conclusions

Lesson \_\_\_\_\_

Lesson \_\_\_\_\_

Name \_\_\_\_\_ Period \_\_\_\_\_

Assessment: Pretest or Posttest Date \_\_\_\_\_ Score \_\_\_\_\_

## Assessment for Survey Research

**Directions:** Follow the instructions to complete each part of the assessment in the time provided.

**Part I. True or False:** Circle T (True) or F (False) for each statement.

- T F 1. A research goal could involve comparing students in a school with students in a different grade or giving feedback of survey results to the student council.
- T F 2. A sample is part of the population or subset selected for a survey.
- T F 3. A variable and attribute are characteristics of a person or thing.
- T F 4. All types of sampling, including random, have possible sources of bias that may effect survey findings and results.
- T F 5. If convenience sampling is selected as a method for giving your survey, then you will be able to generalize the results from the sample to the population.
- T F 6. The response rate is the number of people selected in the sample.
- T F 7. The sample size and response rate values mean the same thing.
- T F 8. Selecting age or grade level would be examples of stratum sampling.
- T F 9. Anonymity means no one will know your survey answers belong to you.
- T F 10. A low response rate increases the likelihood that a selected sample may be misrepresented and the survey information collected is bias.
- T F 11. A rejected hypothesis means the survey research is poorly planned, bias and should be revised or repeated.
- T F 12. A census involves selecting a sample from the population.
- T F 13. The written findings and conclusions in the summary report only report the survey graph and TinkerPlot data results.
- T F 14. It is possible to calculate the mean using only categorical attributes.
- T F 15. Shape, spread, range, center clump and outliers refers to the appearance of graphs from the survey question responses.

**Part II. Multiple-Choice:** Circle the correct letter answer for each question.

1. Where do you enter survey case attributes and values before making *TinkerPlot* graphs?
  - A. T-charts
  - B. Binned scatter plots
  - C. Value bars
  - D. Data cards
  - E. Case table
  
2. Which idea would most likely affect students taking your survey in a negative way?
  - A. Your research question does not relate to the content of study for your selected sample.
  - B. The research goal does not compare the selected sample to another group of students.
  - C. The research question is intrusive of people's privacy.
  - D. The research question is not interesting to other students.
  
3. Students locate information about their research question for what primary research goal?
  - A. To learn about plagiarism and collecting information in handwritten form.
  - B. For students to find information about their research question and to provide ideas for writing a survey.
  - C. To understand the report writing process for collecting note facts, summarizing information, and writing paragraphs.
  - D. To gather information from multiple sources and use bibliography citations.
  
4. What is the purpose of finding information about your research question from books and web sites, and writing a report on this topic?
  - A. Provides ideas to write survey questions for your questionnaire.
  - B. To find out information that already exists to possibly answer all or part of your research question.
  - C. Provides background knowledge for a particular area of knowledge, possibly causing you to change or modify your research question.
  - D. Review and find out if conflicting or different information is found from more than one reference or web site.
  - E. All of the above answers are useful purposes for finding information by collecting notes and writing a report.
  
5. Effectively written survey questions should find out interest in a research topic. Which is the least effective question asking about student interest in astronomy?
  - A. How much time do you spend watching videos on astronomy and space exploration?
  - B. Do you like to learn about astronomy and space travel?
  - C. Do you own a telescope and view constellations?
  - D. How many books have you read about astronomy?
  
6. Which is the most effective written survey question attempting to find out student's interest in ancient Rome?
  - A. Would you choose learning about ancient Rome more than astronomy, biology, geology, and chemistry?
  - B. Ancient Rome was violent with gladiators. Do you agree?
  - C. Why do you want to visit ancient Roman ruins?
  - D. Why do you like watching ancient Rome videos rather than reading about Rome?

7. Elements of well-written surveys include:
- A. Multiple choice questions
  - B. Free response questions
  - C. Rating scales
  - D. Many different question types are needed (all of the above).
8. The following survey question is an example of a:
- Do you like to eat Indian food at a restaurant or at home?
- SD            D            U            A            SA
- (strongly disagree) (disagree) (undecided) (agree) (strongly agree)
- A. Multiple-choice
  - B. Matching
  - C. Free response
  - D. Closed form
  - E. Rating scale
9. The following survey question is an example of a:
- What grabs your interest most about medieval culture – technology, entertainment, clothing, food or armed conflicts?
- A. Multiple-choice
  - B. Matching
  - C. Free response
  - D. Closed form
  - E. Rating scale
10. If a survey answer you do not expect from a question is because of the way it is incorrectly written, this is called:
- A. Leading question
  - B. Subjective answer
  - C. Objective answer
  - D. Response bias
  - E. Field test
11. If a survey question gives hints as to the type of answer you would prefer and results in the person giving you an answer you want, this is called a(n):
- A. Leading question
  - B. Subjective answer
  - C. Objective answer
  - D. Response bias
  - E. Field test
12. If possible, it is a good practice to test your survey questions before giving the questionnaire to your sample. Testing your survey questions is called a:
- A. Pretest
  - B. Stakeholder
  - C. Field test
  - D. Expert test
  - E. Plagiarism

13. Which procedure is the best way to find out a person's interest about a survey topic?
  - A. Ask questions that include the amount of time, money and interest in the topic.
  - B. Write factual questions about the topic rather than opinion questions.
  - C. Ask more personal profile types of questions on the survey.
  - D. Write questions that explain specifics in detail and avoid bias.
  - E. Do not ask embarrassing survey questions.
  
14. The easiest type of sample to choose for giving your survey is:
  - A. Judgment sample
  - B. Systematic or stratified sample
  - C. Randomly selected cluster sample
  - D. Convenience or volunteer sample
  
15. If you want your sample to represent a larger population (e.g., all sixth grade students in a middle school), which type of sampling would be the most appropriate?
  - A. Judgment sampling
  - B. Systematic or stratified sample
  - C. Randomly selected cluster sample
  - D. Convenience or volunteer sample
  
16. Which type of sampling is used if the student council gives a survey to all students who attend the school?
  - A. Judgment sampling
  - B. Census
  - C. Cluster sampling
  - D. Random sampling
  
17. If I give the survey to math teachers at our school what type of sampling is being used:
  - A. Volunteer sampling
  - B. Systematic sampling
  - C. Judgement sampling
  - D. Convenience sampling
  
18. The number of people in your sample who answer the survey questions is called the:
  - A. Cases
  - B. Sample size
  - C. Population
  - D. Stakeholders
  - E. Response rate
  
19. Which guideline for writing a hypothesis is incorrect?
  - A. The hypothesis should relate to your research question.
  - B. If a hypothesis is rejected you should give reasons why.
  - C. Hypotheses can be supported or rejected using your survey data.
  - D. A hypothesis should explain what you expect results to be.
  - E. The hypothesis should be written as a short and clear statement.

20. Which statement is a poorly written hypotheses?
- A. A majority of female students will select astronomy as their favorite subject.
  - B. Seventh-graders will select solar as the preferred alternative energy source.
  - C. Students don't care about different types of healthy choices.
  - D. Significant differences will be found in students' interest in studying ancient Egyptian gods.
21. Which of these hypothesis outcome statements should be rewritten or revised?
- A. I fail to reject the hypothesis because most students (n=10) picked Yellow Stars more than Red Dwarfs and Glue Giants as the most common in the solar system.
  - B. I reject the hypothesis since 11 out of 20 people couldn't report the main cause of pinkeye.
  - C. Significant differences were found about the brain, therefore I reject the hypothesis.
  - D. I fail to reject the hypothesis that students think the brain is interesting, since 70% reported it is interesting to learn about.
22. What is the first thing to do and best idea if you have a low survey response rate?
- A. Give the survey to another sample.
  - B. Pass out the survey to a few nearby passing students to increase the sample size.
  - C. Rewrite the survey questions.
  - D. Use the surveys you have and go ahead and enter cases into the data cards to continue the research project.
23. The answers people give to survey questions are the:
- A. Values for the attribute
  - B. Attributes
  - C. Free responses
  - D. Units for the attribute
  - E. Response rate
24. Your survey findings and results can be generalized to the population only if:
- A. Experts and stakeholders are surveyed.
  - B. The target population of subjects is identified.
  - C. The sample of people selected represents the population.
  - D. The response rate is greater than 50%.
  - E. Sampling bias has been eliminated.
25. The most effective way to report a large number of free response answers on a survey is to:
- A. List all the responses in a text box for reporting.
  - B. List only the most frequent responses in a text box.
  - C. Group the answers and assign attribute values for graphing.
  - D. Select the most frequent response findings in the summary report.
  - E. Group common answers and summarize the findings in a report.
26. When comparing two categorical attributes when making a *TinkerPlots* graph, which function is not possible?
- A. Creating a column percent graph.
  - B. Showing average or mean graph values.
  - C. Showing mode values on a graph.
  - D. Displaying the n value counts on a graph.

27. A method to show variability, to compare different categories or sets of data is creating a:
- Range value
  - Box plot graph
  - Graph of quartiles
  - Median or mid-point
  - Graph of outliers
28. Which section of the summary report explains the action for using the information learned from the survey project findings?
- Hypothesis and findings.
  - Modifications
  - Recommendations
  - Conclusions

**Part III. Sampling Concepts:** Write the letter in the blank that selects the type of sampling method with a particular survey research method. One method will not be used.

- Convenience Sampling
- Random Sampling
- Systematic Sampling
- Stratified Sampling
- Judgement Sampling
- Cluster Sampling
- Volunteer Sampling

- \_\_\_\_\_ Members of student council are selected to take a survey.
- \_\_\_\_\_ Student names are selected and drawn from a container.
- \_\_\_\_\_ A survey is passed out to students who want to take it in the lunch room.
- \_\_\_\_\_ Homerooms are randomly selected to take a survey.
- \_\_\_\_\_ Surveys are only given to students in one classroom.
- \_\_\_\_\_ Every 15<sup>th</sup> person is selected from a school directory list.

**Part IV. Survey Steps:** Write the letters, in order, for doing survey research in the blanks.

- Write the findings, conclusions, and recommendations.
- Enter survey results in *TinkerPlots* making graphs and finding statistics.
- Decide on your research question and set goals.
- Identify the population to collect and find information from media sources.
- Give the survey to people in the sample.
- Write hypotheses about how people will respond to the survey.
- Select a sample of individuals from the population.
- Write the survey questions.

1<sup>st</sup> \_\_\_\_\_ 2<sup>nd</sup> \_\_\_\_\_ 3<sup>rd</sup> \_\_\_\_\_ 4<sup>th</sup> \_\_\_\_\_ 5<sup>th</sup> \_\_\_\_\_ 6<sup>th</sup> \_\_\_\_\_ 7<sup>th</sup> \_\_\_\_\_ 8<sup>th</sup> \_\_\_\_\_

**Part V. Survey Research Study:** Complete the information in the blanks for each numbered item using the information provided. The study modifications, conclusions, and recommendations are not included at the end of the summary research report.

Begin on the next page . . .



**Hypothesis and Findings**

6. Evaluate the hypothesis written about the attribute “AltFuelUseExp.” Begin the sentence with “I reject the hypothesis and found . . .” or “I support (fail to reject) the hypothesis and found . . .” Use Table 1 and Graphs 1 to evaluate and write the hypothesis findings.

A majority of students will report supporting use of alternative fuels instead of nonrenewable oil, even if it is more expensive.

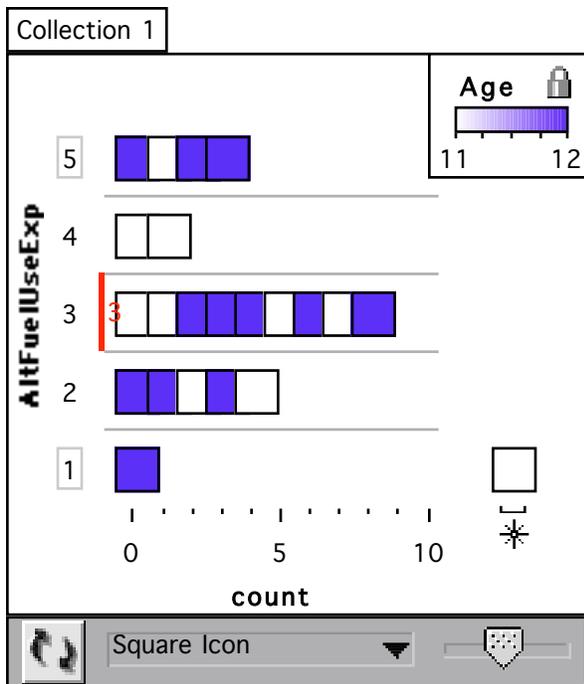
**Table and Graph Findings**

7. Record the mode, range, median and mean for survey findings “AltFuelUseExp.” Use Table 1 and Graph 1 to write the number results.

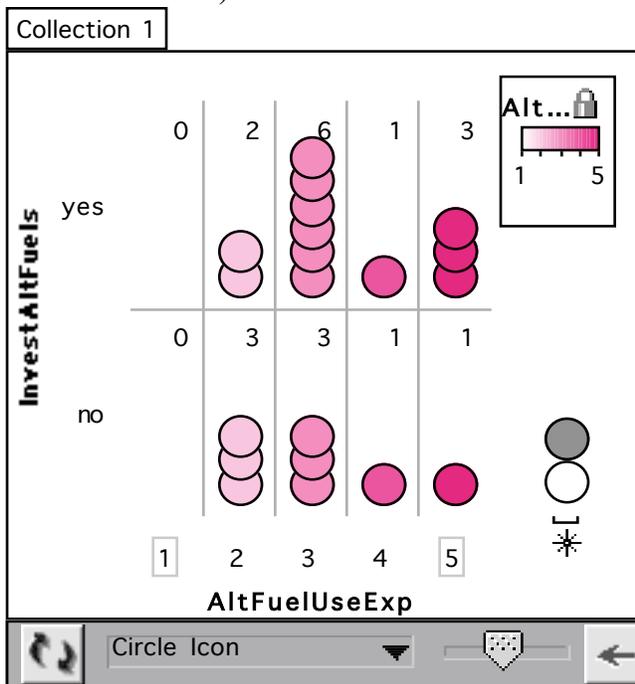
Mode = \_\_\_\_\_ Range = \_\_\_\_\_ Median = \_\_\_\_\_ Mean = \_\_\_\_ • \_\_\_\_

8. Use Graph 3 and 4 to write two findings statements about what the data tells about the sample of students surveyed using alternative fuels. Write two complete sentences.

Graph 3. “AltFuelUseExp” by “Age”



Graph 4. “AltFuelUseExp” by “InvestAltFuels” (InvestAltFuels: Do you think we should invest in alternative fuels?)



# Assessment for Survey Research Answer Key

## Part I. True or False

- |      |       |
|------|-------|
| 1. T | 10. T |
| 2. T | 11. F |
| 3. T | 12. F |
| 4. T | 13. F |
| 5. F | 14. F |
| 6. F | 15. T |
| 7. F |       |
| 8. T |       |
| 9. T |       |

## Part II. Multiple-Choice

- |       |       |
|-------|-------|
| 1. D  | 15. B |
| 2. C  | 16. B |
| 3. B  | 17. C |
| 4. E  | 18. E |
| 5. B  | 19. B |
| 6. A  | 20. C |
| 7. D  | 21. C |
| 8. E  | 22. A |
| 9. A  | 23. A |
| 10. D | 24. C |
| 11. A | 25. C |
| 12. C | 26. B |
| 13. A | 27. B |
| 14. D | 28. C |

## Part III. Sampling Concepts

- |      |      |
|------|------|
| 1. E | 4. F |
| 2. B | 5. A |
| 3. G | 6. C |

## Part IV. TinkerPlot Terms

- |      |      |
|------|------|
| 1. C | 5. F |
| 2. D | 6. E |
| 3. I | 7. B |
| 4. H | 8. A |

## Part V. Survey Research Study

1. Web sites, books, or other electronic and online resources like World Book.
2. Answers may include a convenient sample and middle school population of students. (Answers will vary)
3. Random cluster, systematic, or stratified sampling (not judgment or convenience sample)
4. Bias may result from the random sample not possibly representing the population, misleading survey questions, or survey response bias. (Answers will vary)
5.  $21/22 = 95.45\%$
6. I support the hypothesis and found a majority of students ( $n=9$ ) moderately to more strongly agree ( $n=6$ ) use of alternative fuels instead of nonrenewable oil. I reject the hypothesis and found a majority of students ( $n=14$ ) do not or only moderately support using alternative fuels instead of nonrenewable oil. (Answers will vary)
7. Mode = 3    Range =  $5-1=4$     Median = 3    Mean = 3.14
8. (Answers will vary) Students tend to moderately support, based on age, using alternative fuels instead of nonrenewable oil, even if it is more expensive. No significant differences were found between ages of 11 and 12 year old students in support use of alternative fuels. More students support investing in alternative fuels. About the same proportion who reporting “yes” or “no” to investing moderately support use of alternative fuels instead of nonrenewable oil, even if it is more expensive..

## Points

**Part I. 15    Part II. 28    Part III. 6    Part IV. 8    Part V. 13    Total = 70**

Teacher Notes . . .