American Psychological Association

TOPSS
TEACHERS OF PSYCHOLOGY IN SECONDARY SCHOOLS

Conducting Psychological Research for Science Fairs:

A Teacher's Guide and Resource Manual

Revised 2016

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INTRODUCTION

In an effort to advance psychology as a scientific discipline, the APA Teachers of Psychology in Secondary Schools (TOPSS) created this document to serve as a guide to increase high school psychology teachers' comfort with teaching the scientific method and engaging students in the research process. Ideally, this manual will empower psychology teachers to mentor their students in conducting original psychological research that could be entered into a local, regional, or national science fair competition.

The scientific method should be a fundamental component of any high school psychology course. Additionally, active learning experiences are central to a successful course. Creating opportunities for student research integrates the scientific method with active learning to create a dynamic learning experience.

Therefore, this guide provides a step-by-step outline of the scientific method, demystifying this process. Concrete examples of research projects are also provided to illustrate principles for conducting research. Teachers can use the examples either to conduct classroom demonstrations or as starting points for independent projects for students.

Science fairs provide students with an opportunity to engage in exciting discoveries, learn, and receive potential awards and recognition. Participating in a science fair allows students to engage in hands-on learning experiences that will enhance their knowledge of psychology and provide a platform for them to share their learning with others. As teachers and students become more comfortable with the scientific method, entering a science fair becomes a realistic and exciting possibility. Science fair entries can range from extremely simple demonstrations to those that entail sophisticated research design and statistical analysis. Sophisticated projects often involve researchers who are external to a local high school; yet students can enter a science fair without this support. We have included a list of references that will provide teachers with additional resources to assist students in designing more sophisticated projects. We also make recommendations about how students can secure the assistance of a university faculty mentor on the APA website as they design and conduct their projects.

IN STUDENTS' OWN WORDS

"Conducting research has helped me improve my work ethic and critical thinking skills. I now think differently in daily life; my curiosity has deepened, and I am determined to find answers."

—Tiffany Sun, Roslyn High School, NY

"Participating in research in high school gave me analytical, communication, and presentation skills that have been extremely useful. The opportunity to attend research competitions, such as Intel's ISEF, was eye-opening in that it exposed me to the array of research being done by high school students around the world."

—Arshia Aalami, Roslyn High School, NY
(2nd Place, Behavioral and Social Sciences, ISEF 2013)

"My experience in science fair allowed me to study topics outside the normal high school curriculum and explore my own unique interests. Through my project, I discovered my own passion not only for psychology and bioethics, but for solving problems in unconventional ways. Presenting my research in front of experts provided me with countless opportunities and the inspiration to continue with research in college."

—Margaret Steiner, Academy of Science and Technology, The Woodlands, TX (3rd place APA award, ISEF 2015)

As described in the *National Standards for High School Psychology Curricula* (APA, 2011), one of the overarching themes that should serve as the foundation for the high school psychology course is the development of scientific attitudes and skills, including critical thinking, problem solving, and an appreciation for scientific methodology. Accordingly, the goal of this manual is to encourage high school psychology teachers to engage their students in active learning and critical thinking through the scientific method. Psychology has pursued a scientific understanding of human behavior for more than a century. Not only can psychology students learn more about human behavior by engaging in research, but they will find that science fairs also offer scholarships and opportunities that can help them at the next levels of learning. The bright stars of psychology's tomorrow are sitting in high school classrooms today, and we need to encourage them to pursue psychological science. Introducing students to the scientific method early in their psychological education will help those stars shine their brightest in the future.

ACKNOWLEDGMENTS

The APA Teachers of Psychology in Secondary Schools (TOPSS) wishes to thank the APA Board of Directors and, particularly, J. Bruce Overmier, PhD, for his support and encouragement for the original project in 2004.

OVERVIEW

Supervising a competitive student science fair project can be exciting, challenging, and rewarding. Psychology lends itself to projects that students find engaging and interesting because they encounter so many psychological phenomena in everyday life. This manual offers guidance for facilitating students in selecting a topic of study, reviewing the literature, helping them formulate a hypothesis, designing and conducting the study, analyzing the results, and, finally, preparing and entering a project into a science fair. It is important to guide students through the process and keep them on track to meet all deadlines. A set of websites with comprehensive listings of science fairs and other competitions is included in Appendix A.

Conducting research entails a significant investment of time for both student and mentor over the course of one semester or an entire academic year. Therefore, we begin with a suggested timeline and series of steps that will help guide the research endeavor. We recommend that both student and mentor review the timeline early so that the project can be adequately developed. Appendix B provides a step-by-step guide for guiding students through a science fair project.

Any project begins with the selection of a good research question, and we offer specific suggestions about how to guide students in their selection of a topic. Developing a good research question can be a lengthy and frustrating process. Initially, it is important for the mentor to generate enthusiasm for the scientific investigation of a psychological phenomenon.

Subsequent to identifying an interesting topic, students should search the literature to find out what research has already been done and identify a specific question of interest for the project. We offer suggestions for assisting students in the literature review, developing a research question, and creating research hypotheses. Specific suggestions for accomplishing these steps are provided in the second section of this manual. Introductory information about research design and statistics appears in the third section, and additional resources are identified in the event that further reference materials are needed. As the project begins to evolve, it may become evident that additional resources could strengthen its quality. Although we provide the basic outline in this manual, it may be useful to involve an external mentor to assist in the project. A local university faculty member may be able to offer guidance in the areas of design and

analysis. It is also possible that a local university or research psychologist may be able to provide the student with access to laboratory facilities.

Clear and practical guidance for data collection, with particular reference to the use of human participants, is provided in the section entitled "Conducting the Study." Information about the use of animals has been included in Appendix C in the event a student decides to engage in research with animals. Finally, we provide information about writing and presenting the results of the study and in taking the final step of submission to a science fair.

PLANNING THE PROJECT

DEVELOPING A TIMELINE

Psychological research projects can be done in a short period of time (e.g., a month or two) or in a much longer period of time (e.g., a year), depending on a number of factors such as the sophistication of research design, amount of time for IRB approval, and so on.

Teachers can assist students in developing a timeline to guide this process. Students must derive a research question and a hypothesis and a method for conducting the study, collecting and analyzing data, and presenting the results. A suggested timeline that will allow students to use the scientific method to complete a psychology science fair project is included in Appendix D. The timeline provides an integrated approach to using the scientific method while meeting science fair deadlines.

IDENTIFYING A TOPIC

The first step toward participation in a science fair is for students to become enthusiastic about a topic, preferably a topic that fully captures their interest and imagination. Teachers can serve as a catalyst for generating enthusiasm by introducing the idea of a science fair project early in the school year. Developing a research idea is often the most difficult and intimidating step.

One way to select a topic is to consider a psychological question. Research questions can also be derived from daily news items or from scientific publications. The science section of a major newspaper or the *APA Monitor on Psychology* offers a nonthreatening entrée into scientific research. APA maintains an extensive website (www.apa.org) with many accessible summaries of current research on a wide variety of topics. For example, questions that might capture students' interest include: Are girls more politically active than boys? Is it more difficult for an older person to get hired for a job than a younger person? Do drug education programs in health classes decrease drug use? Why are so many high school students tired so much of the time? Students can also review award-winning entries from previous science fairs to get ideas for their own projects. For example, past winning behavioral and social science projects at the Intel International Science and Engineering Fair (ISEF) can be found online at www.societyforscience.org/intel-international-science-and-engineering-fair.

In addition to helping students select a topic of interest, it is also important for teachers to assist students in identifying a mentor, if one is needed, who can assist in the research process. Depending on the topic, students may enlist the aid of the psychology teacher, or they may need to find a mentor who is outside of the high school. For instance, most high schools don't have the equipment necessary to perform a project using medical or expensive equipment. Therefore, a university or medical school mentor could be extremely valuable. Even if external resources are not necessary, sometimes a university mentor can provide valuable assistance with a particular content area or with data analyses.

An alternative means of developing a research project and acquiring a college mentor is to look into the research of psychology faculty (or faculty in related fields) at a local university. Many college faculty members are open to helping serious and highly motivated students learn more about the research process. Any research project will usually have tasks a high school student can do. Even if the work is likely unglamorous, such as data entry or equipment preparation, it can give students a firsthand experience in research. In the best of circumstances, the faculty member might help the student develop and carry out a project. At the very least, the faculty member might be willing to discuss possible research ideas the student could pursue on his or her own. Many faculty members maintain a website that lists their research interests, and reviewing these websites is a good and nonthreatening way to start this process. APA has also provided a list of faculty willing to assist students with science fair projects online at www.apa.org/ed/precollege/topss/research-mentor.aspx. This approach is best suited for students who are genuinely interested in pursuing psychology as a career and who see their project as a first step toward that goal rather than an end unto itself.

In research with human participants, one recommendation is that unless students have an experienced teacher or college faculty advisor, those who want to conduct research with human participants should plan only research considered exempt under current federal regulations. The final determination of whether or not a proposed study meets the regulatory requirements of an exempt or low-risk study must be made by an independent overseeing body such as an institutional review board (IRB) and not by the individual student or faculty sponsor. The list of types of studies deemed exempt under federal regulations are available at §46.101(b) of Title 45 Code of Federal Regulations, Part 46. See Appendix E for a summary of these federal exemptions.

PERFORMING A LITERATURE REVIEW

Once students have identified a topic, it is important to find scientific (empirically based) reference materials that can be used to develop the project. Students are often reluctant to search for materials that are not immediately accessible or available online. Despite the challenge associated with using empirically based journals, it is important that students learn to use scientific journals available either in print or online. College and university librarians can provide information about search strategies that can be used to find psychological articles in PsycINFO, PsycARTICLES, or related social science databases; local libraries and some high schools may also have subscriptions to da-

tabases. (PsycINFO is an abstract database that can be used to find scientifically based articles and books. PsycARTICLES is a database offering complete access to the full text of more than 100 landmark journals in behavioral science and related fields.) A listing of free databases available to students and teachers is provided in the resource section of this guide. High school students can usually access a university's library with special permission; teachers may want to establish a contact with the university librarian to arrange for instruction on how to use the library and for information about the library's resources. Using a collegiate library will not only help students conduct their literature review, but also provide opportunities to check out a local college campus.

As students obtain empirically based articles, they may benefit from guidance regarding how to successfully read and interpret information presented in these articles. Research articles follow a commonly used format—an abstract, literature review, method, results, discussion, and references. Often, articles can be complicated; therefore, the following guide for reading journal articles might serve as a valuable guide for students.

Abstract: Most journal articles begin with a brief overview of the study. The overview, or abstract, provides a description of the topic, the method, and the findings. A quick review of the abstract will allow the reader to determine whether the full article will be of interest. Additionally, the abstract provides a framework for understanding the rest of the article. This framework is particularly useful for young readers, who should read the abstract carefully before proceeding to the body of the article.

Introduction/Literature Review: The introduction contains the purpose of the research, a review of literature related to the research, the hypotheses being tested, and the predictions for the results along with a rationale of how the predictions flow from the hypotheses. A summary of previous literature related to the study usually constitutes the beginning of the article. Authors also provide background information that led to development of a particular study. Sometimes, authors will provide extensive references to related studies, which can be a valuable source of additional material about the topic.

Method: This section details exactly how the researcher conducted the study and who served as participants. All the information necessary to repeat (i.e., replicate) the study generally appears in this section. The Method section includes information about apparatus (i.e., physical equipment) or instrumentation (e.g., survey) used for both the independent and dependent variables. The complete procedures used to administer the independent variable, control extraneous variables, and measure the dependent variable are described in this section. This section of a published study often serves as a guide for developing a new study.

Results and Discussion: In these two sections, the researchers report what they found (Results) and what it all means (Discussion). The Results section will be the most difficult to understand because it typically includes a good deal of statistical information. Fortunately, the typical journal article is set up so the findings are repeated in the Discussion section (without the statistical details) and then explained. Therefore, even without being able to fully understand the statistical details in

the Results section, a reader can usually determine what occurred by carefully reading the Discussion section. The Discussion section will often contain ideas about research projects that build on the present research, and this information can be a source of research ideas for students.

References: The References section of an article is often an underestimated source of valuable information. The sources cited in the article can provide additional linkages to related articles that may help in development of a project. Students need to do a thorough review of the literature to make sure their project has not been done before, help them develop the best possible research project, and help them write up and present their project once it is done.

In addition to providing students with an overview about the structure of an article, it may also be beneficial to provide students with a worksheet for reviewing journal articles if they need additional structure to guide their literature review. A sample worksheet that can be distributed to students is included in Appendix F.

FORMULATING A HYPOTHESIS

A review of the literature provides students with information that can be used to develop a research study, yet the teacher/mentor may need to help students formulate a specific hypothesis and select a research design. Because this may be the first time a student has undertaken research, it is advisable to use an established design and instrumentation that has been previously validated for use in research. For example, if students want to study the relationship between self-esteem and classroom performance, they would be well advised to use an empirically validated self-esteem scale rather than try to develop a new one from scratch. Basing the research project on an established method and procedure from previous research not only saves time, it increases the likelihood the student will conduct a successful research project. Although it may appear from reading journal articles that researchers got the research method and design perfect the first time, most researchers go through an extensive series of experiments in which they refine their methods and figure out how to overcome difficulties before they get to the set of experiments that finally gets published. By basing a research project on a published study, the student is taking advantage of another person's work, saving precious time, and avoiding many unforeseen difficulties. Students should be encouraged to do variations or extensions of published research. Research grounded in prior work has the best chance of succeeding and the best chance of making a meaningful scientific contribution.

Students should be reminded that a hypothesis is a testable prediction of a relationship between variables. For example, a student might propose the following research question: "What is the relationship between eating breakfast and academic performance?" This question could lead to a variety of hypotheses, such as:

1. Students who eat breakfast will have higher GPAs than students who do not eat breakfast.

2. Students who eat protein for breakfast will have higher GPAs than students who do not eat protein for breakfast.

A review of the literature will provide valuable background information that will help students develop a hypothesis or specify a relationship between breakfast and grades that is scientifically warranted. Teachers should remember that articles published in scholarly journals usually test multiple hypotheses with multiple experiments. Students will probably need to limit the scope of their research projects to test one or two specific hypotheses rather than try to test a large set of hypotheses. A guiding principle for student research is to keep the project simple, straightforward, and easy to understand, especially if the student has not done research before.

Once the student has formulated a hypothesis, it is important for the student to design a process for evaluating it. Generally, a study can be designed using an experimental or nonexperimental approach. A summary of different research methods is provided in the side bar to the right and page 12. To establish a cause-and-effect relationship, psychologists would need to use an experimental method. Sometimes it is difficult (or even impossible) to conduct a laboratory experiment. For example, to experimentally test the hypothesis that students who eat breakfast will have higher grades, students would need to be randomly assigned to a group that eats breakfast or a group that does not eat breakfast. After some period of time, grades from these two groups would be compared. It may be difficult to conduct this study by randomly assigning students to a specific group. Therefore, a quasi-experimental study might be conducted. Rather than randomly assigning students to experimental groups, participants may simply record whether or not they ate breakfast, and grades would then be compared to reported behavior. This type of study might use a survey to investigate the hypothesis.

Even after a hypothesis is formulated, many decisions remain. An appropriate set of research participants must be identified, questionnaire measures or instrumentation must be carefully selected, and detailed procedures must be developed. Again, the background literature can be a fertile source of ideas, and this information can be used to create a study that is similar to, but not an exact replication of, an earlier study.

RESEARCH METHODS

Many research strategies can be used, each with its own strengths and weaknesses. A brief summary of the strengths and weaknesses is discussed below. Students should review the research strategies to determine the research design that would best suit the theory and hypothesis they are addressing in their study. For additional information on research methods, teachers should refer to the TOPSS unit lesson plan on *Research Methods and Statistics,* to be available online to TOPSS members at www.apa.org/ed/precollege/topss/lessons/index.aspx by late 2016.

Correlational research is used to identify whether an association or relationship between two factors/variables exists. Correlational studies have one major limitation: Cause and effect cannot be inferred. But the relationships examined can be described using a correlation coefficient, which shows the strength and direction of the relation-

ship between the two factors/variables being studied.

Different types of studies can be used in correlational research. **Natural observation** is the observation of a naturally occurring behavior without intervention in the situation. Researchers do not control factors/variables and are sometimes unable to gather enough information to formulate any specific conclusions, especially in trying to explain why the behaviors took place. A strength of this method is that researchers see the actual everyday behaviors they hope to explain. A weakness is that not all individuals behave the same way in everyday life, so generalization of behavior to other individuals may not be accurate. Sometimes **structured observations** are used, in which the investigator sets up a laboratory situation to cause a specific behavior that he/she wants to study, giving every participant an equal opportunity to exhibit the response. This type of observation can provide valuable information about the behavior but still cannot explain why the individuals respond as they do.

Surveys, questionnaires, tests, and inventories are used in experimental and nonexperimental research, and students might find one of these instruments suitable for their research. A structured interview may allow for exact expression of the participants' thoughts and feelings; but a face-to-face interview could be intimidating, takes more time, and there is the possibility of interviewer bias and potential ethical concerns. Surveys and questionnaires might seem easier to use, but students will need assistance developing good questions. One advantage is the researcher does not have to be present. Surveys and questionnaires can be distributed in the schools, or even mailed, so a large number of participants can be contacted. Low return rate is a problem, and students also need to be taught how to statistically compile the survey results.

Experimental design permits inferences about cause-and-effect relationships because researchers use evenhanded procedures to assign participants to two or more treatment conditions. The independent variable is the one the investigator manipulates, anticipating this will cause changes in the other variable being measured—the dependent variable. To control for participants' characteristics that might reduce the accuracy of their findings, investigators use random assignment of participants to treatment conditions. Depending on the type of experiment the student wishes to conduct, the facilities of the school may or may not be suitable, and many other issues need to be addressed. Bottom line—if the student wants to attempt to prove a cause-and-effect relationship, then he/she will want to conduct a controlled experiment.

Quasi-experiments may utilize quasi-independent variables and treat subject variables like they are independent variables. A *quasi-independent variable* is one in which the researcher selects people for having a certain trait or property. Although they've determined the form of experiments, using an existing trait or quality as the independent variable does not allow for random assignment, so causality cannot be established. Because participants were selected based on preexisting characteristics, as opposed to being assigned to conditions, there are always uncontrolled variables that may be affecting the outcome.

DESIGNING THE PROJECT

IDENTIFYING RESEARCH PARTICIPANTS

Although this guide provides examples for working primarily with humans, research participants can be human or nonhuman. The type of participant students choose will depend on the time, resources, and availability of these participants. APA has published guidelines for the use of both human and nonhuman participants, and these guidelines must be taken seriously whenever any research project is conducted. The complete text of these guidelines and regulations can be found at: www.apa.org/science/about/publications/index.aspx.

Humans are likely the most accessible participants for high school psychology classes. Although it may be difficult to find a group of adult participants, it is often desirable to use adults rather than children (anyone under 18 years of age), for whom permission from a parent or guardian must be obtained. Ethical concerns, such as coercion, are also greatly reduced when students study adults rather than their peers. Every person who decides to participate in the study must provide informed consent; additional information about this process is included in the section about research ethics.

Many students are interested in studying people with a psychological disorder, such as depression, an eating disorder, or schizophrenia, but this type of research is extremely difficult for a student to do because of privacy and increased ethical concerns and also practical problems, such as finding enough participants. Using healthy adults will greatly reduce the heightened ethical considerations that must be undertaken when working with more vulnerable groups of participants (i.e., children, prisoners, or other people who are not free to make decisions without feeling pressure).

DESIGN AND PROCEDURE

One hallmark of good experimental research is that the researcher randomly assigns people to different conditions in order to detect differences actually due to the independent variable (the variable that is thought to be the cause in a cause-effect relationship). The dependent variable is the outcome measure that gauges the impact of the independent variable, and if a study is designed with more than one condition (e.g., treatment and control), randomly assigning participants to different groups strengthens the study. Random assignment can be conducted using simple methods, such as the flip of a coin for two conditions, the

roll of a die for up to six conditions, or a random drawing. For example, as participants arrive for the study, or even before they arrive, the experimenter selects a slip of paper listing one of the treatment conditions from a box containing slips of paper that assign each of the treatment conditions. Each slip should be returned to the container to meet the underlying assumption that each participant has an equal chance for assignment to a group. Although this one example of a method of random assignment is unsophisticated, this type of process will ensure that random assignment consistent with scientific principles has been conducted. Random assignment can also be conducted using more sophisticated methods that can be found in the reference texts in the Resources section at the conclusion of this document.

Sometimes it is not possible to randomly assign participants to a particular condition. If participants are not randomly assigned to a particular condition, then the study is termed "quasi-experimental" or "nonexperimental." For example, a new teaching method might be used in one classroom, while an older method is used in a second classroom. Thus, students in each classroom would receive a different instructional method. In this case, students were not randomly assigned to the different classrooms. Despite the lack of random assignment, all other aspects of the study are similar to an actual experimental approach. To control conditions within the quasi-experimental study, the researcher should maintain as much consistency as possible for each group. For example, if instructions about how to complete an instrument are given to participants, these instructions should be scripted and read (verbatim) to the participants to ensure consistency. Maintaining similar conditions will not allow for a true experimental conclusion, but it will substantially strengthen the study.

A nonexperimental study does not include random assignment, and thus, would not allow for a cause-and-effect relationship to be established. However, a nonexperimental study may provide useful information that would inform the scientific community. Survey research, observational studies, and correlational research are all considered nonexperimental or quasi-experimental. For example, it would be possible to observe and record the frequency of hand washing in a restaurant. When designing a nonexperimental study, students should strive to select instruments and develop observation techniques that will provide reliable and valid results. Specific procedures must be employed when conducting a study of this type, and this type of study may be simpler for the beginning student.

Regardless of whether an experimental, quasi-experimental, or nonexperimental study is used, the procedure for conducting the project should be carefully documented. For example, imagine a study designed to contrast the effect of watching various film clips on participants' mood. The researcher should carefully describe the conditions under which the clips were viewed (e.g., in a classroom or laboratory; individually or in groups), the instructions given to the participants, and any other information about how the study was run that would be necessary to replicate it. Documentation of conditions can be included in the written report that describes the study, though a formal written report is not a requirement for conducting

research. A student can conduct research without writing a formal paper and still gain much from the research experience.

INDEPENDENT VARIABLE OR TREATMENT CONDITIONS

A sound psychological project will clearly identify exactly how the independent variable (the condition that is manipulated) will be applied and how the dependent variable (the response of the participant) will be measured. This clear description of variables is often referred to as "operationalizing" the variables.

Operationalizing variables may lead to a discussion about the possible variables or conditions that may have an effect on the response the student is interested in studying. It is important to note that sometimes confounding variables can affect or influence the results of a study. A confounding variable is an uncontrolled variable that affects the outcome of the experiment. A confounding variable may be linked to the dependent variable such that it makes it difficult to determine if the independent variable is the factor that makes a difference in the project. It is not always possible to control all of these influencing factors, but it is important for the student to consider that other variables may be present.

The design of the project includes a clear description of the independent variable or the specific manipulation of a particular condition. One frequently employed technique is to compare one group of people who receive a treatment (the independent variable) against a second group of people who do not receive a treatment to determine if the treatment has had an effect on the behavior of the participants. The treatment should be well defined and described in clear terms.

For example, a student may wish to conduct research on the effect of studying a course topic all in one session (known as "cramming" or massed practice) compared to spacing out study of a topic (called spaced practice) on learning. The hypothesis might be that massed practice may improve learning in the short term, but spaced practice is the better strategy for long-term learning. This hypothesis contains two independent variables: study strategy (massed versus spaced study) and time-course of learning (short term versus long term). The student can operationalize massed practice as studying a short excerpt from a textbook for one hour. Spaced practice can be operationalized as studying the same excerpt in three 20 minute periods with a 5-minute rest between study periods. Short-term learning can be operationalized as student performance on a test over the course material immediately after studying is completed. Long-term learning can be defined as student performance on the test a week later. The dependent variable in this study is learning, which can be operationalized in a number of ways. Participants can be asked to recall all the facts they can remember from the material they studied, or the researcher can devise some kind of test (short answer, multiple choice, or fill in the blank) of the material. To make this study a true experiment, participants should be randomly assigned to one of the two study strategy conditions. All participants will be tested twice, immediately and after a week.

The experiment requires the researcher to find a textbook excerpt that is suitably long and unfamil-

iar to students with the right level of complexity. It is important for the experimenter to control for extraneous variables. Note how both groups study for the same total of 60 minutes. The researcher should make sure that participants are not already familiar with the material and eliminate any distractions in the study environment. The same test can be used for both short- and long-term recall, but the experimenter must check to make sure participants did not gain any knowledge that might help them during the week between the two tests.

This same hypothesis could be studied using a correlational design. Students in a class could be surveyed about their study strategies before an exam, such as how long they studied and if they crammed or spaced out their study. A correlation could be calculated between the amount of study time and exam performance. Furthermore, students could be divided according to whether they massed their study or spaced it out. The researcher can calculate the correlation between study time and exam score separately for each group and compare them, or the researcher can simply compare the mean exam score of the two groups. There are always multiple ways to design a study to test a hypothesis. The challenge is to select the best design to test the hypothesis the researcher has the time and resources to complete. For more information about different research designs, consult a textbook on research methods. A list of selected texts is in the Resources section of this manual.

DEPENDENT VARIABLE OR COLLECTION OF DATA

The dependent variable is the outcome measure that gauges the impact of the independent variable. Equipment may be used to measure a dependent variable, such as a response to a computerized task (e.g., how long it takes people to identify a series of photos as male or female), a physical change in function (e.g., how many M&Ms participants ate while waiting to meet another person), or a response to a survey. Research in psychology frequently employs the use of a survey or similar self-report document to measure the dependent variable. If a student is measuring a response that is a common human characteristic (e.g., personality, anxiety), an expedient way to measure the characteristic or variable is to use an existing instrument. Students should consider the reliability and validity of the instrument for the study that they are conducting. Good instruments will be reliable and valid. Reliability means the survey yields consistent results; in other words, someone who completes the instrument several times should score about the same each time. An instrument that has validity means the instrument measures what it is supposed to measure; it is accurate within the context of use. The best way to have students find reliable and valid instruments is to encourage them to pay close attention to the instruments described in the articles they obtain during the initial literature review.

When evaluating a survey instrument for use in a project, it is also important to consider copyright issues. If the instrument is copyrighted, permission to use the instrument must be granted by the author, and/or the necessary copies must be purchased. Some instruments are available for general use. Indiana State University provides a listing of instruments that may be of use to teachers and students: libguides.indstate.edu/instruments.

If a previously published instrument is not available, it is possible to write several questions to measure a dependent variable. This procedure should be considered as a last resort, because measures of reliability and validity will generally not be available. However, if the instrument simply asks participants to report factual information, this method will probably be acceptable for use in the project.

INSTRUMENTATION

Research reported in journals sometimes uses highly specialized equipment for the precise presentation of stimuli and measurement of behavior. Students and teachers will often not have access to this kind of equipment. In fact, the instrumentation requirements will probably be one of the factors determining whether a student can conduct a particular research project. Students and teachers, however, should not automatically discard a research idea because of instrumentation. In much research that uses high-tech equipment, it is often possible to find low-tech methods that still allow students to conduct perfectly acceptable research. For example, reaction times may be able to be measured by a stopwatch with acceptable accuracy, or frequency of a behavior may be measured instead. Stimuli can be presented on an overhead projector or through PowerPoint or flashcards. A lot of good research is accomplished with only paper and pencil. Remember that good science is not synonymous with high-tech equipment.

RESEARCH ETHICS

Before any project is actually conducted, it is important that the project be reviewed for sound ethical practices. Students should be aware that the review process is essential because it is designed to protect all human beings and/or animals that participate in any type of research study. The review process also ensures the study has been designed and will be conducted in accordance with ethical principles.

All studies must be reviewed by an independent oversight group that has been established at the local school or university. Federally registered institutions, such as universities, generally maintain an institutional review board (IRB), and some also maintain an Institutional Animal Care and Use Committee (IACUC). Use of the IRB/IACUC process ensures the best possible care is taken to protect people and animals that participate in the study. Similarly, it ensures the project has been designed in accordance with appropriate protections. If a university faculty member is sponsoring the student, it is best to use the university IRB/IACUC for review. The university faculty member should direct and advise the student about the application and approval process at the local campus.

Because many regional fairs provide students with an opportunity to compete at the national competition, it is advisable to follow the procedures defined by the particular competition as a minimum set of criteria. Thus, if a university faculty member is not directing the student's research, then the local school must constitute an IRB to ensure that the participants (i.e., people or animals) are treated appropriately. ISEF offers valuable guidance for constructing a local IRB, which should consist of a minimum of three individuals. To address conflicts of interest, the review panel should not include the adult sponsor or the faculty

supervisor of the project. The panel should include a science teacher, a school administrator, and a scientist (e.g., school psychologist) who is familiar with psychological research.

Materials developed and reviewed must include a clear set of procedures. If human participants will be recruited, it is important to specify exactly how. For example, if participants will be recruited through advertising, the IRB or a similar panel should review a copy of the advertisement. Using minors for experiments is more complex, so additional safeguards must be taken. Parental consent is required; the age of majority varies by state (for example, in Alabama, the age is 19); recruitment materials sent to parents must be carefully reviewed to ensure there is no coercion. An established IRB review of any project that proposes using minors is strongly recommended.

Potential risks should be identified, and an informed consent statement should be developed for the participants who will volunteer for the study. Each participant should be given informed consent documents, and it should be clear to each participant that he or she has the right to stop participating in the study at any time and for any reason. Additionally, participants should be told they can request their data be removed from the study. The informed consent document should include:

a. a statement about the type of research being undertaken or what the study is about;

b. the approximate amount of time required;

c. information about compensation, if any;

d. information about what will happen or the procedures to be used;

e. information about any potential risks or benefits of participation;

f. information about how the data will be safeguarded and limits to confidentiality;

g. information about whom to contact if additional information is needed; and

h. clear instructions that a person can stop participating at any time (without penalty) and have the data destroyed.

It is helpful to consider how each participant might respond to a particular treatment or question that might be asked. Again, it is important to note that adult volunteers can independently provide informed consent; parental permission must be obtained before a child volunteer can participate. After a parent provides permission, the child should be informed about the study and given an opportunity to elect to not participate in the study.

After the informed consent document has been developed, care should be exercised in using the document. The teacher should ensure that data are carefully collected and stored consistent with the method specified in the IRB proposal and on the informed consent document. In other words, the teacher should have a mechanism for ensuring that data are maintained in a secure environment. Whenever possible, it is advisable to collect data anonymously or remove identifying information from data that have been collected. Removal of this information helps ensure specific information about a participant is not inadvertently disclosed.

Finally, participants should be debriefed. Participants should be given a copy of the informed consent document they signed. Additionally, they

should be given a more detailed written explanation about the study. A handout explaining the purpose of the research and information about how to contact the faculty supervisor should be provided for participants' questions or concerns. If the research project involved deception or potentially distressing information (such as a measurement of depression or self-esteem that might reflect negatively on the participant), then extra care in debriefing is warranted. Tips and strategies for debriefing in these kinds of situations can be found in the more extensive texts listed in the Resources section.

Appendix G contains sample documents that can be used for submission to an IRB. More information about the federal regulations that govern the review process and IRBs at research institutions is available from the U.S. Department of Health and Human Services Office of Human Research Protections (OHRP) website.

A FINAL NOTE ON DESIGNING RESEARCH

One of the most common pitfalls students encounter in conducting research is trying to make their project too broad in scope. Students want to design an experiment to answer all the research questions once and for all. The end result typically is an experiment so complicated that the results are difficult, if not impossible, to interpret. Experienced researchers know a series of simple, straightforward experiments is preferred to a comprehensive, complex one. This principle is especially important for student research, in which there is usually only one chance to get everything right, and unforeseen complications are likely. A good student research project is simple in that it addresses one or two questions in a complete manner. The teacher needs to help students achieve the right balance of depth and breadth. Keeping the experiment simple reduces student frustration, promotes student ownership of the project, and maximizes the educational benefit to the student, regardless of how the experiment turns out.

CONDUCTING THE PROJECT

After the project has been designed and the appropriate approval process has been undertaken, it is time for the student to actually conduct the project. Clear and careful planning is essential. If the project has been carefully designed, this portion of the project often is the least time consuming. Nevertheless, students should be carefully supervised as they collect their data. Pilot testing the procedures that will be used, before officially conducting the study, is strongly recommended. Students should practice the instructions and manipulations with peer volunteers to make sure the procedures are well rehearsed for the real participants. This way students can get feedback about what is unclear or confusing. Pilot testing can help ensure the independent variable is effective and that extraneous variables are controlled. The teacher should observe a pilot test run before the experiment is run with actual participants. Nothing is more frustrating to students than completing an entire experiment and then finding out they made a fundamental and preventable error that invalidates the findings.

When conducting the experiment, students should adhere to the specific procedures specified in the students' research proposal so that participants are protected. In other words, informed consent documents should be carefully administered to the participants, and all procedures specified in the IRB materials should be followed. As mentioned above, in the event minors are used in the study, permission must be obtained from the parent or guardian, and informed consent must be obtained from the minor participant before the experiment is conducted. It is important that the student researcher be

NOTHING IS MORE FRUSTRATING TO STUDENTS THAN COMPLETING AN ENTIRE EXPERIMENT AND THEN FINDING OUT THEY MADE A FUNDAMENTAL AND PREVENTABLE ERROR THAT INVALIDATES THE FINDINGS.

provided with clear instructions for storing these documents in a secure location.

At the conclusion of an experimental session, and usually before debriefing, students should administer a posttest questionnaire. This questionnaire should do at least three things. First, it should ask whether participants understood and followed directions and gave the experiment a sincere effort—it is important to determine if the participants took the experiment seriously, or, if not, whether the results should be discarded. Ask participants to be honest and stress that results are confidential and there is no penalty involved. Second, the questionnaire should contain some sort of manipulation check to see if the operationalization of at least the independent variable was effective. One of the most common ways an experiment fails is when the manipulation of the independent variable is too weak or ambiguous.

Third, the questionnaire should ask whether the participants were aware of the hypothesis of the study and if this affected their performance. The posttest questionnaire is also a convenient place to gather other information that might be useful, such as demographic information and any background information relevant to the current research.

DETERMINING RESULTS OF THE PROJECT

Data analysis should be part of the experimental design. By taking care ahead of time to think carefully about plans for collecting and analyzing data, teachers can provide important guidance to aid the student research process. Analyzing data that have been collected can be expedient if a study was properly designed. To ensure an analysis can be conducted, the spreadsheet should be designed and the appropriate statistics for use in the study identified prior to collection of any data. Designing a spreadsheet for the data in advance of collecting data may lead to a discovery that the data collection method is not clear. If a problem is encountered when the spreadsheet is designed, changes can be made in data collection prior to undertaking the study.

Statistical analysis of data allows the researcher to describe results, draw conclusions, and make generalizations. Descriptive statistics, such as graphs, tables, means, and standard deviations, are used to summarize the data and describe basic trends in the data. Inferential statistics, such as t tests, allow researchers to determine the statistical significance of the results and draw conclusions about the study. Both types of statistics should be used so the researcher can determine if the hypothesis was supported and describe the results of the study.

Data analysis can be daunting for many researchers, however not everyone must be a statistician to conduct a sound study. A simple guide to elementary data analysis techniques has been included in Appendix H. More complex techniques may require the assistance of someone who has particular expertise in statistics. If this is the case, we suggest a university faculty member be consulted.

DATA ANALYSIS CAN BE DAUNTING FOR MANY RESEARCHERS, HOWEVER NOT EVERYONE MUST BE A STATISTICIAN TO CONDUCT A SOUND STUDY.

INTERPRETING AND DISCUSSING THE RESULTS OF THE PROJECT

In addition to determining the results of the study, students need to interpret and discuss the implications of the data. First, the student should relate the findings back to the hypotheses and predictions made in the introduction. Was the hypothesis supported? Did the results come out as predicted? Second, the student should place the results of the current study in the context of prior research on the same topic. Does the present research replicate prior work? Does it support one hypothesis over another? Does it contradict prior results? In this section, students should discuss the implications of the results for the theory, research, or practical applications. This process is where students get to put their spin on the results. They can point out the next experiment that should be done to follow up on the present results. Students should anticipate questions and criticisms people might have about the experiment and address them. Next, the students should discuss the problems encountered during the research. Were there unforeseen and uncontrolled factors that might have influenced the results? If so, they should be mentioned and discussed. Students should make suggestions about how these problems might be overcome in future research. Finally, students should close with a summary of the main points of the study.

Students have a tendency to be overly critical of their research. They may spend the discussion section dismissing their work. If they did a good job of designing and conducting the study, then they should take the results seriously from the perspective that the results are valid. On the other hand, if there were unforeseen problems, students should also be honest in exploring the impact and consequences of these. In the discussion section, students are allowed to present more than one possible explanation of the data.

PRESENTING THE PROJECT

If participating in a science fair, students must prepare a presentation or poster board. Although not all science fairs require a research paper, it is helpful to write a research paper first and to extract key components for display on the presentation board. The paper can be available at the science fair, and it can even be submitted for publication (e.g., in *The Whitman Journal of Psychology* or other student research journals). Minimally, most contests require an abstract that summarizes the study. The abstract should include the purpose of the study; the procedures used; the data collected, along with an explanation of the data; and conclusions about the study. The Society for Science and the Public provides a sample abstract on its website (www.societyforscience.org). The key components for the research paper and the presentation board are described below:

- The Introduction begins with a statement of the problem that is being investigated. It should establish a context for the project by reviewing related work in the field. The introduction generally ends with a statement of hypotheses.
- The Method section describes participants (e.g., who, how many, the selection process), the materials used (e.g., surveys), and the procedures employed. This section should include sufficient detail so the reader could replicate the study using the information provided.
- The Results section states the findings but does not

MINIMALLY, MOST CONTESTS REQUIRE AN ABSTRACT THAT SUMMARIZES THE STUDY. THE ABSTRACT SHOULD INCLUDE THE PURPOSE OF THE STUDY; THE PROCEDURES USED; THE DATA COLLECTED, ALONG WITH AN EXPLANATION OF THE DATA; AND CONCLUSIONS ABOUT THE STUDY.

explain what they mean. This section should make clear which statistical tests were conducted and provide the numerical results, including the probability (p) values.

- The Discussion section is where results are explained. This section should make clear whether the findings support the original hypothesis. Explanations should tie back to the literature that was presented in the introduction. In addition, this section should include logical ways to extend the research.

- The References page(s) should include only those sources cited in the paper in APA format (www.apastyle.org).

- An optional Acknowledgments page thanking everyone who helped with the process of designing, carrying out, and writing up the study can be included.

It is important that all involved consider the guidelines for each science fair regarding the project exhibit board. Although the board should be attractive and clear, it is important to adhere to the rules of the sponsoring fair. Components of the poster can be created in a basic word processing program or in a slide presentation program (e.g., PowerPoint). Individual pieces can then be mounted on the display board. Display boards are typically available at office supply stores. Suggestions for preparing effective poster presentations can be found at the APA TOPSS website (www.apa.org/education/k12/science-fair.aspx).

APPENDIX A:
RESEARCH COMPETITIONS FOR PSYCHOLOGY

Although there are a number of highly competitive national and even international competitions that students with psychology projects can enter, many localities or even schools have smaller-scale science fairs that welcome psychology projects. Unfortunately, since these fairs are specific to particular places we cannot list them all below, but it is worth noting that students with simple psychology projects can and should pursue entry into such general science fairs. Local high school fairs often provide the first opportunity to compete, and sometimes there are additional regional and national competitions available for winners of local competitions.

There are many regional science fairs available in the United States, and most of these fairs are affiliated with the Intel International Science and Engineering Fair (ISEF). In the ISEF, a psychology project can be entered in the Behavioral and Social Sciences category. Entry requirements vary with each regional fair and you should refer to the local sponsor for specific information. This appendix includes information about the largest national science fair competition (ISEF) and other national science-oriented competitions available to high school students with psychology projects.

INTEL INTERNATIONAL SCIENCE AND ENGINEERING FAIR (ISEF)

This fair is open to students who qualify via local, state, and regional ISEF-affiliated fairs. The Intel ISEF is the world's largest precollege celebration of science. Held annually in May, the ISEF brings together more than 1,700 students from nearly 75 countries, regions, and territories to compete for scholarships, tuition grants, internships, scientific field trips, and the grand prize: a $75,000 college scholarship. Students who win a local or regional competition are invited to advance to larger competitions. Information regarding eligibility and the instructions for competing in this fair are listed at the Society for Science and the Public website at www.societyforscience.org/intel-international-science-and-engineering-fair. Check this site for information on local, state, and regional ISEF-affiliated fairs that are open to all students.

INTEL SCIENCE TALENT SEARCH (STS)

The STS is open to high school seniors in the United States and territories and American students attending school abroad. Each year, nearly 2,000 students accept the challenge of completing an entry for the STS, with finalists competing for the top prize, a $100,000 scholarship. The Intel Science Talent Search School Award recognizes excellence in teaching and school support of individual student research. Each school will receive an award of $1,000 for each semifinalist named. For complete details and procedures for submitting entries, please check the Society for Science and the Public website at student.societyforscience.org/intel-sts.

JUNIOR SCIENCE AND HUMANITIES SYMPOSIUM

This scholarship competition encourages students to get involved in science, engineering, technology, or mathematics related research. The symposia give students an opportunity to present their original research findings in front of a judging panel and their peers. In addition, the regional or national symposia offer a number of experiences for students including workshops, panel discussions, career exploration, research lab visits, and networking events. For more details, visit the Junior Science and Humanities Symposium website at www.jshs.org.

UNITED STATES ARMY'S ECYBERMISSION COMPETITION

High school freshmen, along with sixth, seventh, and eighth graders, are invited to compete for state, regional, and national awards given by the United States Army in this Web-based science, technology, engineering and mathematics competition. The eCybermission competition challenges students to choose one of seven challenges—alternative sources of energy; environment; food, health and fitness; forces and motion; national security and safety; robotics; or technology. After identifying a problem in their community related to one of these challenges, students are asked to use the scientific method or the engineering design process to come up with a viable solution. For more details, visit the eCybermission competition website at www.ecybermission.com.

GOOGLE SCIENCE FAIR

This global online science competition is open to all students who are between 13 and 18 years old. The competition, which was launched in 2011, accepts submissions in all areas of science. From thousands of submissions, 60 semifinalists are selected, and 15 finalists are chosen to participate in a final live Google Science Fair at the Google headquarters. The prizes are furnished by Google and partners CERN, LEGO, National Geographic, and Scientific American. For details, visit the Google Science Fair website at www.googlesciencefair.com/en/competition.

INTERNATIONAL PSYCHOLOGY SCIENCE FAIR ON MODERN EDUCATION AND STUDENT WELL-BEING

This international psychology science fair offers the opportunity to students from all over the world to design, conduct, and present original research relating to modern learning and student well-being. The goal of this fair is to promote a scientific evaluation of the multiple interactions between innovation, wellness, and efficiency in education. For details, visit the International Psychology Science Fair website at internationalsf.weebly.com.

THINK SCHOLARS PROGRAM

The THINK Scholars Program is an educational outreach initiative that promotes science, technology, engineering, and mathematics by supporting and funding projects developed by high school students. The program is run by undergraduate students at the Massachusetts Institute of Technology (MIT) and sponsored by technology companies and educational organizations. THINK project proposals are science and engineering ideas that span many fields, from green technologies and practical devices to software applications. Projects must be completed by an individual or team of two in the spring semester with a $1,000 budget. Winners receive a $200-$500 scholarship and an all-expenses-paid trip to MIT to meet and network with MIT professors and students. For more details, visit think.mit.edu.

RESOURCES

The University of Florida website (history.cpet.ufl.edu/sciproj/default.html) offers useful information about the steps involved in designing a project and helpful tips on how to prepare for science fairs affiliated with the International Science and Engineering Fair.

Chris Gould at the University of Southern California maintains a virtual library (physics.usc.edu/~gould/ScienceFairs) of state, regional, national, and international science fairs.

The Society for Science and the Public (SSP) (www.societyforscience.org) publishes rules and guidelines for entering projects for Intel ISEF and Intel STS.

The **Neuroscience for Kids** website (faculty.washington.edu/chudler/fair.html) provides specific information to help students design strong psychology projects. Links to additional sites provide information about ideas for science fair projects, guidelines project preparation, and steps for completing a successful project.

The **Science Buddies** website (www.sciencebuddies.org) has more than 1,000 project ideas in more than 30 different areas of science and includes resources for teachers and an "ask an expert" section that provides an online help environment.

Additional resources from APA on conducting research are available online at www.apa.org/education/k12/science-fair.aspx.

APPENDIX B:
A STEP-BY-STEP APPROACH FOR GUIDING A STUDENT THROUGH A SCIENCE FAIR PROJECT

1. Student demonstrates interest in or teacher introduces student(s) to the idea of doing a research project for submission to a science fair.

- Determine student's area of interest and assist in exploring possible topics.
- Determine whether sponsorship/mentorship from an established expert/university faculty is required or if the teacher can guide the student through the project with no outside assistance.

If faculty expert is required—either because of topic area or facilities (lab space/equipment) needed to conduct the study—identify and contact possible local mentor(s).

2. The remaining steps are to be followed either alone or in collaboration with the faculty expert, as the case may be.

(a) Develop student's research study.

- Perform literature reviews.
- Develop a research question.
- Fine tune hypothesis: What are the variables? How will they be manipulated, if needed?
- Identify research population—whether subjects involved will be humans or other animals, how research participants will be accessed and recruited, etc.
- Develop research design: What kind of study will it be? Survey, observational, experimental, etc.
- Identify equipment/instruments that might be needed: How will these be obtained? Access to some standardized assessment tools is extremely limited; what, if any, alternatives might there be?
- Develop data-analysis plan: What statistics will be used? Why?
- Develop research protocol for institutional review. (This exercise might be of didactic value regardless of whether IRB/IACUC review is required.) Deal with informed consent/assent/permis-

sion, as appropriate; determine compensation, if any, for human research participation; debrief, as needed; justify the use and the number of lab animals to be used; etc.

(b) Monitor data collection.

(c) Oversee and guide data analysis and interpretation.

3. Assist in submitting the project to the science fair—provide advice on where/how to get information regarding rules, deadlines, and so on, of different science fairs.

4. Provide tips for preparing an effective poster for presentation at the science fair.

5. Provide guidance on writing up the research findings (scholarly paper), if required by science fair sponsors or if desired by student and/or mentor.

APPENDIX C:
RESEARCH WITH ANIMALS*

RESEARCH ETHICS WITH ANIMALS

[With] the decision to use live animals for teaching and research purposes comes a responsibility to care humanely for them and minimize their pain or discomfort whenever possible. Working with research animals is a privilege, and our society has developed important rules and guidelines to ensure these animals are treated humanely. For example, the use of vertebrate animals in teaching and research at colleges and universities must comply with strict U.S. government regulations set forth in the Animal Welfare Act and/or the Public Health Service Policy on Humane Care and Use of Laboratory Animals,[1, 2] as well as the guidelines found in the *Guide for the Care and Use of Laboratory Animals*.[3] Likewise, projects in secondary schools intended for publication or science fair exhibition must comply with the requirement of the journal or fair sponsor (e.g., the Intel International Science and Engineering Fair), which relies on these same government standards. By following these rules and guidelines, researchers ensure animals are treated humanely and safeguard the continued use of animals in important behavioral research.

Because many psychologists conduct animal research, the American Psychological Association has established the Committee on Animal Research and Ethics (CARE), a committee whose mission is to help safeguard responsible research with nonhuman animals. In response to this charge—and in the hope that all professional educators will join us in helping protect the welfare of nonhuman animals used in research and teaching—CARE has developed guidelines for the use of nonhuman animals in behavioral projects in schools, K-12. These guidelines have been derived from the rules and regulations mandated by the federal government and APA guidelines for nonhuman animal research in colleges and universities across the country,[4] and they have as their basis important ethical principles that safeguard the humane treatment of animals.

* Cited from: APA Committee for Animal Research and Ethics. (2013). *Guidelines for the use of animals in behavioral projects in schools (K-12)*. Washington, DC: American Psychological Association. (www.apa.org/science/leadership/care/animal-guide.aspx)

[1] Available from the USDA National Agriculture Library Animal Welfare Information Center, 10301 Baltimore Avenue, 5th Floor, Beltsville, MD 20705-2351 or at https://awic.nal.usda.gov/government-and-professional-resources/federal-laws/animal-welfare-act.

[2] Available from the Office of Laboratory Animal Welfare, National Institutes of Health, RKL1, Suite 1050, MSC 7982, 6705 Rockledge Drive, Bethesda, MD 20892-7982 or grants.nih.gov/grants/olaw/references/phspol.htm.

[3] Available online at oacu.od.nih.gov/regs/guide/guide.pdf.

[4] American Psychological Association Committee on Animal Research and Ethics. (2012). *APA Guidelines for ethical conduct in the care and use of nonhuman animals in research.* Available from the APA Science Directorate at 750 First Street, NE, Washington, DC 20002 or at http://www.apa.org/science/leadership/care/care-animal-guidelines.pdf.

APPENDIX D:
SCIENCE FAIR PLANNING SCHEDULE

The following is a sample schedule that could be followed by students; any given step or steps could take longer or shorter than indicated below.

Date of Competition_____/_____/_____

Deadlines for application in desired competitions should be added to the appropriate week within the timeline below.

14 weeks before the local science fair_____/_____/_____

- Assist students with selection of topic.
- Provide students with information about conducting a literature review.
- Review with students sources for gathering information/literature.
    - Library resources
    - Online resources

13 weeks before the local science fair_____/_____/_____

- Assist students in obtaining necessary literature for topic.
- Provide students with the Journal Article Review Form.
- Contact university faculty for mentorship support as necessary.
- Instruct students to begin a logbook for recording all information relevant to their study.

12 weeks before the local science fair_____/_____/_____

- Assist students in the development of a research hypothesis.
- Identify the independent and dependent variables to be used in the study.
- Consider whether to use humans or animals in the study.
- If human participants will be used, identify desired group of participants.
- If animals will be used, refer to animal research guide.
- Identify necessary materials/apparatus for use in the project.

11 weeks before the local science fair_____/_____/_____

- Obtain necessary materials/apparatus for use in the project.
- Investigate potential procedures for conducting the project.
- Evaluate availability of resources for conducting the project.
- Consider issues of participant welfare.
- Develop recruitment materials for obtaining participants.

10 weeks before the local science fair_____/_____/_____

- Complete forms for institutional review board (IRB) process.
- Attach all necessary supporting documentation to IRB application (e.g., copies of surveys).
- Submit IRB application for review.

9 weeks before the local science fair_____/_____/_____

- IRB APPROVAL MUST BE GRANTED BEFORE PROCEEDING.
- Secure an appropriate location for conducting the project.
- Ensure all materials are available for beginning the project.
- Begin to recruit participants for the study.
- Prepare location for the project.
- Make copies of all necessary documents for use with participants (e.g., informed consent information).

8 weeks before the local science fair_____/_____/_____

- Conduct the project.
- Provide informed consent information.
- Assign participants to conditions.
- Administer treatment or survey.
- Debrief participants.
- Secure any materials that may have been used in the project.

7 weeks before the local science fair_____/_____/_____

- Continue collecting data on the project.
- Begin entering data for analysis.
- Continue recording information in log.

6 weeks before the local science fair_____/_____/_____

- Conduct analysis of the data.
- Begin writing analysis of the data.

5 weeks before the local science fair_____/_____/_____

- Consult experts for support with data analysis.
- Begin to integrate results into a discussion of the study.
- Develop a preliminary draft of a complete research paper.

4 weeks before the local science fair_____/_____/_____

- Refine the draft of the research paper.
- Use the draft to begin designing a display of the study.
- Obtain display materials to be used in the science fair.

3 weeks before the local science fair_____/_____/_____

- Draft text and graphs using guidelines that are appropriate for display.
- Print and design materials for use in the display.
- Continue work on research paper to accompany the display.

2 weeks before the local science fair_____/_____/_____

- Write the abstract to conform to rules of the science fair.
- Continue work on the research paper.
- Complete display board.

1 week before the local science fair_____/_____/_____

- Evaluate completeness of the board.
- Evaluate additional materials to add to the display.
- Finish the final research report.
- Practice presentation of results.

APPENDIX E:
STUDIES DEEMED EXEMPT UNDER THE FEDERAL REGULATIONS

From §46.101(b) of Title 45 Code of Federal Regulations, Part 46

www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html#46.101

The following exemption categories are from Title 45, Part 46 of the Code of Federal Regulations for the Protection of Human Subjects:

(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

(3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

(5) Research and demonstration projects which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine:
(i) Public benefit or service programs; (ii) procedures for obtaining benefits or services under those

programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

(6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

APPENDIX F:
SAMPLE JOURNAL ARTICLE REVIEW FORM

To facilitate your understanding, make sure you put the information into your own words.

ARTICLE CITATION

(Use APA format found at www.apastyle.org.)

BRIEFLY STATE THE MAIN IDEA OF THE ARTICLE:

PARTICIPANTS (PEOPLE OR ANIMALS ON WHOM THE STUDY WAS CONDUCTED):

PROCEDURE:

MATERIALS:

RESULTS:

SIGNIFICANCE/RELEVANCE TO YOUR TOPIC:

Name: _____

Date: _____/_____/_____

APPENDIX G:
TEMPLATES AND SAMPLE FORMS FOR RESEARCH PROJECTS

This appendix provides templates and forms that can be used by teachers leading students through a research process. These forms provide a step-by-step guide for students as they engage in this mode of inquiry. Please note that the forms should be modified for each project. If the project will be entered in a contest (e.g., ISEF), respective forms from the competition should be used. Contest requirements vary, and failure to abide by them may result in disqualification. Included in this appendix are the following forms:

TEMPLATES

Research Description for the Institutional Review Board (IRB)

Research Consent Form

Research Consent Form for Minors

Demographic Data Sheet

SAMPLES

Sample Research Description for the Institutional Review Board (IRB)

Sample Research Consent Form

TEMPLATE FOR RESEARCH DESCRIPTION FOR THE INSTITUTIONAL REVIEW BOARD (IRB)

Project Title: _____

Investigator(s): _____

School Name: _____

Adult Sponsor: _____

Please attach the following materials to this form:

- The answers to the questions posed below
- A copy of the consent and, if minors are involved, consent forms for minors
- A copy of all materials to be used in the study

1. What is the purpose of the study?

2. What activities/procedures does participation in the study involve?

3. Who will the participants in the research be, and how will they be selected?

4. How much time will participation involve?

5. Will people be paid to participate?

6. What risks or discomforts (e.g., physical, psychological, social, legal) can be reasonably expected due to participating in this research?

7. What potential benefits does the research offer to the individual participant?

8. What potential benefits does the research offer to society?

9. How will informed consent be obtained? Keep in mind that informed consent is a process, not just a form.

10. How will the confidentiality of the data be maintained?

11. Where will the research take place?

TEMPLATE FOR RESEARCH CONSENT FORM

Project Title: _____

Investigator(s): _____

School Name: _____

Adult Sponsor: _____

1. What is the purpose of the study?

2. What activities/procedures does participation in the study involve?

3. How much time will my participation take?

4. Will I be paid to participate?

5. What risks or discomforts (e.g., physical, psychological, social, legal) can be reasonably expected due to participating in this research?

6. What potential benefits can the research offer to me?

7. What potential benefits does the research offer to society?

8. How will the confidentiality of my data be maintained?

Participant Rights

- Your participation in this study is voluntary.
- You have the right to withdraw from the study at any time, for any reason, without any penalty.
- Any information derived from the research project that personally identifies you will not be voluntarily released or disclosed without your consent.

Questions About the Study

If you have questions about this study, please contact the adult sponsor named above at the following phone number:

My signature means I agree to participate in this study.

Participant's Signature: _____

Date:_____/_____/_____

Participant's Printed Name:_____

TEMPLATE FOR RESEARCH CONSENT FORM FOR MINORS

Project Title: _____

Investigator(s): _____

School Name: _____

Adult Sponsor: _____

1. What is the purpose of the study?

2. What activities/procedures does participation in the study involve?

3. How much time will my child's participation take?

4. Will my child be paid to participate?

5. What risks or discomforts (e.g., physical, psychological, social, legal) can be reasonably expected due to participating in this research?

6. What potential benefits can the research offer to my child?

7. What potential benefits does the research offer to society?

8. How will the confidentiality of my child's data be maintained?

Participant Rights

- Your child's participation in this study is voluntary.
- You have the right to withdraw your child from the study at any time, for any reason, without any penalty.
- Any information derived from the research project that personally identifies your child will not be voluntarily released or disclosed without your consent.

Questions About the Study

If you have questions about this study, please contact the adult sponsor named above at the following phone number:

My signature means I agree to have my child participate in this study.

Participant's Printed Name: _____

Guardian's Printed Name: _____

Guardian's Signature/Consent: _____

Date: _____/_____/_____

TEMPLATE FOR DEMOGRAPHIC DATA SHEET

For the purposes of analyzing our data, it would be helpful to know a little information about you.

Please check the correct response.

1. Sex:

- Male

- Female

2. Race:

A. White

B. African American

C. Asian American

D. Hispanic

E. Native American

F. Other (Please specify.) _____

3. Date of Birth:_____/_____/_____

SAMPLE RESEARCH DESCRIPTION FOR THE INSTITUTIONAL REVIEW BOARD (IRB)

Project Title: Adults' Attitudes Toward and Use of Computers

Investigator(s): Joan Neeson

School Name: Central High School

Adult Sponsor: Ms. Madeline Kreeger

Please attach the following materials to this form:

- The answers to the questions posed below
- A copy of the consent and, if minors are involved, consent forms for minors
- A copy of the materials to be used in the study

1. What is the purpose of the study?

The purpose of this study is to explore how adults use and feel about computers.

2. What activities/procedures does participation in the study involve?

Participants will be given a 27-item survey composed of close-ended questions about their use of and attitudes toward using computers. A copy of this survey is attached. They will also be asked for some demographic information (e.g., gender, race). A copy of the demographic data sheet is also attached.

3. Who will the participants in the research be, and how will they be selected?

Volunteers will be solicited at a local library; permission to collect data at the library will be acquired from the library staff. A flyer will be posted on the door of the library, and the researchers will sit at a table with a large poster that advertises the study.

4. How much time will participation involve?

The survey takes approximately 10 minutes to complete.

5. Will people be paid to participate?

There is no payment for participation.

6. What risks or discomforts (e.g., physical, psychological, social, legal) can be reasonably expected due to participating in this research?

No more risk is anticipated than that typically involved in daily life. Participants will merely be asked to answer the questions on a short survey. However, it is possible that some participants experience some anxiety related to computers, and, if so, the survey questions might trigger similar feelings.

7. What potential benefits does the research offer to the individual participant?

There are no potential benefits for the participant.

8. What potential benefits does the research offer to society?

It is hoped that the research will shed light on how adults of various ages in the 21st century are using computers and the prevalence of their feelings toward this type of technology.

9. How will informed consent be obtained?

Potential participants will be greeted by the researcher and told: “I am conducting a study on how adults use and feel about computers. Participation is voluntary and would involve only 10 minutes of your time. Would you be willing to participate?” If the participant agrees, the researcher would ask the participant to read the consent form and to ask any questions s/he might have. Participants would be given a copy of this form to keep.

10. How will the confidentiality of the data be maintained?

Informed consent forms will not be linked to the survey that the participant completes. Informed consent forms will be immediately submitted to the sponsoring teacher, and the teacher will lock the forms in a file cabinet. The survey and the demographic data sheet will be stored in a separate secure location by the teacher. The completed sheets will not leave school property.

11. Where will the research take place?

The research will take place at the Anytown Public Library, 12 Reading Avenue, Anytown, NY.

Because the survey referenced does not actually exist, a copy is not included. Normally a copy of the survey or instrument would be submitted to the IRB.

SAMPLE RESEARCH CONSENT FORM

1. What is the purpose of the study?

The purpose of this study is to explore how adults use and feel about computers.

2. What activities/procedures does participation in the study involve?

You will be given a 27-item survey composed of close-ended questions about your use of and attitude toward using computers. You will also be asked for some demographic information (e.g., gender, race).

3. How much time will my participation take?

The survey takes approximately 10 minutes to complete.

4. Will I be paid to participate?

There is no payment for participation.

5. What risks or discomforts (e.g., physical, psychological, social, legal) can be reasonably expected due to participating in this research?

No more risk is anticipated than that typically involved in daily life. Participants will merely be asked to answer the questions on a short survey. However, it is possible that some participants experience some anxiety related to computers and, if so, the survey questions might trigger similar feelings.

6. What potential benefits can the research offer me?

There are no potential benefits for the participant.

7. What potential benefits does the research offer to society?

It is hoped that the research will shed light on how adults of various ages in the 21st century are using computers and the prevalence of their feelings toward this type of technology.

8. How will the confidentiality of my data be maintained?

The data and the consent forms will be stored separately in secure locations at the sponsoring institution.

Participant Rights

- Your participation in this study is voluntary.
- You have the right to withdraw from the study at any time, for any reason, without any penalty.
- Any information derived from the research project that personally identifies you will not be voluntarily released or disclosed without your consent.

Questions About the Study

If you have questions about this study, please contact the adult sponsor named above at the following phone number: (555) 555-5555.

My signature means that I agree to participate in this study.

Participant's Signature: _____

Date:_____/_____/_____

Participant's Printed Name:_____

APPENDIX H: DATA ANALYSIS

Most standard spreadsheet programs (e.g., Excel, Quattro Pro) allow for basic statistical analysis. It is relatively simple to obtain basic descriptive statistics (i.e., measures of central tendency, measures of variability, and measures of relationship) and elementary inferential statistics (i.e., correlation, t test, and chi-square), along with graphs and charts. If a sophisticated statistical analysis is proposed, and it is beyond the scope of the teacher's expertise, it is important to obtain support from a knowledgeable colleague or college faculty member. A brief review of a few simple and frequently used methods of analysis is provided below.

Chi-square (x2) (test for independence): This test is used to compare two groups (e.g., men and women) against another categorical variable (e.g., Democrat and Republican). Under normal circumstances, proportions (or the number of men and women of each party) would be expected to be equal. The number of people in each group (frequency) would be used to conduct this analysis. The result indicates whether the proportion in each group differs significantly from the expected equality. This simple analysis can be conducted using formulas that are available in an elementary statistics text. It may be easier to conduct a chi-square without aid of a computer program.

t test (for two different treatments): This test allows for comparison of two different groups when the dependent variable has a numerical value that is of at least an interval level scale. An interval level of measurement implies equal distances or intervals between values (e.g., test scores, elapsed time). For example, to determine if one teaching method is better than another, exam scores from two groups of students would be used for a comparison by a t test. The result indicates whether the difference between the groups is significant.

Pearson correlation coefficient (r): A correlation coefficient would be used to determine if a relationship exists between two variables. For example, a correlation would provide an index of relationship if one group of students provides information about two different characteristics (e.g., number of hours of TV watched and GPA).

RESOURCES

Akins, C. K., Panicker, S., & Cunningham, C. L. (2005). (Eds.). *Laboratory animals in research and teaching: Ethics, care, and methods.* Washington, DC: American Psychological Association.

APA Committee for Animal Research and Ethics. (2013). *Guidelines for the use of animals in behavioral projects in schools (K-12).* Washington, DC: American Psychological Association. Retrieved from www.apa.org/science/leadership/care/animal-guide.aspx

Council on Undergraduate Research (2011). *Undergraduate journals.* Retrieved from www.cur.org/resources/students/undergraduate_journals

Goldman, B. A., & Mitchell, D. F. (2008). *Directory of unpublished experimental measures, Vol. 9.* Washington, DC: American Psychological Association.

TEXTBOOKS ON RESEARCH METHODS AND STATISTICS

Beins, B. C., & McCarthy, M. A. (2012). *Research methods and statistics.* Boston, MA: Pearson.

Davis, S. F., & Smith, R. A. (2005). *An introduction to statistics and research methods: Becoming a psychological detective.* Upper Saddle River, NJ: Prentice Hall.

Gravetter, F. J., & Wallnau, L. B. (2014). *Essentials of statistics for the behavioral sciences* (8th ed.). Belmont, CA: Cengage Learning.

Gravetter, F. J., & Forzano, F. B. (2016). *Research methods for the behavioral sciences* (5th ed.). Belmont, CA: Cengage Learning.

Jackson, S. L. (2008). *Research methods and statistics: A critical thinking approach.* Boston, MA: Cengage Learning.

Martin, D. W. (2007). *Doing psychology experiments* (7th ed.). Belmont, CA: Wadsworth.

Pelham, B. W., & Blanton, H. (2012). *Conducting experiments in psychology: Measuring the weight of smoke* (4th ed.). Belmont, CA: Wadsworth.

Smith, R. A., & Davis, S. F. (2013). *The psychologist as detective: An introduction to conducting research in psychology* (6th ed.). Upper Saddle River, NJ: Prentice Hall.

DATABASES

Finding full-text psychology journals online can be difficult, especially for students with limited access to academic libraries or online databases. The following journals offer access to a selection of full-text articles online, and some of them offer at least a few free full-text PDF documents.

Education Resources Information Center (ERIC)
eric.ed.gov/
ERIC is an online library of education research and information, sponsored by the Institute of Education Sciences (IES) of the U.S. Department of Education. It offers peer-reviewed sources and full-text FREE access.

Addictive Behaviors
www.sciencedirect.com/science/journal/03064603
Addictive Behaviors offers a sample issue of the journal online. The sample issue contains full-text articles in both HTML and PDF format. This is a great resource for students researching addictions.

American Journal of Drug and Alcohol Abuse
www.tandfonline.com/toc/iada20/current
Find full-text articles on the study and treatment of drug abuse and alcoholism. The *American Journal of Drug and Alcohol Abuse* focuses on a wide range of topics, including clinical, pharmacological, administrative, and social aspects of substance abuse.

Archives of Internal Medicine
archinte.jamanetwork.com/journal.aspx
Archives of Internal Medicine offers free full-text articles to registered users 12 months after publication. Published by the American Medical Association, the journal covers a wide range of topics related to internal medicine. Free registration is required to access the articles.

Biology of Reproduction
www.biolreprod.org
Find full-text articles as well as article abstracts dating back to 1969 from the *Biology of Reproduction* journal.

Brain: A Journal of Neurology

brain.oxfordjournals.org

Find free full-text articles on neurology as well as free editorials. This is a useful resource for students of neuroscience and biopsychology.

British Journal of Psychiatry

bjp.rcpsych.org

Find articles covering all topics in psychology from the *British Journal of Psychiatry*. The journal is focused on clinical aspects of mental health and includes issues of interest to psychiatrists, clinical psychologists, and students of psychology. Full-text articles are available from January 2000, and articles become available one year after publication.

CogPrints

cogprints.org/view/subjects

CogPrints is an electronic archive for self-archive papers in any area of psychology; neuroscience; linguistics; computer science; philosophy; biology; medicine; anthropology; and physical, social, and mathematics sciences pertinent to the study of cognition.