HSTA Curriculum

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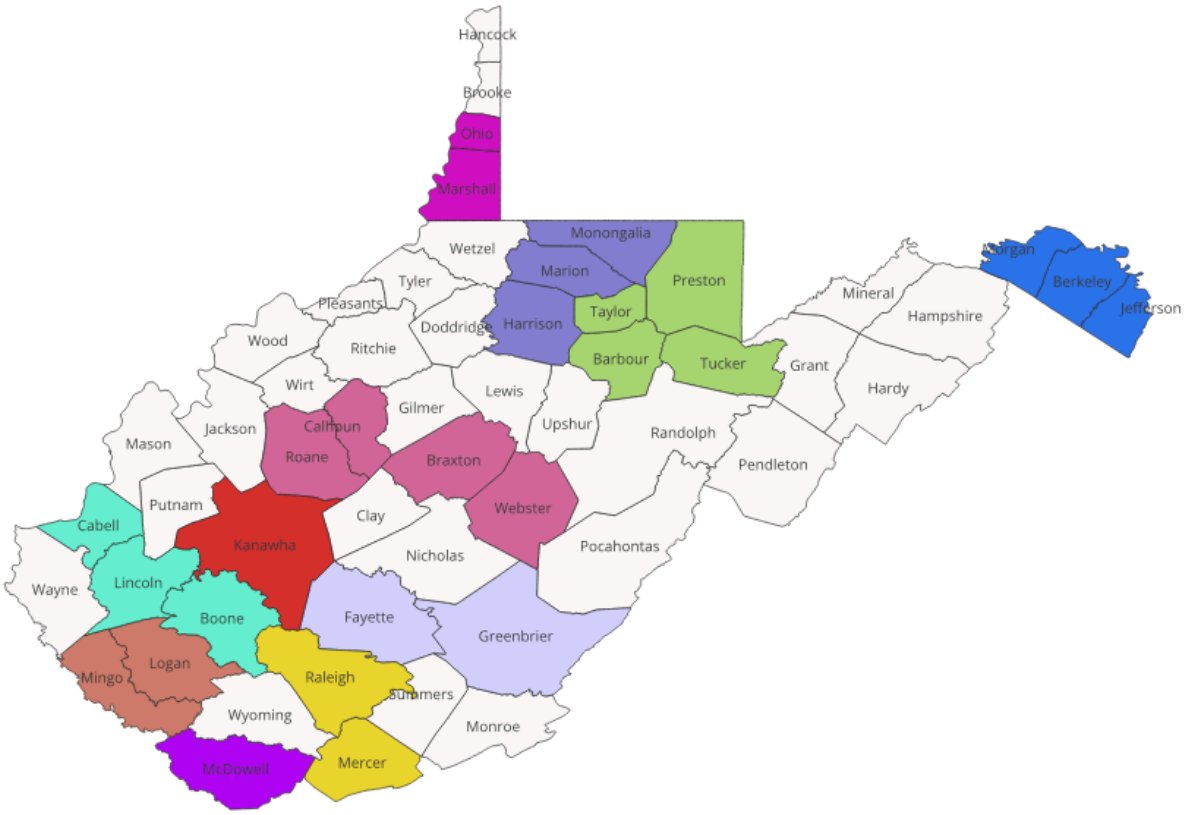
HSTA Curriculum

This curriculum will span four years with content and activities to support students' growth in research skills. The main framework of the curriculum is designed to guide students through the steps of creating an HSTA research project. Throughout the four years, different types of hands-on activities will be suggested to help students gain an understanding of key research concepts.

At the beginning of each school year, new pages with updated dates, links, and other relevant information will be provided during the annual teacher training.



HSTA Website Outline

Check out the HSTA website https://health.wvu.edu/hsta/resources/teachers/ to access

Teacher Resources

- Resource Notebook
- New Teacher Training
- Fall Teacher Training
- Spring Teacher Training
- Teacher Report

Curriculum

- Curriculum (Word File)
- Curriculum (PDF
- Student Workbook (Word File)
- Student Workbook (PDF)
- Curriculum Resources (PowerPoints and Hands-on Activities for Lessons 1-25)

Research Projects

- Research Proposal Score Sheets
- Symposium Score Sheet
- Research Menu
- State Data

Important Dates for 2025-2026

- Club meetings are on _____ from ____:____PM until ____:____PM.
- Freshmen: CITI Training Due October 17, 2025
    - Students need to email their certificates to their Field Site Coordinator
- All students must submit on proposal deadlines by uploading it through their project REDCap link
    - October 31, 2025: Observation – Research Question – Variables
    - December 19, 2025: Background – References – Hypothesis – Procedures
    - February 6, 2026: Full Proposal to be approved and earn 40 points
- Seniors: The required 75 community service hours are due December 1, 2025.
    - If a student misses the deadline, the Field Site Coordinator will issue a final letter, and the student may be at risk of not meeting the requirements for the HSTA Waiver.
- Senior Waiver Application opens December 1, 2025.
- All students must submit a proposal by uploading it through their project REDCap link
    - February 6, 2026: Full Proposal to be approved and earn 40 points
- Summer camp applications open March 1, 2026 – close March 31, 2026.
    - Summer Camp dates for July 2026 are pending.
- Talk with Field Site Coordinator for a symposium excusal request form. If a student or teacher is requesting to be excused from a symposia event:
    - Talk with Field Site Coordinator for a symposium excusal request form.
    - Submit excuse by regional deadline _____ for Local Governing Board review.
    - All Local Governing Board reviews are due by April 10, 2026, to the Joint Governing Board.
- Final Symposium Projects are due on April 24, 2026, by 5:00PM EST in REDCap. All students will individually submit a copy of their final project to REDCap.
- Symposium window is April 25, 2026 – May 9, 2026. Your Field Site Coordinator will follow up with a date, time, and location.
- **Make sure to follow up with your HSTA teacher and Field Site Coordinator for other important dates.**

Lesson 1: Introduction to HSTA and Lab Safety

Summary: Welcome students to a new year of HSTA. Students will be introduced/re-introduced to HSTA rules and regulations. Students will complete lab safety training as well as their lab safety contract and first hands-on activity.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Introduction to HSTA: Understand the purpose, structure, and goals of the Health Science and Technology Academy (HSTA).
    a. Deliver the PowerPoint Presentation.
2. Complete Lab Safety Training: Acquire the necessary knowledge and skills to ensure safety and compliance in the laboratory environment.
    a. Deliver a PowerPoint Presentation.
    b. Watch a lab safety video.
    c. Complete lab safety contract. *This contract will be emailed to students individually through REDCap.*
3. Complete First Hands-on Activity (HOA): Successfully engage in and complete the initial hands-on activity to apply lab safety knowledge.

Introduction to HSTA

Below is an introduction to HSTA written for HSTA students.

Welcome to the start of a new HSTA year! We are excited to begin another successful year of in-person club meetings. We know you are most successful when you're consistently engaged and participating, so we have worked hard to make that happen.

Let's remember, first and foremost, HSTA is here to help you prepare for college and earn undergraduate, graduate, and professional tuition waivers, but you must do your part. Failure to meet minimum program requirements will result in dismissal from the program and forfeiture of the HSTA tuition waivers. A college tuition waiver is not a scholarship, and money is not given or transferred to colleges. A college tuition waiver means that tuition is waived or not charged to your account.

HSTA is an after-school and summer program. Read more about the HSTA program below.

Attendance – You will earn attendance credit by attending club meetings in person and completing activities, along with a community-based research project. Your HSTA teacher will discuss how meetings will be conducted during your first HSTA meeting. Per policy, you need to

attend at least 70% of your total club meeting time per semester. Note that club meetings are set up to prepare you to complete your annual community-based research project. Each meeting is a lesson, and you build on that knowledge as you work through your research project. HSTA meetings will be in person and your HSTA teacher will give you a schedule. Work with your HSTA teacher and Field Site Coordinator if you miss a meeting. This would be a good time to talk about the club schedule.

We know a lot of you have jobs. If you work, talk to your employer to arrange your schedule so you are available for meetings. If your job/supervisor is not understanding of your participation in the HSTA program, ask your Field Site Coordinator or teacher to help you explain the importance of HSTA.

Sports are important, but so is HSTA. Talk to your coach about the importance of your HSTA meetings. Your coaches and teachers can work out a compromise if you bring the conflict to their attention. All (**100%)** students that successfully complete HSTA receive tuition waivers to college, while fewer than **2%** of high school student athletes are offered athletic scholarships, most of which are not full rides. HSTA attendance is money in the bank.

Community Service **–** You need to complete and report 75 community service hours by December 1st of your senior year. Check with your HSTA teacher and Field Site Coordinator to see if an opportunity counts towards community service. Keep track of the community service hours you complete. Make sure to turn your community service sheets into your Field Site Coordinator. You need to keep a copy of your hours in your notebook or email. Remember you need 75 hours to graduate from the HSTA Program.

HSTA Community Research Project **–** As a HSTA student, you are required to conduct a community research project that sets out to improve the wellbeing of your community. You will complete four projects over the course of your HSTA career. You may work in a group of three or less (check with your Field Site Coordinator to see if this is different for your region). Your HSTA teacher, peers, Field Site Coordinator, and Community Research Associate (CRA) will assist you in completing the project.

Attendance at Symposium **–** This is a mandatory event. You will come together with HSTA peers and share your final research presentation. Presentations will be judged by community members, teachers, and STEM+M or other healthcare experts. The location, date, and time will be released later this year by your Field Site Coordinator.

Academics **–** You must maintain GPA standards per semester as set by your Local Governing Board (LGB). A 3.0 GPA per semester is required after your freshman year. You can do this. Stay on top of your assignments. If you fall behind, ask for help. Talk to your teacher. Find a study group. Your HSTA teacher and peers will help you.

Family **–** Your family is a support for you. They want you to be successful. Sometimes, families are under duress and fall upon difficult times. We understand. We've all been there. Your HSTA family is here to help.

Summer Camp – HSTA offers a total of four summer camps. The first one is the summer before your 9th grade year in high school. You are required to attend at least two HSTA summer camps before the start of your senior year.

Student and Parent Handbook
The following link is the Student and Parent Handbook for HSTA students. It is important to make sure students and parents know where to access the handbook.
https://health.wvu.edu/hsta/resources/students/

Student Waiver Quick Guide
The following link is the Student Waiver Quick Guide for HSTA students.
https://health.wvu.edu/hsta/resources/students/
It is important to make sure students and parents know where to access the quick guide.

Student Contract

Students sign an electronic student contract with their parents/guardians when they are first selected into HSTA. It is important to have students read over the contract every year to remind them of the requirements to complete HSTA and earn HSTA College Waivers.

1. I am a United States citizen, a West Virginia resident, and I attend an approved high school in an approved county served by the HSTA program.
2. I will meet or exceed the semester GPA (Grade Point Average) as stated in Section 5 of the HSTA Policy and Procedures Manual: [9th grade – 2.5 both semesters, and 10th to 12th grade – 3.0 both semesters].
3. I agree to attend 70% of all HSTA meeting time offered per semester and attend all HSTA activities or make special arrangements with the HSTA teacher and HSTA Local Governing Board (LGB).
4. I agree to follow my school's 'Acceptable Computer/Internet Use' policy, all HSTA rules and behavioral and safety guidelines, and recommendations from the HSTA teacher and Field Site Coordinator for all HSTA activities.
5. I agree to complete a yearly science project and present the project at the state Science Symposium. I understand that to remain in the HSTA program, my symposium project presentation must receive a passing score designated by HSTA. I understand that I must complete all aspects of my science project by the given deadlines.
6. I agree to attend at least 2 HSTA Summer Institute camps before my senior year.
7. I agree to complete at least 75 documented hours of community service prior to filling out the HSTA waiver application my senior year. I understand that the amount of the HSTA waiver granted by a WV college or university will vary, subject to the policies established by each individual WV college or university.
8. If I am suspended or expelled from school for any reason, I understand that I will be suspended or expelled from HSTA. I will immediately contact my HSTA teacher and the Field Site Coordinator as soon as I am suspended or expelled.
9. I understand that I will be placed on probation for only one semester during my entire participation in the HSTA program for not meeting academic, attendance, or behavioral requirements. If I fail to comply with these requirements and/or have any major discipline problems, the LGB can terminate my HSTA Club membership, which would result in forfeiture of my eligibility for the HSTA waiver.
10. I agree that if my HSTA membership is terminated, I have ten working days after receipt of written notification from the LGB to make an appeal for reinstatement to the program. In my written appeal, I must state the reasons I contend the termination decision violates my rights under this agreement.
11. I agree that within ten working days of receipt of the denial of appeal by the LGB, I have the right to make a written appeal to the HSTA Joint Governing Board (JGB).
12. In the event the HSTA Program in my region is discontinued due to the lack of funding or factors beyond the control of HSTA, this contract may be terminated.
13. I give HSTA permission to include my GPA and test scores for program evaluation purposes. My name and other personal information will not be included with this evaluation data

Safety Contract

As part of the HSTA club experience, HSTA students engage in hands-on activities and/or conduct research experiments. Before diving into these activities and projects, all HSTA students must first familiarize themselves with lab safety protocols and complete the lab safety contract.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Read over the Lab Safety Contract and sign the contract. *This contract will be emailed to students individually through REDCap.*

1. I have read over the Lab Safety PowerPoint Presentation and have watched the Lab Safety Video.
2. I will always conduct myself in a responsible manner in the laboratory, no horseplay.
3. I will follow all written and verbal instructions carefully. If I do not understand a direction, I will ask my teacher before proceeding.
4. Any time chemicals, heat, or glassware are used, I will wear protective eyewear.
5. I will not eat food, drink beverages, or chew gum in the laboratory area.
6. I will know the locations and operating procedures of all safety equipment, including the first aid kit, eyewash station, safety shower, fire extinguisher, and fire blanket. I will also know where the fire alarm and the exits are located.
7. I will always work in a well-ventilated area.
8. I understand that all chemicals should be considered dangerous.
9. If a chemical should splash in my eye(s) or on my skin, I will immediately flush with running water from the eyewash station (remove contacts) or safety shower for at least 20 minutes. I will also notify my teacher immediately.
10. I will dispose of all chemical waste properly. For more information, refer to the following link on how to dispose chemical waste properly: https://www.acs.org/education/policies/middle-and-high-school-chemistry/safety/hazardous-waste-and-disposal.html
11. I will wash my hands with soap and water after performing all experiments.
12. I will always use caution when handling knives and other sharp instruments.
13. I will dress properly during a laboratory activity. Long hair must be tied back, dangling jewelry and loose or baggy clothing must be secured, and shoes must completely cover the feet.
14. I will report any accident (spill, breakage, etc.) or injury (cut, burn, etc.) to my teacher immediately. Never dispense flammable liquids anywhere near an open flame or source of heat.
15. I will exercise extreme caution when using a heat source. Light gas (or alcohol) burners only as instructed by my teacher.
16. If I have any allergies, I will let my teacher know. Please specify:
17. I will fully cooperate to maintain a safe lab environment.

HOA #1 STEM: Lab Safety

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

This HOA is designed to be both fun and educational, giving students the chance to practice essential lab safety skills in a controlled, exciting environment. While the focus is on safety, we encourage making it a bit messy and engaging! Below are some suggested experiments your club might do:

- Rainbow Fire
- Mentos and Diet Coke
- Baking soda and vinegar experiment
- Carbon Sugar Snake or Elephant toothpaste experiment

Lesson 2: Ethics/CITI Training and Activities

Summary: Students will be introduced/re-introduced to ethics training and CITI training. Students will complete lab safety training as well as their first hands-on activity. After a fun icebreaker, today's goal is to register freshmen for CITI training. Once registered, you will begin completing the assigned modules. While freshmen are completing CITI training, upperclassmen can choose between assisting freshmen in completing CITI training or completing the case study exercise.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Complete an icebreaker activity to explore working in a group and leadership.
2. Complete Ethics Training
    a. Deliver a PowerPoint presentation on ethics
    b. Complete an ethics case study exercise
3. Complete the ethics contract. *This contract will be emailed to students individually through REDCap.*
4. Register freshmen for CITI Training and start on the modules: Understand the purpose, structure, and goals of the Health Science and Technology Academy (HSTA).
    a. Register freshmen (and new HSTA teachers) for CITI training.
    b. Upperclassmen can assist freshmen with registration.
    c. Freshmen complete as many CITI training modules as possible.
    d. Email a copy of the CITI training completion certificate to the Field Site Coordinator.
5. Upperclassmen explore ethics through a case study exercise if not assisting freshmen.

Creating Research Teams

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Using an icebreaker activity, such as the Marshmallow Challenge, provides students with an engaging and interactive opportunity to explore key aspects of teamwork and leadership. By working together to achieve a common goal, students can experience firsthand the importance of communication, collaboration, and decision-making within a group. The activity encourages students to take on various roles, including leadership, and fosters an environment where they can reflect on their own leadership styles, as well as learn how to effectively contribute to group success. This initial experience helps students build trust, enhance problem-solving skills, and gain insight into the dynamics of group work and leadership in a real-world context.

Working in teams can be challenging, as it involves managing different opinions and relying on each member to contribute effectively. Despite these difficulties, teamwork is a crucial skill for both college and future careers, where collaboration is often essential for success.

We recommend that students work in teams of 2-3. If any issues arise later, HSTA teacher can divide the group, with each student taking the project individually to complete it on their own.

Why is teamwork important:

- **Collaboration Enhances Learning:** Working in teams allows high school students to pool their knowledge and skills, helping them grasp complex subjects and develop a deeper understanding of the material. This collaborative learning mirrors the group projects and study groups they'll encounter in college.
- **Developing Communication Skills:** Teamwork helps students practice clear and effective communication. These skills are essential not only for academic success but also for building strong relationships and working efficiently in college and future careers.
- **Fostering Problem-Solving Abilities:** Through teamwork, students learn to approach problems from multiple perspectives, which enhances their critical thinking and problem-solving skills. These abilities are crucial for tackling the diverse challenges they'll face in college.
- **Building Leadership and Responsibility:** By working in teams, students have opportunities to take on different roles, from leadership to supportive team member. These experiences help them develop a sense of responsibility and leadership skills that are valuable in a college setting and beyond.
- **Preparing for Diverse Environments:** College often involves interacting with people from various backgrounds and perspectives. Teamwork in high school prepares students for this by encouraging them to work with peers who have different viewpoints and approaches, fostering a more inclusive and adaptable mindset.

Introduction to Ethics

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

As you conduct research, you are responsible for the ethical treatment of all subjects. It is mandated by law that you adhere to strict rules.

The reason these rules were developed was due to the unethical treatment of research subjects in past experiments, labs, and studies. These rules were created to protect everyone in the research process, including you.

These rules are known as **THE BELMONT PRINCIPLES.** The Belmont Report was created in 1978 by the US Department of Health to establish some basic ethical principles to be considered when people participate in research. The Belmont Report is a guideline for using human subjects in research. The full report can be found here
https://videocast.nih.gov/pdf/ohrp_appendix_belmont_report_vol_2.pdf

Watch this short video about the Belmont Report:
https://www.youtube.com/watch?v=kA1dL6NqVyw

The Belmont Report
http://www.nwabr.org/teacher-center/humans-research#overview

1. Respect for Persons
    a. Description: Respect for individuals and their autonomy; obtain informed consent.
    b. How does this apply?
        i. A person has the right to make choices, hold views, and take actions according to his own beliefs.
        ii. If a person does not have the capacity to make her own choice, she must be protected from harm.
        iii. A person must enter research voluntarily and must be informed in an adequate manner.
        iv. To truly respect a person's autonomy, he must be able to give genuinely informed consent with full knowledge of both the harms and benefits of the study.
2. Beneficence (maximize benefits and minimize harms)
    a. Description: Beneficence stresses "doing good" and "doing no harm" by minimizing all potential harm(s) and maximizing all potential benefit(s) to the subject as well as potential benefit(s) to society.
    b. How does this apply?
        i. There is an obligation to minimize the harm/risks to the greatest extent possible.
        ii. Maximize the potential benefits.

iii. Ensure the rights and well-being of the patient take precedence over the needs of science.

3. Justice
    a. Description: Be fair in the distribution of the benefits and in bearing the burden of research.
    b. How is the applied?
        i. The benefits and burdens of the research should be justly distributed.
        ii. Guard against using vulnerable populations.
        iii. Ensure fair selection of research participants.
        iv. Guard against coercion and undue influence.
        v. Avoid potential financial or other conflicts of interest.

Autonomy: A person's freedom and ability to make his or her own decisions.

Coercion: The act of pressing someone to do something using force, intimidation, or threats without respect for individual choice. This includes the idea that a person with few choices may find participation in a study to be so appealing that they feel they cannot decline, even if being in the study is not a good decision for other reasons.

Conflict of interest: A situation in which someone is responsible for making a decision in an official capacity (e.g. someone holding a public office) that could benefit them personally.

Undue influence: Is exerted when a person of higher power or authority takes advantage of another person; undue influence can often include coercion.

Vulnerable (populations): Groups who may be exploited for use in research, e.g. children, illiterate people, and prisoners.

After reading about the Belmont principles, read the case study and answer the discussion questions as a club.

Upperclassmen Exercise for Understanding Ethics

Upperclassmen will review the articles below in preparation to analyze a case study. *Click on the hyperlink to access the case studies https://health.wvu.edu/hsta/resources/teachers/curriculum/* and apply information from the Belmont Report or its summary reports to complete the blank case study table found on the next page.

- Full Report: https://videocast.nih.gov/pdf/ohrp_appendix_belmont_report_vol_2.pdf
- Summary Report: https://www.hhs.gov/ohrp/sites/default/files/the-belmont-report-508c_FINAL.pdf
- Belmont Report for nursing students: https://journals.lww.com/dccnjournal/fulltext/2010/07000/a_brief_review_of_the_belmont_report.7.aspx

Ethics Contract

As part of the HSTA club experience, HSTA students engage in human-subject research projects. Before diving into research projects, all HSTA students must first familiarize themselves with the ethics contract.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Read over the Ethics Contract and sign the contract. *This contract will be emailed to students individually through REDCap.*

Directions: After you have reviewed the Ethics Presentation, discussed the case study, and read over the Ethics Contract, sign the Ethics Contract.

- I understand and will always put into practice the Belmont Principles.
- As a Researcher or Investigator, I will conduct my research with integrity and safeguard my research participants/subjects and any data I may gather.
- I will protect all participants/subjects and adhere to the research standards set forth in federal and state code.
- I will design my research to be fair and provide the same opportunity to all subjects. I will adhere to my approved research protocol.
- When recruiting subjects/participants I will explain:
    - what the research is about
    - why it is being conducted
    - why I want them to participate
    - what they will be asked to do
    - how and when they will be asked to do it
- I will explain how the research data will be measured and collected and the plan to protect their privacy and information.
- Furthermore, I will explain to the subject/participant how the knowledge learned from the research may be of benefit to them or others.
- I will explain any possible harm that may occur during the research, and the safeguards in place to prevent such harm.
- I will assure them that they may choose not to participate or may opt out of participation at any time with no repercussions.
- I understand the importance of research and will conduct my research with honor and integrity.

New HSTA Students: CITI Training

CITI training stands for Collaborative Institutional Training Initiative or CITI. It is a college level ethics training that all researchers affiliated with a university or Institution must complete before beginning any research. It teaches why we must have training so that studies like Tuskegee, Willowbrook, or Nazi experiments never occur again. **Everyone must complete the training during their freshmen year.** This training is good for four years.

Once students complete the training, email the certificate to the Field Site Coordinator.
Due October 17, 2025.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Next meeting preparation: Select a group to present their HSTA community-based project from last year. Have printed copies of the presentation score sheet for students to follow along.

Lesson 3: HSTA Projects

Summary: Students will be introduced/re-introduced to HSTA's Annual Research Project.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Introduction to the HSTA Community-Based Projects
    a. Define "HSTA community-based project"
    b. Introduce students to logistics and deadlines associated with the HSTA community-based project
2. Demonstration of HSTA Community-Based Project Presentation
    a. Review the HSTA presentation score sheet
    b. Have a group present their HSTA community-based project from last year, and students use the presentation score sheet to score the presentation

Note: this lesson is heavy in information. Teachers may want to include a short activity or icebreaker. Teachers can also use part of this meeting to have freshmen finish their CITI Training.

HSTA Community Research Project

During the HSTA after-school program, students will complete six hands-on activities, have a visit from at least one guest speaker, and complete a community-based research project.

Engaging in research projects can significantly enhance your preparation for college in several ways:

1. Development of Critical Thinking Skills: Research projects require students to analyze data, interpret results, and make evidence-based conclusions, which sharpens critical thinking. Students learn to approach complex problems methodically, a skill crucial for tackling challenging coursework in college.
2. Communication Skills: Research projects require students to present their findings to an audience, whether through written reports, oral presentations, or visual displays. This process helps improve their ability to clearly and effectively convey complex information, adapt their message to different audiences, and engage in public speaking. Research projects frequently involve working with others, such as team members, mentors, or stakeholders. Effective communication is crucial in these collaborations to share ideas, coordinate tasks, and provide feedback. This experience strengthens their

ability to listen actively, negotiate, and articulate your thoughts clearly within a team setting.

3. Enhanced Research and Writing Abilities: Conducting research teaches students how to gather, evaluate, and synthesize information from various sources, a skill useful for academic papers and projects. Preparing reports or research papers improves their ability to communicate complex ideas clearly and effectively.
4. Familiarity with Scientific Methods and Processes: Students gain hands-on experience with scientific methods, including designing experiments, collecting data, and analyzing results, which is essential for science and research-oriented courses. Research projects help them develop meticulousness and precision, important for academic and scientific work.
5. Experience with Independent Work and Time Management: Many research projects require independent work, fostering self-discipline and the ability to manage time effectively. Students learn to plan, execute, and manage long-term projects, a valuable skill for handling college assignments and responsibilities.
6. Strengthened Problem-Solving and Innovation Skills: Research often involves tackling unexpected challenges and finding innovative solutions, encouraging creativity and adaptability. Students develop the ability to question assumptions, evaluate arguments, and consider alternative viewpoints.
7. Preparation for Advanced Coursework: Engaging in research helps students acclimate to the demands of rigorous academic work, preparing them for higher-level college courses. Students might develop expertise in a specific area, which can be beneficial if they pursue related fields of study in college.
8. Increased Confidence and Resilience: Completing a research project boosts students' confidence in their abilities and academic pursuits. Students learn to handle setbacks and persist through challenges, which is essential for thriving in the college environment.
9. Opportunities for Networking and Mentorship: Research projects often involve working with mentors, professors, and peers, helping students build a network of academic and professional contacts. Gaining guidance from experienced researchers or mentors can provide valuable insights and support for their college journey.
10. Enhanced College Applications: Involvement in research showcases their commitment to learning and intellectual curiosity, which can strengthen their college applications. Having research experience sets them apart from other applicants, potentially leading to more opportunities for scholarships, internships, and special programs.

By developing these skills and experiences through research projects, students can build a strong foundation that can help them navigate the challenges and opportunities of college more effectively.

Humans are curious and we make observations and want to find out "why". Scientists take this curiosity one step further. Through science, preliminary evidence is examined, a *hypothesis* is proposed, experiments are designed to either *reject or accept the hypothesis*.

Hypothesis testing is a tool used in science to answer a question. A *hypothesis* is a statement that proposes an "if" and a "then". Null hypotheses are evaluated by scientists using statistics, much like to the way a jury participates in a trial:

- Defendant is presumed innocent until proven guilty. It is the evidence or facts that prove if the defendant is guilty.
- Null hypothesis is stated to presume what will happen under random conditions. A statistical test can show if the observed situation doesn't conform to random expectations. There must be enough data for statistics to show a significant difference or a correlation. Then null hypothesis is rejected.

HSTA students are required to conduct a community research project that sets out to understand and/or improve the well-being of their community. Students will complete four projects over the course of their HSTA career. Students may work in a group of three or less (check with your Field Site Coordinator to see if this is different for the region, but the group can be no bigger than three HSTA students). HSTA teacher, peers, Field Site Coordinator, and Community Research Associate (CRA) will assist in completing the project.

Before we move on, watch a short video on "What is research?" https://www.youtube.com/watch?v=mV0bUQpz468.

Completed Past Projects

Have upperclassmen present their project from last year. This will be a good introduction to HSTA Community Research Projects.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Summary of Project Logistics

This is a lot of information. Highlight it and then focus on Part 1.

1. Once students have selected their community research topic, they will work on the HSTA research project during the after-school club meetings.
2. Community research projects are divided into four parts.
    - Part 1 is a proposal that students will develop with their HSTA teacher and peers to submit via REDCap for approval by a CRA. This proposal will consist of a project's title, background information, research question, hypothesis, variables, procedures, and references. Students must also complete CITI training as a freshman before they can have an approved project.
        - To access a copy of the Research Project PowerPoint Guide, visit the website https://health.wvu.edu/hsta/resources/teachers/research-projects/
        - Project selections
            - 9th & 10th Graders: Must complete a state survey project.
                - Click https://health.wvu.edu/hsta/resources/teachers/research-projects/state-data/ to access the State Survey Document.
            - 11th & 12th Graders: Can work with 9th/10th Grader(s) on State Survey, create a project using their own idea, or use the Project Menu
                - Click https://health.wvu.edu/hsta/resources/teachers/research-projects/research-menu/ to access the access the Project Menu.
        - Scoring
            - Points will be given for each fully completed item.
            - All projects must be approved by CRA.
            - There are 40 points for title, background slides, research questions, hypothesis, variables, procedures, and references.
                - You must complete all 40 items to be approved.
    - Part 2 is data collection and data analysis.
    - Part 3 is submitting a final presentation to REDCap.
    - Part 4 is presenting at the Symposium.
3. There are specific deadlines that students will need to follow.
    - Part 1: Students will submit a project proposal for comments/scoring over the next four months. Students' HSTA CRA will comment/score their project's title, research question, hypothesis, variables, background research, procedures, and references.
        - Submission Directions: The HSTA teacher will email the group a link.
            - *Use this [LINK] to submit your HSTA project proposal by each deadline. If you're working in a group, only one group member needs to submit per deadline. However, all group members can use the link to view uploaded files and CRA feedback. Be sure to save this link for future use.*

- *You will also use the same link to access comments from your CRA. After each submission, allow some time for the CRA to review your proposal before checking for feedback.*
- *Every group/single project must submit by the deadline.*
- *No matter the state of the project, submitting a project by each deadline is required.*
- *If you need help submitting your proposal, click on the hyperlink to access the video https://health.wvu.edu/hsta/resources/teachers/research-projects/*
- *If you need help reviewing your CRA comments, click on the hyperlink to access the video https://health.wvu.edu/hsta/resources/teachers/research-projects/*

- Submission Deadlines
  - October 31, 2025: Observation – Research Question – Variables
  - December 19, 2025: Background – References – Hypothesis – Procedures
  - February 6, 2026: Full Proposal to be approved and earn 40 points
  - Once a student has an approved project, they may start collecting data. There are four options for project status:
    - **Missed Deadline**, student name(s) are reported to the Local Governing Board.
    - **Not approved**, cannot start data collection. The student still needs to earn 40 points.
    - **Not approved, may** start data collection. The student still needs to earn 40 points.
    - **Approved with 40 points;** no other proposal submission is needed.
  - If a student doesn't have an approved project after the February 6, 2026, deadline or misses the February 6, 2026, deadline, the student will receive notification for non-compliance and will have 10 working days to get an approved project OR be dismissed from the program.

- Part 2: Data Collection
  - During data collection and data analysis, make sure to communicate with the HSTA teacher, Field Site Coordinator, and CRA with updates and any problems.
- Part 3: Final presentation will be submitted to REDCap by **April 24, 2026, 5:00 PM EST.**
  - The final presentation must be submitted to REDCap on or before **April 24, 2026, 5:00 PM EST**. REDCap will send a link to all students individually to submit their project. All students will submit their project to REDCap, i.e., if they work in a group, each group member will submit their own copy of the presentation to REDCap via their email.

- Presentations will be pre-loaded and ready to go on the day of the symposium, so it is very important that students submit their final project on or before **April 24, 2026, 5:00 PM EST**. If students fail to submit on time, they will not be able to present at the Symposium and will need to speak to their Local Governing Board.

- Part 4: Students will present at the Symposium. The annual symposia are important parts of the HSTA experience. These events are mandatory for students to attend. The presentation of projects helps develop crucial skills, share student work with community members, and is a requirement for the HSTA waiver.
  - April 25, 2026 – May 9, 2026, is the Symposium window. The Field Site Coordinator will follow up with a date, time, and location.
  - To earn symposium credit, all students must:
    - Attend the session.
    - Present and listen to all presentations.
    - Earn a passing score. At the symposium, judges will give a point for each correctly completed content item. To pass, students will need to receive at least **20 out of 24 points**.
    - Complete your evaluation online.
  - Scheduling issues for Symposium
    - We understand that sometimes circumstances arise that require special attention to students' attendance.
    - Talk with the Field Site Coordinator for a symposium excusal request form. If a student or teacher is requesting to be excused from a symposia event:
      - Talk with the Field Site Coordinator for a symposium excusal request form.
      - Submit excuse by regional deadline _____ for Local Governing Board review.
      - All Local Governing Board reviews are due by April 10, 2026, to the Joint Governing Board.

  - The following circumstances are acceptable reasons for a schedule change:
    - Prom: If you have prom, you can request to present during the morning session.
    - College graduations: Students with immediate family members graduating may be excused.
    - Serious illness
    - Other valid reasons could include funeral, wedding, major family events

CRA Regions

The following CRA will provide your region with comments.

1. Dr. Kris Adkins kadkins@hsc.wvu.edu
    - Mountain HSTA, Ohio/Marshall, Harrison/Monongalia/Marion, and Greenbrier/Fayette
2. Christine Anderson canders4@hsc.wvu.edu
    - McDowell, Mingo/Logan, Kanawha, and BWRC
3. Dr. Cathy Morton catherine.morton@hsc.wvu.edu
    - Cabell/Lincoln/Boone and Eastern Panhandle
4. Summer Kuhn slkuhn@hsc.wvu.edu
    - Mercer/Raleigh

9th and 10th Grader Project (State Survey) Directions:

Click on the hyperlink to access information about the state survey
https://health.wvu.edu/hsta/resources/teachers/research-projects/state-data/

All 9th and 10th grade students will use the HSTA Statewide Survey to conduct a cross-sectional/prevalence study. This type of study examines a population at a specific point in time. For example, if you measure the attitudes of 9th graders at your school in September, their attitudes might change by May.

The HSTA State Survey has pre-developed questions students will use in their research project. HSTA student researchers will share the State Survey with family and friends between September 2025 and January 2026. Then students will use the data collected through the State Survey to complete a HSTA research project.

Using the HSTA State Survey, allows student researchers to learn how to build comparisons, analyze data, and enhance their presentation skills before diving into their own research ideas during their junior and senior year of high school.

Students will begin developing their research question, variables, and hypotheses in later lessons. They will write procedures during lessons 11 and 12, but they can start sharing the survey with family, friends, and peers next club meeting. Data collection will continue through January 2026. Data will be submitted to the teacher in early February, provided everyone has completed their CITI training. In the Spring, club lessons will help students answer their research question using the data collected through the HSTA State Survey.

HSTA students will submit their project slides to the HSTA teacher during club meetings and submit their project slides for CRA review. Review the CRA deadlines.

Note: There are four options for project status:

- **Missed Deadline**, student name(s) are reported to the Local Governing Board.
- **Not approved**, cannot start data collection. The student still needs to earn 40 points.
- **Not approved, may** start data collection. The student still needs to earn 40 points.
- **Approved with 40 points;** no other proposal submission is needed.

HSTA teacher will let students know how to submit their project for CRA review.

11th/12th Grade Project (Menu, Self-Selected, or with 9th/10th graders) Directions:

Click on the hyperlink to access information about the Research Menu
https://health.wvu.edu/hsta/resources/teachers/research-projects/research-menu/

All 11th and 12th graders can create with own idea with approval, work from the Project Menu, or work with 9th/10th Grader(s) on State Survey. To complete your Community Research Project Presentation, follow the instructions in the PowerPoint Presentation Guide. Submit your PowerPoint to your CRA through REDCap by the deadlines.

Note: Once you have an approved project, you may start collecting data. There are four options for project status:

- **Missed Deadline**, student name(s) are reported to the Local Governing Board.
- **Not approved**, cannot start data collection. The student still needs to earn 40 points.
- **Not approved, may** start data collection. The student still needs to earn 40 points.
- **Approved with 40 points;** no other proposal submission is needed.

Project Selection:

  - Choose your own community research topic.
  - Engage with a project from the Project Menu.
  - Collaborate with a 9th/10th grader on the Statewide Survey Project.
- **Sensitive Information:** All sensitive or protected health information (e.g., blood pressure, weight, sex, drug use) must be approved by your CRA and/or WVU-IRB.
- **Animal Research:** Any research involving vertebrate animals must be approved by your CRA and/or WVU-IACUC.
- **Bacteria Culturing:** Culturing bacteria is not permitted.
- **Approval of Materials:** All surveys and intervention materials must be approved by your CRA before approval is given.

Project Types

a. Cross-Sectional/Prevalence Study: This type of study examines a population at a specific point in time. For instance, if you assess the attitudes of 9th graders at your school in September, those attitudes might change by May if tested again.
b. Intervention: An intervention is a structured program aimed at inducing change within a group. This could involve altering behaviors (such as promoting healthy eating) or improving health outcomes (like reducing blood pressure).
c. Human Experiment: This involves conducting experiments with human participants to observe effects. For example, you might test whether students perform better on exams when using iPads versus traditional books for studying.
d. Non-Human Experiment: This refers to traditional science experiments that test hypotheses using non-human subjects. For example, you might investigate how varying light levels affect bean growth or examine the impact of different caffeine levels on zebrafish.

Presentation Score Sheet

After introducing students to the logistics of the HSTA community-based project, show them the presentation score sheet. Then, have an upperclassman present a past project survey and have students score the project using the score sheet below.

Presentations should contain all the content on the score sheet, and presentation slides should be in the same order as the score sheet. 1) To have your proposal approved you must earn all 40 points by completing: Title, Observation, Background Information, Research Question, Hypotheses, Variables, Procedures, and References slides. Approval and points will be given by your HSTA CRA. 2) To pass at symposium, complete Past Tense, Results, Data Analysis, Conclusion, & Presentation Skills and to receive at least 20 out of 24 points.

CONTENT		0 or 1
Title *3 pts*	Title was a complete statement/question	
	Title matched the research question	
	Title clearly defined the purpose of the project	
Observation *3 pts*	Observation stated the project's problem clearly	
	Observation included why this project was important to the community and me	
	Observation included a short summary of project including project type: prevalence, intervention, human experiment, or non-human experiment	
Background Research *8 pts*	Background information included two facts about the independent variable or variable one.	
	Background information included two facts about the dependent variable or variable two.	
	Background information included four facts about the relationship between the independent and the dependent variables or variable one and variable two.	
	Background information was referenced using correct in-text APA citations.	
	Background information is cited from at least four academic references (i.e. government agency, Google Scholar articles)	
	Background information was highlighted in bulleted format, not in paragraph form	
	Background information was not plagiarized (summary in own words)	
	Background information was limited to 20% of quotes	
Research Question *3 pts*	Research question includes the independent and dependent variables or variable one and variable two, and characteristics of the study population (where applicable).	
	Research question identifies the relationship or difference being investigated between the independent and dependent variables or variable one and variable two.	
	Research question has been reviewed by a CRA and has been determined to be safe and ethical.	
Variables *4 pts*	Correct independent variable OR variable one	
	Correct dependent variable OR variable two	
	Correct control (If no control, state no control)	
	Correct Inclusion Criteria or Constants ○ Two or more inclusion criteria	

	○ Cross Sectional/Prevalence ○ Intervention ○ Human Subject Experiment OR ○ Two or more constants ○ Non-Human Subject Experiment	
Hypotheses *4 pts*	Alternative hypothesis is a statement of an effect/relationship between the independent and dependent variables or variable one and variable two.	
	Null hypothesis has been reviewed by a CRA and has been determined to be testable using an approved statistical test.	
	Alternative hypothesis is justified using some of your background research on the hypotheses slide.	
	Null hypothesis is a statement of no effect/relationship between the independent and dependent variables or variable one and variable two.	
Procedures *11 pts*	Project Procedures are listed below: Prevalence, Human Intervention, Human Experiment and Non-Human Experiment	

Prevalence ☐	***Intervention ☐***	***Human Experiment ☐***	***Experiment ☐***
Procedures were numbered in the order that each step was completed. ☐	Procedures were numbered in the order that each step was completed. ☐	Procedures were numbered in the order that each step was completed. ☐	Procedures were numbered in the order that each step was completed. ☐
Procedures identified all safety precautions (including how participants' identities will be kept confidential, i.e., CITI Training completed) ☐	Procedures identified all safety precautions (including how participants' identities would be kept confidential, i.e., CITI Training completed) ☐	Procedures identified all safety precautions (including how participants' identities would be kept confidential, i.e., CITI Training completed) ☐	Procedures identified all safety precautions (i.e., completed lab safety training) ☐
Procedures explained who the study population was ☐	Procedures explained who the study population was ☐	Procedures explained who the study population was ☐	Procedures explained what plant, natural resource, invertebrate (other) the project was experimenting with ☐
Procedures explained what the study population did ☐	Procedures explained details of the of the intervention ☐	Procedures explained what the study population did ☐	Procedures explained details of the experimental environment and/or change in environment (if you have more than one experimental group

			explain differences among all groups) ☐
Procedures explained how at least 100 participants were recruited ☐	Procedures explained how at least 30 participants were recruited ☐	Procedures explained how at least 30 participants were recruited for EACH group (experimental & control) ☐	Procedures included a control group ☐
Procedures included a list of materials used for the project ☐	Procedures included a list of materials used for the project ☐	Procedures included a list of materials used for the project ☐	Procedures included a list of materials used for the project ☐
Procedures included a copy of the measurement tools (Example: Survey/observation sheet) ☐	Procedures included a copy of the pre and post measurement tools (Example: Survey/ observation sheet) ☐	Procedures included a copy of the measurement tools (Example: Survey/observation sheet) ☐	Procedures explained that there were at least 5 replications per experimental group ☐
Procedures included a participant cover letter explaining the project ☐	Procedures included a participant cover letter explaining the project ☐	Procedures included a participant cover letter explaining the project ☐	Procedures provided a clear description of the project. ☐
Procedures included data collection sheet ☐	Procedures included data collection sheet ☐	Procedures included data collection sheet ☐	Procedures data collection sheet ☐
Procedures explained how data was collected ☐	Procedures explained how pre and post data was collected ☐	Procedures explained how data was collected ☐	Procedures explained how data was collected ☐
Procedures included how data will be analyzed (i.e. states the name of the statistical test to be used) ☐	Procedures included how data will be analyzed (i.e. states the name of the statistical test to be used) ☐	Procedures included how data would be analyzed (i.e. states the name of the statistical test to be used) ☐	Procedures included how data would be analyzed (i.e. states the name of the statistical test to be used) ☐

References *4 pts*	Reference slide included 4 or more academic references	
	Reference slide had ONLY in-text citations that were included as full references	
	References were in the correct APA format (including being placed in alphabetical order)	
	References were listed with hanging indents	

Symposium Score Sheet

Title, Observation, Background Information, Research Question, Hypotheses, Variables, Procedures, & References have been scored.

Score Sheet		0 or 1	Comments
1 pt	Procedures are written in past tense		
Results *7 pts*	Results displayed pictorial evidence of research study (photos)		
	Results displayed raw data in a chart		
	Results included descriptive statistics (averages, percentages, etc.)		
	Results included a properly labeled graph(s) (title, key, x-y-axis)		
	Results including graphs and charts were explained well		
	Correct Number of Participants/Replications ● Prevalence – at least 100 Participants ● Intervention – at least 30 Participants (Pre/Post) ● Human Subjects – 30 Participants in each group (at least one control/one experimental) ● Experiment – at least 5 replications in each group (at least one control/one experimental)		
	Results displayed data that matched research question		
Data Analysis *4 pts*	Data analysis included a statistical test used to test the hypotheses		
	Data analysis included an explanation of why statistical test was used		
	Data analysis included a p-value		
	Data analysis included an explanation of the statistical significance of statistical test		
Conclusion *5 pts*	Conclusion included a brief summary of the project		
	Conclusion interpreted the data to conclude if it supported/rejected hypotheses		
	Conclusion answered the research question		
	Conclusion discussed limitations		
	Conclusion discussed how student(s) would implement change and/or bring awareness to their community		
Presentation Skills *7 pts*	Student(s) spoke clearly during the presentation		
	Student(s) could answer questions with confidence		
	Student(s) didn't read slides word for word		
	Student(s) presented slides in the correct order		
	Presentation had limited spelling/grammar errors		
	Presentation's background (color/animation) was not distracting		
	Presentation's text size/font were consistent		

Lesson 4: Project Selection and Observation

Summary: Students will select their research project topic and complete their observation slide.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Introduce 9th and 10th Grade Students to the HSTA Statewide Survey
    a. Discuss how to recruit participants for the HSTA statewide survey
    b. Identify the procedures for conducting research using the HSTA statewide survey
    c. Complete and share the HSTA statewide survey
    d. Review the variables included on the HSTA statewide survey
    e. Identify a research question that can be answered using the HSTA statewide survey
2. Introduce 11th and 12th-grade students to Menu, Self-Selected, and/or working with 9th/10th grader
    a. Discuss strategies for selecting a research topic
3. Complete Observation PowerPoint Slide
    a. Download the HSTA Presentation PowerPoint template
    b. Complete the Observation slide using information

Begin the meeting by having everyone complete the state survey. While students are enjoying their snack, teachers will step into the role of the researcher and model how to carry out the project. This approach is beneficial for older students too, as it may spark interest in certain topics and help them get back into the research mindset.

Important Notes About the Statewide Survey: Students will use the survey to select two questions they are interested in as they follow the exercise below. Then they will continue to build their Research PowerPoint through other lessons. Students will be asking family, friends, and peers to complete the survey. Once students have completed their CITI training, earned 40 points on their Research PowerPoint, and shared the survey, they will get access to the data. Teachers will have a spring workshop to discuss lessons 13 – 25. These lessons will walk students through analyzing data and completing their Research PowerPoint.

- ***Everyone is required to share the survey link and assist in data collection.***
- County-specific data will be posted if at least 50 surveys are fully collected from that county. When data starts to be collected, we will share how many surveys have been collected by county.
- Data will be accessible with a password.
- Each categorical survey question will be limited to 5-7 response options.

- There are sections in the survey that you must be 18 years of age to complete.
    - The survey will control which questions they see based on age.
    - Students can have data for all questions

State Survey Participant Recruitment

We are going to talk about recruiting for the Statewide Survey human subject research project. All 9th and 10th graders are working with the WV State Survey. Students will collect data from their families, friends, schools, communities, neighbors, social media networks, etc.

When recruiting participants for a research study, remember the three main ethical principles: Respect, Beneficence, and Justice.

Respect: When recruiting subjects to participate in your study, 1) first explain what the survey is about [topic], 2) why you are conducting it, [for a research project for HSTA to learn about_____], 3) how you are going to protect their autonomy they can chose to not participate or may cease to participate if they become uncomfortable, and 4) how you will protect their anonymity [no names or identifiers will be used].

Recruitment Script: Thank you for talking with me about my HSTA project. I am going to ask that you participate by doing a survey. This survey will ask about stress, sleep, exercise, nutrition, environment, and habits. It should take about 15-20 minutes. Everyone must be at least 13 years of age. No personal information will be collected, and no questions will be asked that will connect you to your data. You can skip any question you want.

Beneficence (Do Good/Not Harm): When recruiting subjects to participate in your study, explain how your research may benefit them and/or others by increasing or improving the knowledge about what you are testing.

Recruitment Script: This project is under WVU and will help me better understand our local community's health. Please click on the link or scan the QR code, read the cover letter, and start the survey. https://redcap.link/state2526

Justice: When recruiting subjects to participate in your study, make sure that you treat everyone equally. This means being fair.

Recruitment Script: Let me know if you need help or have any questions.

Recruitment Goals: Students working on the state survey need to ask 20 individuals from their community or as a club, ask three classes in their school to complete the survey. If you have research questions about teens, asking classes to complete the survey is a great way to collect information. If you have research questions about adults, asking community members to complete the survey is a great way to collect information. Think about your population.

State Survey Cover Letter and Link

Dear Participant,

This letter is a request for you to take part in a research project understanding our community health. This project is being conducted by HSTA Students.

If you decide to participate, you will be asked to complete a health survey about stress, sleep, exercise, nutrition, environment, habits, and COVID. Your participation will take approximately 15 - 20 minutes.

You must be at least 13 years of age or older to participate.

Your involvement in this project will be kept as confidential as legally possible. All data will be reported in the aggregate. You will not be asked any questions that could lead back to your identity as a participant. Your participation is completely voluntary. You may skip any question that you do not wish to answer and you may discontinue at any time. West Virginia University's Institutional Review Board approval of this project is on file.

If you have any questions about this research project, please feel free to contact the researchers by e-mail at slkuhn@hsc.wvu.edu. If you have any questions about your rights as a research participant, please contact the WVU Office of Human Research Protection by phone at 304-293-7073 or by email at IRB@mail.wvu.edu.

We hope that you will participate in this research project, as it could help us better understand local communities.

Thank you for your time and consideration. If you want to continue, please click Next Page.

Sincerely,
HSTA Researchers

https://redcap.link/state2526

After students take the state survey, have 11th and 12th graders read over the Research Menu https://health.wvu.edu/hsta/resources/teachers/research-projects/research-menu/ or brainstorm other ideas. Have 11th and 12th graders read over *Project Selection for Students in the 11th and 12th grades*. If they are working with a 9th or 10th grader, they will do the next part with the younger students.

While 11th and 12th graders are reading about project ideas, walk the other students through the state survey procedures.

HSTA State Survey – Observation

All 9th and 10th grade students, will use the HSTA Statewide Survey to conduct a cross-sectional/prevalence study. This type of study examines a population at a specific point in time. For example, if you measure the attitudes of 9th graders at your school in September, their attitudes might change by May.

The HSTA State Survey has pre-developed questions students will use in their research project. HSTA student researchers will share the State Survey with family and friends between September 2025 and January 2026. Then students will use the data collected through the State Survey to complete a HSTA research project.

Choosing a research topic can be challenging, and by starting with a State Survey, students will gain a solid foundation in research methodologies before selecting they select their own topics during their junior and senior year of high school. Furthermore, using the HSTA State Survey, allows student researchers to develop essential research skills, such as formulating a research question, selecting variables, writing a hypothesis, designing procedures, and applying statistics to answer questions and draw conclusions before diving into their own research ideas during their junior and senior year of high school.

Students can start sharing the survey with family and friends. They may want to read over the general procedures of the project to get an idea how the project will follow. During later lessons, students will review procedures.

1. Completed CITI training to learn about research ethics as a freshman in high school.
2. Used the HSTA State Survey 2025-2026 to collect community data on the **insert the topic**.
3. Selected variables that we were interested in and asked a research question.
4. Worked on background research and other presentation elements during our HSTA Club.
5. Shared the survey link from September 2025 – January 2026 with family, friends, and community members.
    a) Participants read a cover letter before they started the survey to learn about what types of questions were asked.
6. Once the survey was closed, HSTA CRAs posted a password-protected raw data file for download.
7. Learned about statistics and graphing through HSTA club lessons.
8. Completed descriptive statistics and graphing to display data to describe the data set.
9. Completed **insert statistical test name here** to see if our data supported or rejected our null hypothesis.
10. Drew conclusions.

Now, that students are familiar with the project, they need to select two survey questions they want to study. These two survey questions will drive their research question, variables, and hypothesis. Today, they will use these two survey questions to write a research observation.

Click on the hyperlink to access a copy of the HSTA State Survey questions
https://health.wvu.edu/hsta/resources/teachers/research-projects/state-data/

As students work through the survey, their goal is to pick two survey questions they want to compare against each other. Students can use the following guide questions to help them connect survey questions.

- Is there a difference among Survey Question A and Survey Question B?
- Is there a relationship among Survey Question A and Survey Question B?

Note: As a 10th grader, your project must be distinct from last year's. Avoid using projects from previous students.

The Statewide Survey has many questions. When students read over the survey questions, tell them to think about problems they see in their community. For instance, there is a survey question about BMI. Based on online information, 70.9% of WV residents are overweight or obese (WV Department of Health, 2024). This is a community problem.

Take another survey question that asks how many days did you feel your mental health was not good? Based on information from United Health Foundation (2024), 21.1% of WV adults said their mental health was poor 14 + days in the past month. These same online resources state that WV is ranked 50th for mental distress. This is a community problem.

Tell students to take time and look over the other survey questions and do a short internet search. What does the internet say about BMI and WV, mental health and WV, nutrition and WV, vaccines and WV, etc.? *Students will want to save the websites they visit for when they do background research.*

Have students select one survey question they find the most interesting.

Write down the survey question ***(survey question # 1)**:*

Now students need a second survey question to help them build a research project. Students should take their *first survey question* and ask

- do I want to see if there is a difference among ***survey question #1*** and *blank*?
- do I want to see if there is a relationship among ***survey question #1*** and *blank?*

blank can be several things such as: gender, county, stress levels, eating breakfast, access to grocery store, etc.

Students may want to pick a few survey questions and do a short internet search.
What does the internet say about *survey question #1* and *blank*? *Students will want to save the websites they visit for when they do background research.*

Have students select one survey question they find the most interesting.

Write down the survey question ***(survey question # 2)**:*

Now that students have two survey questions, have them look at their internet searches and complete the observation statements:

- The project problem is ____.
- This project is important to the community and me because ____.
- The project summary is ____.
- The project type is prevalence/cross-sectional.

Before students leave the club meeting, they should download the Presentation PowerPoint and complete their observation slide. They need to save it in a location they can easily access next meeting. If they have group members, they need to make sure all members have access to the file.

Project Selection for Students in the 11th and 12th Grades

All 11th and 12th graders can create with own idea with approval, work from the Research Menu https://health.wvu.edu/hsta/resources/teachers/research-projects/research-menu/ or work with 9th/10th Grader(s) on State Survey.

Ask 11th and 12th graders what research topics they are interested in? If they are struggling with ideas, 1) think about the project from Summer Camp, 2) visit the research menu, and/or 3) look over their research project from last year and see how they can grow or improve the project.

Note: You may build upon or enhance your project from last year, but you cannot reuse the same project. Avoid using projects that were completed by other students in the past.

Once they have selected a research topic, they will begin working on their observation slide. The project score sheet gives the observation slide three points.

- *Observation states the project's problem clearly.*
- *Observation includes why this project is important to the community and me.*
- *Observation includes a short summary of the project, including project type: prevalence, intervention, human experiment, or non-human experiment.*

Before students leave the club meeting, they should download the Presentation PowerPoint and complete their observation slide. They need to save it in a location they can easily access next meeting. If they have group members, they need to make sure all members have access to the file

Lesson 5: Research Question

Summary: Students will write a research question.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Identify a Research Question for the HSTA Community-Based Project
2. Complete Peer-Evaluation of Research Questions Exercise
    a. Share proposed research questions with peers
    b. Peers evaluate research questions
3. Complete HOA #2

Research Question

A research question is the foundation of all successful research projects. A research question is a specific question that guides from forming a hypothesis to collecting data and drawing conclusions. A well-written research question identifies what students will research, the variables involved, and the characteristics of the population/subject students are researching. It also makes clear whether the students are exploring a relationship or a difference between their research variables.

Having a strong research question is essential because it focuses the student's work. Without one, it's easy to drift into vague investigations that lack direction. The research question ensures that the HSTA project is both safe and ethical, and it shapes the student's hypothesis, variables, procedures, and conclusions.

It's easy to get carried away when writing a research question, especially when students are excited about the topic. While enthusiasm is great, cramming too much into a single question can make the study unclear, confuse results, and weaken the overall conclusions. For HSTA projects, students will only have two research variables. This will help them keep their research focus.

A good research question is not just about academic rigor; it's about impact. The question students create should connect to their community. Whether students are looking for a relationship among variables, looking for differences among groups, or measuring the effects of an intervention, their research question is their guide.

Before students begin to formulate their research question, make sure they read over the score sheet criteria:

- Research question includes the independent and dependent variables or variable one and variable two, and characteristics of the study population (where applicable).

- Research question identifies the relationship or difference being investigated between the independent and dependent variables or variable one and variable two.
- Research question has been reviewed by a CRA and has been determined to be safe and ethical.

Writing a Research Question

There are many ways to craft a research question. In HSTA, we will guide students by providing a clear framework to help them develop their research question.

1. Students need a clear idea about the topic they want to research.
    a. *9th and 10th graders will have two surveys they will use for their topic*
    b. *11th and 12th graders who are not using the state survey will use their observations to help guide their research topic*
2. There are many other ways to write a research question. As students start out learning about research, suggest having them use the following guide questions to write their research question.
    a. Guide research questions (See below for examples)
        i. Is there a significant relationship between $$$ and ### ?
        ii. Is there a significant difference between $$$ and ### ?
    b. This format allows students to set up a successful statistical analysis, and it limits students to two research variables.
    c. As 9th and 10th graders, the state survey guides their research topic, and they will be encouraged to use the suggested research question format.
    d. As 11th and 12th graders, they can pick their research topic. However, they are still encouraged to use the research question format to help make sure their research questions are set up for a successful statistical analysis.
3. Have students start drafting their research questions.
4. They can exchange their work with other groups in the club.
5. During the next lesson, students will learn about research variables. They may rewrite their research questions using inclusion criteria or constants.

Example Research Questions

Examples 1-3 are for 9th and 10th grade projects and/or cross-sectional projects.

Example #1 (variable responses are both quantitative)
This is a 9th and 10th grade project and/or cross-sectional example. $$$ and ### will be survey questions for 9th and 10th grade project. Then, students will rewrite to make the research question flow better.

- Two state survey questions
    a. During the past 7 days, how many days did you eat breakfast? (0-7 Days)
    b. What is your BMI? (18 - 40 kg/m²)
- Guide Research Question
    a. Is there a significant relationship/difference between $$$ and ### ?
- Write with state survey questions
    a. Is there a significant relationship/difference between During the past 7 days, how many days did you eat breakfast? and What is your BMI? ?
- Rewrite the research question for better flow.
    a. Is there a significant relationship between how many days a person eats breakfast and their BMI?

Example #2 (variable responses are both qualitative)

- This is a 9th and 10th grade project and/or cross-sectional example. $$$ and ### will be survey questions for 9th and 10th grade project. Then, students will rewrite to make the research question flow better.
- Two state survey questions
    a. Would you say that in general your health is (Excellent, Very good, Good, Fair, Poor)
    b. During your day, what best describes what you do? Would you say that you (Mostly sit, Mostly stand, Mostly walk, Mostly do heavy labor or physically demanding work)
- Guide Research Question
    a. Is there a significant relationship/difference between $$$ and ### ?
- Write with state survey questions
    a. Is there a significant relationship/difference between Would you say that in general your health is and During your day, what best describes what you do? Would you say that you?
- Rewrite the research question for better flow.
    a. Is there a significant relationship between general health status and whether a person says they mostly sit, stand, walk, or do physically demanding work all day?

Example #3 (one variable response is qualitative and the other is quantitative)

- This is a 9th and 10th grade project and/or cross-sectional example. $$$ and ### will be survey questions for 9th and 10th grade project. Then, students will rewrite to make the research question flow better.
- Two state survey questions
    a. Sex (Female, Male)
    b. Stress Score (0 - 40)
- Guide Research Question
    a. Is there a significant relationship/difference between $$$ and ### ?
- Write with state survey questions
    a. Is there a significant relationship/difference between Sex and Stress Score?
- Rewrite the research question for better flow.
    a. Is there a significant difference between males and females and their stress score?

Example research question for 11th and 12th grade project that is an intervention (one variable response is qualitative and the other is quantitative)

- Will an educational intervention impact nutrition knowledge among females in fifth grade who attend ABC Elementary School?
- Will there be a difference among pre- and post-scores on lung health knowledge after the Lung Health knowledge intervention among middle school students in Raleigh County?

Example research question for 11th and 12th grade project that is a human experiment (one variable response is qualitative and the other is quantitative)

- Is there a difference in test scores among students who chew gum and those who do not chew gum before a test?
- Is there a difference in test scores among students who listen to music and those who do not list to music during a test?

Example research question for 11th and 12th grade project that is a non-human experiment

- Will there be a difference in the rate of regeneration among Planaria exposed to **no** ethanol, 0.01mg, 0.02mg, and 0.03mg of ethanol? (one variable response is qualitative and the other is quantitative)
- Will there be a relationship between no caffeine, 0.01mg, 0.02mg, and 0.03mg of caffeine and the nighttime sleep behavior of fruit flies? (one variable response is qualitative and the other is qualitative)

HOA #2: Testing a Research Question

This HOA is designed for students to investigate a simple research question using a fun and engaging topic—like food! Choose a question that can be tested quickly and easily during a club meeting. *Click on the hyperlink to access information about this lesson* https://health.wvu.edu/hsta/resources/teachers/curriculum/

- Is there a difference in taste preference among different shaped Reese's Cups (round, mini, holiday-themed)?
- What is the relationship among temperature of water affect the rate at which sugar dissolves?
- Is there a difference in the cookie filling mass among Oreo and Double Stuf Oreo?
- Using X Gum, will there be a difference in bubble length among different chewing times of 15, 30, and 45 seconds?

Lesson 6: Research Question and Variables

Summary: Students will edit their research question and complete their variables slide.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Discuss the Concept of Research Variables
    a. Select the correct research variables
    b. Classify research variables as being numeric or categorical
2. Review the HSTA Community-Based Project Score Sheet
    a. Identify the criteria used to score the selection and classification of variables used in student-selected HSTA community-based research project

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Research Variables

Research variables are the specific factors that are measured, controlled, or changed in a study. They help researchers understand relationships and test hypotheses by showing how one variable may affect another or the relationship between variables. Having clearly defined variables is essential for designing experiments and drawing meaningful conclusions.

There are different types of variables in research, including independent variables, dependent variables, and controlled variables. Each type plays a unique role in how a study is designed and how data is collected and analyzed.

Two basic types of variables can be labeled as **quantitative**, which involve numerical measurements [*height, weight, amount of time, temperature*], and **qualitative**, which describe characteristics or categories [*Yes/No, Male/Female, States, Counties*]. Both types are important for understanding different aspects of a research study. Knowing the type of variable will also help identify what statistical test students will run.

Now that students know about quantitative and qualitative variables, they will use their research question to determine their research variables. For HSTA projects, we have four research variables

- independent variable or variable one
- dependent variable or variable two
- control
- inclusion criteria or constants

For HSTA projects, independent and dependent variables are used to determine if there is a difference among groups/categories and a quantitative (numeric) outcome.

- The independent variable is measured, manipulated, or selected by the experimenter to determine its relationship to the dependent variable. The independent variable in HSTA projects should be qualitative. Quantitative independent variables require advanced statistical analysis that students will learn in college.
- The dependent variable is observed and measured to determine the impact of the independent variable. The dependent variable in HSTA projects should be quantitative.

For HSTA projects, variables one and two are used to determine if there is a relationship among the two variables. In this case, variables one and two are both quantitative or variables one and two are both qualitative.

For HSTA projects, a control variable is the group or condition that receives no 'treatment,' allowing it to be used to compare to the 'treatment' groups. Below are notes for the types of projects HSTA has:

a. Cross-Sectional/Prevalence Study: No Control is present
b. Intervention: No Control is needed. You can use pre-intervention results as your control environment or establish a separate control group that does not receive the intervention. After completing the intervention, ensure that the control group receives the intervention materials as well. Note: All interventions must be educational.
c. Human Experiment: The control is the group of human subjects who do not receive the treatment. A control group is required.
d. Non-Human Experiment: The control is the item (i.e., plant, worms) that does not get the treatment. A control group is required.

For HSTA projects, the last variable is either the inclusion criteria or a constant. Inclusion criteria are specific characteristics that potential participants must possess to be included in a research study. HSTA projects that are Cross-sectional/Prevalence, Intervention, or Human Subject Experiment will have inclusion criteria like participants having to be a certain gender or age.

Constants are elements of a project that stay the same throughout the project – like water temperature, survey questions, etc. HSTA projects that are non-human subject experiments.

While HSTA projects focus on specific ways of using variables, there are many other ways variables can be applied in research. In advanced research, combinations of qualitative and quantitative variables can provide deeper, more complex insights into a topic.

Before students begin writing their variables, have them read the next page to better understand how variables relate to HSTA projects.

Variable Resource Table

		Dependent Variable or Variable Two	
		qualitative	quantitative
Independent Variable or Variable One	qualitative	***Box #1*** If both variables are qualitative, they will be labeled as - Variable One - Variable Two *These projects are determining relationships.* *You will evaluate the relationship with a **chi-square**.*	***Box #2*** If one variable is qualitative and the other is quantitative, they will be labeled as - Independent Variable (group) - Dependent Variable (numeric outcome) *These projects are measuring differences among groups.* *You will evaluate the difference with a **t-test** (two groups) or **ANOVA** (three or more groups).*
	quantitative		***Box #3*** If both variables are quantitative, they will be labeled as - Variable One - Variable Two *These projects are determining relationships.* *You will evaluate the relationship with a **correlation**.*

Student Exercise Variables
Use this exercise to help students write their research variables.

Note: Do not create a research question using a quantitative independent variable with a qualitative dependent variable. We are purposely not including logistic regressions. When you start learning about research, regression models come much later.

Research Question		
Independent Variable or Variable One	Response – Write down the responses for your variable.	Type – qualitative or quantitative
Dependent Variable or Variable Two	Response – Write down the responses for your variable.	Type – qualitative or quantitative

For state survey projects and cross-sectional projects, there are no control variables or control groups. Survey participants simply provide their responses to the questions without receiving any treatment or intervention aimed at changing behaviors.

For cross-sectional, intervention, and human subject projects, name at least two inclusion criteria:
1.
2.

For non-human subject projects, name at least two constants:
1.
2.

Lesson 7: Background Research and Citing Sources

Summary: Students will work on their background slides.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Begin Collecting Background Information for the HSTA Community-Based Research Project
2. Teach Students How to Cite References
    a. Demonstrate how to cite references in-text and on a reference list
    b. Utilize APA 7th edition formatting for all citations
3. Review the HSTA Community-Based Project Score Sheet
    a. Identify the criteria used to score the background slides in the HSTA community-based project
    b. Identify the criteria used to score the references in the HSTA community-based project

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Background Research

Research projects often begin with a literature review (background research) or as is common with many HSTA projects, with a research question. Once students have developed their research question, they will conduct background research on their two variables to build context and deepen their understanding of the topic.

Students should start by creating a list of keywords related to their research question and variables. Their goal is to find four academic references that provide:

- Two facts about the independent variable,
- Two facts about the dependent variable, and
- Four facts about the relationship between the two variables.

As students gather facts, they must record where each fact came from, i.e., websites or articles. HSTA requires citing references in APA (American Psychological Association) format. While there are programs that automatically format citations, it's important for students to learn the parts of a reference. The Purdue Owl website is a helpful resource for formatting APA citations.

Students will use references in two places in their HSTA project:

1. On the slides with their facts, they will use in-text citations to show the source of each fact.
2. On the final slide of their presentation, they will list full references in APA format.

Before students start researching and writing their background information, have them read over the items from the score sheet.

Score Sheet Items – for Background information

- Background information included two facts about the independent variable, or variable one.
- Background information included two facts about the dependent variable or variable two.
- Background information included four facts about the relationship between the independent and the dependent variables or variable one and variable two.
- Background information was referenced using correct in-text APA citations.
- Background information is cited from at least four academic references (i.e., government agency, Google Scholar articles)
- Background information was highlighted in bulleted format, not in paragraph form
- Background information was not plagiarized (summary in own words)
- Background information was limited to 20% of quotes

Score Sheet Items – for References

- Reference slide included 4 or more academic references
- Reference slide had ONLY in-text citations that were included as full references
- References were in the correct APA format (including being placed in alphabetical order)
- References were listed with hanging indents

Below is more information on where to find academic references, how to search for information on research variables, how to write in-text citations, and how to write references in APA format.

Where to find academic references

Academic references can be found in scholarly databases such as Google Scholar, JSTOR, and academic library catalogs. Students can access peer-reviewed journals, books, and reputable websites through different online resources.

Here are some reliable health websites that students can use for background research:

1. Centers for Disease Control and Prevention (CDC) https://www.cdc.gov
2. World Health Organization (WHO) https://www.who.int
3. National Institutes of Health (NIH) https://www.nih.gov
4. MedlinePlus (by the U.S. National Library of Medicine) https://medlineplus.gov
5. Mayo Clinic https://www.mayoclinic.org
6. KidsHealth https://kidshealth.org
7. Healthline https://www.healthline.com
8. American Heart Association https://www.heart.org
9. National Health Service (NHS UK) https://www.nhs.uk
10. Nutrition.gov https://www.nutrition.gov

Here are some reliable health websites about WV that students can use for background research:

1. West Virginia Health Statistics Center (HSC) https://www.wvdhhr.org/bph/oehp/hsc/abouthsc.htm
2. Vital Statistics Reports https://dhhr.wv.gov/HSC/SS/Vital_Statistics
3. Behavioral Risk Factor Surveillance System (BRFSS) https://dhhr.wv.gov/HSC/SS/BRFSS
4. County Health Rankings & Roadmaps – West Virginia https://www.countyhealthrankings.org/explore-health-rankings/west-virginia
5. West Virginia Health Atlas https://www.countyhealthrankings.org/health-data/west-virginia/data-and-resources

Here are some reliable general science websites that students can use for background research:

1. West Virginia Department of Environmental Protection (DEP) https://dep.wv.gov
2. West Virginia University Extension Service https://extension.wvu.edu/
3. West Virginia State Parks https://wvstateparks.com
4. NOAA National Weather Service Charleston, WV https://www.weather.gov/rlx
5. U.S. Geological Survey (USGS) West Virginia https://www.usgs.gov/
6. National Science Foundation https://www.nsf.gov/
7. West Virginia Department of Agriculture https://agriculture.wv.gov
8. American Museum of Natural History https://www.amnh.org/research
9. Science News for Students https://www.sciencenewsforstudents.org
10. National Institutes of Health (NIH) Science Education https://science.education.nih.gov/

How to search for information on research variables

When searching for information on research variables, start by identifying clear keywords related to each variable and the overall research question. Use reliable academic databases and trusted websites to find facts, studies, and data about each variable individually, as well as their relationship. Be sure students take notes and record their references for citations later.

How to write in-text citations

When using APA format, follow the author-date method of in-text citation. This means that the author's last name and the year of publication for the source should appear in the text.

- For example, if the fact is: *the leading cause of death in WV among females and males is diseases of the heart*
- And it came from this website: https://www.wvdhhr.org/bph/hsc/statserv/Stat_triv.asp
- The in-text citation would be: (WV Department of Health and Human Resources, 2014)

On the PowerPoint slide, the example would look like

- the leading cause of death in WV among females and males is diseases of the heart (WV Department of Health and Human Resources, 2014)

Here are three reliable websites that are great for helping with APA in-text citations:

1. Purdue OWL (Online Writing Lab) provides clear explanations and examples of APA in-text citation formats. https://owl.purdue.edu/owl/research_and_citation/apa_style/apa_formatting_and_style_guide/in_text_citations_the_basics.html
2. APA Style Official Website is the official source of the American Psychological Association. https://apastyle.apa.org/style-grammar-guidelines/citations
3. Citation Machine (APA In-Text Citation Guide) is an easy-to-use tool with examples and a citation generator. https://www.citationmachine.net/apa/cite-a-website/in-text

How to write references in APA format

Encourage students to explore the websites below to learn how to correctly write references in APA format. In college, they will encounter different citation styles for English papers, science papers, and more. It's important for students to be able to follow the specific formatting requirements for different courses.

Students may use an online APA citation generator. However, tell students to double-check what the generator gives them. They may need to edit the reference before they copy and paste it onto the background slides.

Here are three excellent websites to help with writing references in APA format:

1. Purdue OWL (Online Writing Lab) is a guide with detailed examples for all types of references.
   https://owl.purdue.edu/owl/research_and_citation/apa_style/apa_formatting_and_style_guide/reference_list_articles.html
2. APA Style Official Website is source for the latest APA reference guidelines.
   https://apastyle.apa.org/style-grammar-guidelines/references
3. Citation Machine (APA Citation Guide) is a user-friendly tool that generates formatted APA references for a variety of source types.
   https://www.citationmachine.net/apa/cite-a-book

Student Exercise: Background Information
This exercise was created to help students complete their background slides. Feel free to share the Question Table method with 9th and 10th graders or they can use the format below.

Have students read over the score sheet and make sure they address all the items. They need at least 8 facts and use 4 different references. Students will have two meetings to complete their background research.

Remind students to include in-text citations after each fact and the full reference citation at the end of the presentation. Full reference should be in ABC order, no bullet points, and use hanging indents.

<u>Give two facts about the independent variable or variable one</u>

Fact #1 (in-text citation in APA format)

Fact #2 (in-text citation in APA format)

<u>Give two facts about the dependent variable or variable two</u>

Fact #1 (in-text citation in APA format)

Fact #2 (in-text citation in APA format)

<u>Give four facts about how the independent and dependent variables **or** variable one and variable two, are related</u>

Fact #1 (in-text citation in APA format)

Fact #2 (in-text citation in APA format)

Fact #3 (in-text citation in APA format)

Fact #4 (in-text citation in APA format)

Lesson 8: Background Research

Summary: Students will work on their background slides.*Click on the hyperlink to access information about this lesson* *https://health.wvu.edu/hsta/resources/teachers/curriculum/*

Objectives:

1. Complete background and reference slides.

Complete Background and Reference Slides

During this club meeting, students will complete their background and reference slides. Remind students to avoid procrastination and use their time effectively. Have them review the score sheet criteria for the background and references sections.

Background Slides

- Background information included two facts about the independent variable or variable one.
- Background information included two facts about the dependent variable or variable two.
- Background information included four facts about the relationship between the independent and the dependent variables or variable one and variable two.
- Background information was referenced using correct in-text APA citations.
- Background information is cited from at least four academic references (i.e. government agency, Google Scholar articles)
- Background information was highlighted in bulleted format, not in paragraph form.
- Background information was not plagiarized (summary in own words).
- Background information was limited to 20% of quotes.

Reference Slide

- Reference slide included 4 or more academic references.
- Reference slide had ONLY in-text citations that were included as full references.
- References were in the correct APA format (including being placed in alphabetical order).
- References were listed with hanging indents.

It is suggested that students complete a Think–Pair–Share activity. Once students finish their background slides, have them exchange presentations with another group. Each group will provide feedback based on the score sheet, asking questions and offering suggestions to help improve the work.

Lesson 9: Hypothesis

Summary: Students will work on their hypotheses. *Click on the hyperlink to access information about this lesson* https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Introduce the Concept of Research Hypotheses
    a. Define hypothesis
    b. Differentiate between the null hypothesis and the alternative hypothesis
2. Review Hypothesis Criteria on Scoring Rubric
3. Compose your Hypothesis Slide
4. Complete HOA #3 with Guest Speaker

What is a hypothesis?

A hypothesis is a specific, testable prediction about the relationship between two variables. It serves as the foundation for scientific research by providing a statement that can be tested. Data is collected and analyzed to determine whether it supports or rejects the null hypothesis. The key to a good hypothesis is not to overthink it. Keep it simple.

There are two types of hypotheses a HSTA student will use in their project.

 Null Hypothesis (H_0): This hypothesis states that there is no effect or no difference between variables. It serves as a default or baseline assumption that researchers aim to test against.

- Example: "There is no difference in test scores between students who use an online textbook and those who use a traditional textbook."

 Alternative Hypothesis (H_1 or Ha): This hypothesis asserts that there is a difference or relationship between variables. It represents the researcher's prediction that the null hypothesis is incorrect.

- Example: "Students who use the online text will have higher test scores than those who use a traditional textbook."

The items below are from the score sheet. Read them carefully and make sure students address each item. Score Sheet - Worth 4 Points:

- Alternative hypothesis is a statement of an effect/relationship between the independent and dependent variables or variable one and variable two.
- Null hypothesis has been reviewed by a CRA and has been determined to be testable using an approved statistical test.
- Alternative hypothesis is justified using some of your background research on the hypotheses slide.
- Null hypothesis is a statement of no effect/relationship between the independent and dependent variables or variable one and variable two.

Student Exercise: Hypotheses

1. Have students use their research question and variables to write their null and alternative hypotheses.

2. Start with the null hypothesis. The null hypothesis states that students will find no difference or that they will find no relationship between their two research variables.

   Write the null hypothesis:

3. Now have students write their alternative hypothesis that states that there will be a difference or a relationship among their two research variables.
   a. Students may be tempted to write their hypothesis stating that the difference or relationship will favor a certain variable response. Be cautious of this because the statistical test they will use to find their p values will only tell them Yes or No there is a difference or Yes or No there is a relationship.
   b. In their conclusion statement, they can use averages, r values, and other descriptive statistics to make statements about their data.
      i. For example, the alternative hypothesis may read: There will be a relationship among BMI and stress level.
      ii. Students may want to make directional statements like
         1. If BMI is high, then stress will be high.
         2. If BMI is low, then stress will be low.
         3. If BMI is high, then stress will be low.
         4. If BMI is low, then stress will be high.

   Write the alternative hypothesis: _____

4. Before students leave their alternative hypothesis, have them use their background information to help them take a stance on why they think there is a difference or relationship between their two research variables.

   Write a Supporting statement: _____

5. Now have students switch their hypotheses with another group for peer review. Make sure students use the score sheet.
6. Have students read over the feedback and rewrite their hypotheses if needed.
7. Have students type their hypotheses on their PowerPoint.

HOA #3: Guest Speaker

This HOA is designed for a guest speaker to create and facilitate the activity.

Invite a guest speaker from the community to present for approximately 30 to 45 minutes. Potential speakers could include Dr. Epps, HSTA alumni, Rural Health Scholars from AHEC, or representatives from colleges and universities. Coordinate with the Field Site Coordinator to connect with community members. Encourage the speaker to incorporate a hands-on activity, or, if presenting online, to provide clear instructions for an activity students can complete during the club meeting.

Lesson 10: Introduction to Excel and Data Collection Sheet

Summary: Students will work on their procedures and complete HOA. *Click on the hyperlink to access information about this lesson* *https://health.wvu.edu/hsta/resources/teachers/curriculum/*

Objectives:

1. Introduce Students to Excel
2. Generate a Data Collection Chart for the Research Project
3. Complete HOA #4

Excel is a powerful and widely used tool for data organization, analysis, and visualization. Throughout your project, you'll rely on Excel to analyze your results, perform calculations, and present your descriptive statistics and graphs clearly and professionally. Whether you're working with numbers, text, or dates, Excel provides an efficient and flexible platform to manage your data and extract meaningful insights.

There are numerous online resources available to help you master Excel, from beginner tutorials to more advanced techniques. To get started, a simple Google search using keywords like "Excel for beginners" or "Excel data analysis tutorial" will lead you to countless helpful guides, video tutorials, and practice exercises. Additionally, websites like Microsoft's official support page, YouTube, and educational platforms such as Coursera and LinkedIn Learning offer in-depth courses to help you sharpen your Excel skills.

By taking advantage of these resources, you'll be able to unlock Excel's full potential and confidently analyze and present your data.

HOA #4: Excel

This HOA is designed to introduce Excel and HSTA's data collection Excel sheet. Using the data from HOA #2, students can enter the data it into Excel, calculate averages/etc., create a graph, and answer the research question based on the averages and graphs.
OR Students can use example data sets to learn about Excel.

To access HOA #2 and HOA #4 supporting documents visit
https://health.wvu.edu/hsta/resources/teachers/

Data Collection Sheet

After learning a little more about Excel, HSTA students will create a data collection chart for their project. A data collection chart is a tool used to organize data during an experiment, survey, or other research activity. Data charts can be created in an Excel table, with rows and columns that help organize the information being collected.

Review the Data Collection Sheets below, and students need to select the one that best fits their research question and variables. Students will need to create their data collection chart and include it in their PowerPoint. The data collection sheet does not include raw data.

Prevalence Example: Is there a difference among gender and math scores?

- Variables
    - The Independent Variable is categorical
    - The Dependent Variable is numeric
- Project that has summation to get a total score.
- After you score each 'test/survey,' enter your total scores for each participant.
- Run an unpaired t-test because there are two different groups.

Total Score - High Score = 100/100		
Participant #	**Female**	**Male**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

Intervention Example: Is there a difference in stress scores after the intervention?

- Variables
    - The Independent Variable is categorical
    - The Dependent Variable is numeric
- Test/Survey will need to have a 'code' to match pre and post to the same participant.
- After you score each 'test/score,' enter your total scores for each participant. Surveys will have a coding system, replacing words with numbers (categorical coding).
- Run a paired t-test because the same people took the pretest/survey as the posttest/survey.

Total Score - High Score = 100/100		
Participant #	**Pre Survey**	**Post Survey**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

Project has Yes or No

- Variables
  - Variable One is categorical
  - Variable Two is categorical
- Make sure to enter the question or summarize the question. Then enter Yes or No in blank boxes.
- Research Question: Difference among grade levels and if they are present at an event?
- You would run a chi square.

	Present at Event	
Participant #/Code	Yes	No
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

A project that has three groups.

- Variables
  - The Independent Variable is categorical
  - The Dependent Variable is numeric
- Make sure to label your columns to match what you are collecting.
- Research Question: Is there a difference among age groups and weight?
- You would run an ANOVA because you have three groups to compare.

	Age Groups		
Participant #/Code	13-19	20-29	30-39
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

A project where you are looking for how much one variable tends to change when the other changes, collecting both variables.

- Variables
  - Variable One is numeric
  - Variable Two is numeric
- Make sure to label your columns. Column Rainfall and Temperature will be collected at the same time and then repeated.
- Procedures will need to explain how and when records were collected.
- Research Question: Does rainfall relate to temperature?
- You would run a correlation.

Record	Rainfall	Temperature
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Non-human study, collecting data over time.

- Variables
  - The Independent Variable is categorical
  - The Dependent Variable is numeric
- Make sure to set up your data sheet to collect data over time and record data for each group.
- Research Question: Does plant height differ among fertilizer?
- You would run an ANOVA.

Height of plants, 4 different trreatments: water, water with 10% fertilizer, 20% fertilizer,				
Trials	**Plant 1 - Control (cm)**	**Plant 2 - 10% solution (cm)**	**Plant 3 - 20% solution (cm)**	**Plant 4 - 30% solution (cm)**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

Lesson 11: Procedures

Summary: Students will work on their procedures. *Click on the hyperlink to access information about this lesson* https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Introduce Students to Protocol for Writing Procedures
    a. Review provided procedures for the HSTA statewide survey (9^{th}/10^{th} grade projects)
    b. Review strategies for developing procedures for 11^{th}/12^{th} grade projects
2. Review Procedures Criteria on Scoring Sheet
3. Complete HOA #5

Introduction to Procedures

Now that students have a solid research question, they will write procedures to explain how they will collect data to test their null hypothesis. When conducting a research project, procedures are the step-by-step instructions that explain exactly how someone will carry out the research project. Procedures can be considered a "recipe" to complete a research project. Procedures need to be clear, detailed, and repeatable. Good research procedures should make it possible for anyone, even someone who has never seen the project before, to repeat the research project and get similar results.

For HSTA research projects, the research score sheet includes 11 required items designed to ensure the project's procedures are clear, detailed, and well-structured. The procedures section is organized into four sections that align with one of the main types of research projects. Students should first identify which project type best matches their project, then carefully review the procedure requirements specific to that project type.

Cross-Sectional/Prevalence Study: This type of study examines a population at a specific point in time.

- ★ If students are 9th/10th graders and working on the state survey, have them read over the items below, then read over Procedures for State Survey presented later in this lesson.
- ★ If students are 11th/12th graders working on a Cross-Sectional/Prevalence Study, read the items below before they start writing procedures, and read over Procedures Tips for 11th and 12th Graders presented later in this lesson.

- Procedures were numbered in the order that each step was completed.
- Procedures identified all safety precautions (including how participants' identities will be kept confidential, i.e. CITI training completed).
- Procedures explained who the study population was.
- Procedures explained what the study population did.
- Procedures explained how at least 100 participants were recruited.
- Procedures included a copy of the measurement tools (i.e. survey/observation sheet).
- Procedures included a participant cover letter explaining the project.
- Procedures included data collection sheet.
- Procedures explained how data was collected.
- Procedures included how data will be analyzed (i.e. states the name of the statistical test to be used).

Procedures included a list of materials used for the project.

Intervention: An intervention is a structured program aimed at inducing change within a group. If students are 11th/12th graders working on a human intervention, read the items below before they start writing procedures, and read over Procedures Tips for 11th and 12th Graders presented later in this lesson.

- Procedures were numbered in the order that each step was completed.
- Procedures identified all safety precautions (including how participants' identities will be kept confidential, i.e. CITI training completed).
- Procedures explained who the study population was.
- Procedures explained details of the intervention.
- Procedures explained how at least 30 participants were recruited.
- Procedures included a copy of the pre and post measurement tools (Example: Survey/observation sheet).
- Procedures included a participant cover letter explaining the project.
- Procedures included data collection sheet.
- Procedures explained how the pre and post data was collected.
- Procedures included how data will be analyzed (i.e. states the name of the statistical test to be used).
- Procedures included a list of materials used for the project.

Human Experiment: This involves conducting experiments with human participants to observe effects. If students are 11th/12th graders working on a human experiment, read the items below before they start writing procedures, and read over Procedures Tips for 11th and 12th Graders presented later in this lesson.

- Procedures were numbered in the order that each step was completed.
- Procedures identified all safety precautions (including how participants' identities will be kept confidential, i.e. CITI training completed).
- Procedures explained who the study population was.
- Procedures explained what the study population did.
- Procedures explained how at least 30 participants were recruited for EACH group (experimental and control).
- Procedures included a copy of the measurement tools (Example: Survey/observation sheet).
- Procedures included a participant cover letter explaining the project.
- Procedures included data collection sheet.
- Procedures explained how data was collected.
- Procedures included how data will be analyzed (i.e. states the name of the statistical test to be used)**.**
- Procedures included a list of materials used for the project.

Non-Human Experiment: This refers to traditional science experiments that test hypotheses using non-human subjects. If students are 11th/12th graders working on a non-human experiment, read the items below before they start writing procedures, and read over Procedures Tips for 11th and 12th Graders presented later in this lesson.

- Procedures were numbered in the order that each step was completed.
- Procedures identified all safety precautions (i.e. completely lab safety training).
- Procedures explained what plant, natural resource, invertebrate (other) the project was experimenting with.
- Procedures explained details of the experimental environment and/or change in environment (if you have more than one experimental group explain differences among all groups).
- Procedures included a control group.
- Procedures included a list of materials used for the project.
- Procedures explained that there were at least 5 replications per experimental group.
- Procedures included data collection sheet.
- Procedures explained how data was collected.
- Procedures included how data will be analyzed (i.e. states the name of the statistical test to be used).
- Procedures provided a clear description of the project.

Students can continue to write their procedures, or students can practice writing procedures by completing a hands-on activity.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

HOA #5: Procedures Part 1

This HOA is designed for students to practice writing clear procedures. Students will choose a topic, create a structure or item, and then write step-by-step instructions for how to build or complete it. In the next club meeting, students will exchange their written procedures with another group, who will follow the instructions to create the same structure or item. Afterward, the groups will compare their results, discussing any differences and how the procedures could be improved for clarity and accuracy.

Example topics:

- Paper Snowflake or Airplane
- Spaghetti and Marshmallow Christmas Tree Challenge
- Gift Wrapping
- Gingerbread House

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Procedures for State Survey

For 9th and 10th grade projects, please follow the procedures outlined below. These are the same procedures we discussed in Lesson #. We provide these procedures for all State Surveys to help you, as a student researcher, learn how to write and follow directions effectively.

On your procedure slide, begin by copying down these procedures. Be sure to make any necessary edits and put a personal spin on the procedures. The words in green are guide words that you need to use and adjust as needed.

The procedures below are for 9th and 10th-grade projects. Words in green need to be edited by students. Walk through the procedures with students, use the words in Red as a guide.

1. Completed CITI training to learn about research ethics as a freshman in high school. Remind students of lesson 2 and their CITI training.
2. Used the HSTA State Survey 2025-2026 to collect community data on the **insert the topic**. Talk about why we are using the survey for 9th and 10th graders. We are learning about research.
3. Selected variables that we were interested in and asked a research question. Remind students of lesson when they read through the state survey to select two survey questions.
4. Worked on background research and other presentation elements during our HSTA Club. Remind students of lessons when they have completed their background research.
5. Shared the survey link from September 2025 – January 2026 with family, friends, and community members (Students should show a picture of how they shared the survey i.e. social media post, email). Students need to discuss a recruitment plan. How will they share the survey?
    a) Participants read a cover letter before they started the survey to learn about what types of questions were asked (Show cover letter in presentation).
6. Once the survey was closed, HSTA CRAs posted a password-protected raw data file for download. Tell students that once the survey is closed, HSTA CRAs will post all completed surveys in an Excel sheet. This Excel sheet will be protected by a password. They will be able to download the excel sheet and answer their research question. They will learn more about statistics, graphing, and writing conclusions with lessons 13 – 24.
7. Learned about statistics and graphing through HSTA club lessons.
8. Completed descriptive statistics and graphing to display data to describe the data set.
9. Completed **insert statistical test name here** to see if our data supported or rejected our null hypothesis.
10. Drew conclusions.

QR Code and Link for the 2025-2026 WV State Survey

Students should recruit through email, social media, word of mouth, etc., using the link and/or QR code below.

https://redcap.link/state2526

Cover Letter for 2025-2026 WV State Survey

Dear Participant,

This letter is a request for you to take part in a research project understanding our community health. This project is being conducted by HSTA Students.

If you decide to participate, you will be asked to complete a health survey about stress, sleep, exercise, nutrition, environment, habits, and COVID. Your participation will take approximately 15 - 20 minutes.

You must be at least 13 years of age or older to participate.

Your involvement in this project will be kept as confidential as legally possible. All data will be reported in the aggregate. You will not be asked any questions that could lead back to your identity as a participant. Your participation is completely voluntary. You may skip any question that you do not wish to answer and you may discontinue at any time. West Virginia University's Institutional Review Board approval of this project is on file.

If you have any questions about this research project, please feel free to contact the researchers by e-mail at slkuhn@hsc.wvu.edu. If you have any questions about your rights as a research participant, please contact the WVU Office of Human Research Protection by phone at 304-293-7073 or by email at IRB@mail.wvu.edu.

We hope that you will participate in this research project, as it could help us better understand local communities.

Thank you for your time and consideration. If you want to continue, please click Next Page.

Sincerely,
HSTA Researchers

Procedures Tips for 11th and 12th Graders

Review the score sheet and procedure tips provided below. If students are working on a menu project, make sure to visit the website for supporting documents. Begin typing the procedures into your PowerPoint presentation.

Writing Procedures Tips

1. CITI training. Why do they need to include it in the procedures? Even if they have completed this training (the training is good for four years), they still need to include it as a procedure step. It needs to be first on the procedure slide for everyone who is doing a human subject study. This shows that they were trained how to complete a human subject experiment/intervention without harm to the human subject, etc. Names on list - The training list will need to be updated. This is a safety procedure.
2. Safety procedures need to be included in the main procedures. They are not separate from the other procedures they need to be included as a step and as you complete them.
3. In the procedures section, you explain clearly how you conducted your study to: (1) enable readers to evaluate the work performed and (2) permit others to replicate your study.
4. You must describe exactly what you did: what and how experiments were run, what, how much, how often, where, when, and why equipment and materials were used.
5. You should maintain a balance between brevity (you cannot describe every technical issue) and completeness (you need to give adequate detail so that readers know what happened).
6. Order your procedures chronologically or by type of procedure and then chronologically within the type of procedure using subheadings, where appropriate, to clarify what you did. Number the procedures as steps, don't write the procedures like you would in a research paper, i.e., paragraph form.
7. Use the past tense and the third person to describe what you did. For example: “The sample was incubated at 37ºC for 3 days.” - NOT: “I incubate the sample at 37ºC for 3 days.” This is very important for the final presentation, remember when you present the final presentation you have already completed the whole project.
8. Describe your experimental design clearly, including the hypotheses you tested, variables measured, how many replicates you had, controls, treatments, etc.
9. Explain why each procedure was done.
10. Identify the source of any specific type of equipment, tool, ETC which is critical to the success of the experiment. Describe in detail any modifications to equipment if needed.
11. Identify treatments using the variable or treatment name, rather than an ambiguous, generic name or number (e.g., use "healthy donors" rather than "group 1").
12. Describe statistical tests and the comparisons made; ordinary statistical methods should be used without comment; advanced or unusual methods may require a literature citation.
13. Show your procedures slides to other students, teachers, parents, ETC and ask whether they would have difficulty in understanding and/or repeating your study.
14. Don't mix results with procedures.
15. Omit all explanatory information and background - save it for the discussion.

Tips for Cover Letter – Human Subjects

1. You need a paragraph explaining what your project is about and what you are asking participants to do.
2. You can also use this cover letter as a recruitment flyer/letter.
3. Explain in simple terms
   - Display transparency of project
   - Explain who you are
   - Why you are doing this project
   - What the project is about
   - What participants must do in the project
     - How their data will be protected
   - Remember to tell participates this is voluntary
   - What will you do with the data/results

Tips for Intervention

1. An intervention is a 'program' designed to make a change among a group of individuals. This change can be a behavior change (i.e. eating healthy) or improvements in health status (i.e. lowering blood pressure).
2. Interventions can be educational programs, change in policies, improvements to the environment and/or health promotion campaigns.
3. Interventions that use a mixture of approaches are usually the most effective in producing change.
4. Interventions should at least run for 6 weeks.
5. Intervention needs to be more than just one 20-minute presentation during a class period.
6. Be creative when you design your intervention.
7. You can also find lots of interventions from online searches – see what others have already done. (Remember to cite your resources)
8. Find a community member that is an expert on your topic.
9. If you are running the intervention, then all materials need to be submitted for review:
   a. Handouts, PowerPoint, detailed outline of what individual will do, etc.
   b. If you have a guest speaker coming in, you still need to submit a detailed outline of what that person will cover.
   c. If you have a 'program,' the individuals will submit that 'program.' If you have lessons, you are teaching, submit the lessons.

Survey Information

Writing surveys is not easy. **Our first suggestion is that students use a validated survey, one that has already been released.** There are two main issues when students create surveys 1) they don't measure what they need to answer the research question and 2) they have too many questions that don't relate to the topic. Below are tips you can share with students if they are writing their own survey. Remind, students they need to submit their survey and any other project materials to the CRA for approval.

Tips for Survey Part A

1. Start on your survey early to get feedback.
2. See if there are surveys already published. Example – there are many surveys that have been published that measure stress levels, environmental safety, community walkability, etc.
3. Think about how you will 'score' data. Will you look at all the questions or individual questions?
4. Think about how you will record data into Excel. See example data collection sheets.
5. Does your survey measure what your research question is asking?
6. For your pre and post surveys, make sure you have asked the same questions on both surveys.
7. If you have an intervention, make sure the questions in your survey are based on information presented in the intervention. Don't ask questions that you aren't going to present information on during the intervention.
8. You want to measure the change in the scores, weight, BMI, etc. between pre and post surveys. Therefore, you DO NOT want to ask questions like "Have you ever had energy drinks?", but instead "How many energy drinks have you had in the last 2 weeks?" The answer to the first question would not change even after an intervention, but the answer to the second question could change after an intervention.
9. The number of survey questions depends on the project – talk with CRA and/or HSTA teacher for help.

Tips for Survey Part B

1. **Make Sure That Every Question Is Necessary** You're building your survey to obtain important insights, so every question in the survey should play a direct part. It's best to plan your survey by first identifying the data you need to collect and *then* writing your questions.
2. **Keep it Short and Simple** Respondents are less likely to complete long surveys, or surveys that bounce around haphazardly from topic to topic. Therefore, make sure your survey follows a logical order and that it takes a reasonable amount of time to complete.
3. **Ask Direct Questions** Vague or poorly worded questions confuse respondents and make your data less useful. Strive for clear and precise language that will make your questions easy to answer.
4. **Ask One Question at a Time** Take a closer look at questions in your survey that contain the word "and"—it can be a red flag that your question has two parts. Here's a sample:

"Which of these cell phone service providers has the best customer support *and* reliability?" In this case, a respondent may feel that one service is more reliable, but another has better customer support.

5. **Avoid Leading and Biased Questions** Some descriptive words and phrases may interject some bias into your questions or point the respondent in the direction of a particular answer. Scrutinize adjectives and adverbs in your questions. If they're not needed, take them out. In addition, an unbalanced response scale can lead a respondent in the same way a poorly worded question might. Make sure your response scales have a definitive midpoint (aim for odd numbers of possible responses) and that they cover the whole range of possible reactions to the question.
6. **Speak Your Respondent's Language** Use language and terminology that your respondents will understand. Make words and sentences as simple as possible and avoid technical jargon. However, don't oversimplify a question to the point that it will change the way the question will be interpreted.
7. **Use Response Scales Whenever Possible**
   Response scales that give the direction and intensity of attitudes provide rich data. By contrast, categorical or binary response options, such as true/false or yes/no response options, generally produce less informative data.
8. **Avoid Using Grids or Matrices for Responses.** Oftentimes respondents don't fill in grids correctly or accurately according to their true feelings. Also, grids aren't mobile-friendly. It's better to separate questions with grid responses into multiple questions in your survey with regular response scales.
9. **Rephrase Yes/No Questions if Possible.** Many yes/no questions can be reworked by including phrases such as "How much," "How often," or "How likely." Make this change whenever possible and include a response scale for richer data.
10. **Take Your Survey for a Test Drive.** Ask at least five people to test your survey to help you catch and correct problems before you distribute.

from https://www.qualtrics.com/blog/10-tips-for-building-effective-surveys/

Tips for recruiting subjects.

When you are recruiting subjects, it is important to remember your ethics training. Use the sample recruiting script to help you talk with subjects.

Respect: When recruiting subjects to participate in a survey, you first explain to them what the survey is about, (subject), why you are conducting it, (for a research project for HSTA to learn about_____), how you are going to protect their autonomy, (they can chose to not participate or may cease to participate if they become uncomfortable), and how you will protect their anonymity, (no names or identifiers will be used). Then, depending upon the level of research you have a permission slip signed and returned or, if an IRB project, you obtain consent, (and assent if the subject is under 18), on the IRB permission forms.

Beneficence: Explain to the subjects how your research may benefit them or others by increasing or improving the knowledge about what you are testing. For instance, explain how 10 minutes of morning exercise might improve math scores.

Justice: Make sure that you treat everyone equally. This means being fair. You need to offer participants the same opportunity (to use equipment, earn a prize, learn material).

Care: Be sure that what you are doing does not pit one faction against another.

Tips for Non-Human Experiments

For non-human experiments, there are a few things you need to make sure you include in your procedures:

1. Make a list of materials. This list needs to be approved by the HSTA Teacher, CRA, and FSC. Make sure the materials are things they can get and it is within the regional budget.
2. You need a control group and at least one experimental group. Each group needs at least five replications.

Writing procedures for a research experiment is crucial for ensuring that the study is replicable and that others can understand and follow your methods. Here are some tips to help you write clear and effective procedures:

1. **Be Specific and Detailed**: Clearly outline each step of the experiment. Include specifics like measurements, timings, and concentrations. The more detail you provide, the easier it will be for others to replicate the experiment accurately.
2. **Use Clear, Concise Language**: Avoid jargon or complex language that might confuse readers. Your goal is to make the procedure as straightforward as possible. Use simple, direct sentences and define any technical terms that are necessary.
3. **Organize Logically**: Arrange the steps in a logical sequence, starting from preparation through to execution and data collection. Each step should naturally lead to the next. Number the steps to make the procedure easy to follow.
4. **Include Safety and Preparation Information**: Highlight any safety precautions and preparatory work that needs to be done before starting the experiment. This includes handling of hazardous materials, use of personal protective equipment (PPE), and any necessary equipment setup.
5. **Specify Materials and Equipment**: List all materials and equipment needed, including quantities and specific types or brands if applicable. This ensures that others use the same resources and conditions, which is critical for reproducibility.
6. **Describe Measurement and Data Collection**: Clearly state how measurements should be taken and how data should be recorded. Include details on instruments used, units of measurement, and any specific techniques for collecting and analyzing data.
7. **Include Contingency Plans**: Describe what should be done if something goes wrong. Outline common problems and solutions or alternative procedures to handle unexpected issues.
8. **Test the Procedure**: Before finalizing, perform the experiment yourself using the written procedure to identify any ambiguities or missing steps. Adjust the procedure based on this testing to ensure it's clear and functional.
9. **Review and Revise**: Have someone else read the procedure to catch any errors or areas that need clarification. Peer review can help identify parts of the procedure that might be confusing or incomplete.
10. **Document Any Variations**: If your procedure allows for variations or has different options, document these clearly. This will help others understand the flexibility of the procedure and how different approaches might affect the results.

Lesson 12: Procedures

Summary: Students will work on their procedures.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Complete Procedure Slides
2. Complete HOA #6

Complete Procedure Slides

Make sure students submit their project for CRA comments. This would be a good meeting to have students exchange projects for peer feedback and/or have students present to the club/small groups for peer feedback. Students can use the score sheet to give suggestions.

HOA #6: Procedures Part 2

For this HOA, students will exchange their written procedures from HOA #5 with another group, who will follow the instructions to create the same structure or item. Afterward, the groups will compare their results, discussing any differences and how the procedures could be improved for clarity and accuracy.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Lesson 13: Project Title

Summary: Students will complete their title slide, make edits for CRA approval, start collecting data if approved, and/or complete a hands-on activity.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Develop a title for your HSTA research project.
2. Complete HOA #7

Title for HSTA Project

Students will complete their project by developing a title for their research project. Students need to make sure their title covers all the items on the score sheet

- Title is a complete statement/question
- Title matches the research question
- Title clearly defines the purpose of the project

Additionally, the title slide should have all group members' names, grade level, HSTA teacher(s), and high school name.

Complete Project Proposal

Students should be working on their project proposal slides and/or starting data collection. If students need materials, they must have a project status of:

- **Not approved, may** start data collection. The student still needs to earn 40 points, or
- **Approved with 40 points;** no other proposal submission is needed,

then they need to talk with their Field Site Coordinator.

HOA #7: STEM Fun

For this HOA, have students do a lab that is fun and engaging. They should have just submitted for their second CRA deadline and might be waiting on comments.

Suggest Labs:

- Germ Glo Lab
- Ostracod "Sea Firefly" Bioluminescence Lab

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Lesson 14: Completing Project Proposal and/or Start Data Collection

Summary: Students need to work on any outstanding edits for CRA approval, start collecting data if approved, and/or complete a hands-on activity.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Complete project proposal and/or start on data collection.
2. Complete HOA #8 and HOA #9

Complete Project Proposal

Students should be working on their project proposal slides and/or starting data collection. If students need materials, they must have a project status of:

- **Not approved, may** start data collection. The student still needs to earn 40 points, or
- **Approved with 40 points;** no other proposal submission is needed,

then they need to talk with their Field Site Coordinator.

HOA #8 and HOA #9: Dissections

For this HOA, have students do a lab that is fun and engaging. Some students will still be working on their proposal and/or working on data collection.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

It is recommended that students participate in a dissection, as it provides a valuable hands-on learning experience. It is suggested that clubs do two dissections over two meetings.

Suggest Dissections:

- Starfish
- Squid
- Grasshopper
- Dogfish Shark
- Frog
- Perch
- Crayfish
- Worm
- Cow Eye
- Sheep Heart
- Sheep Brain
- Sheep Kidney

Lesson 15: Sorting and trimming DATA

Summary: Students will learn how to sort and trim data in a Microsoft Excel file.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Introduce students to the HSTA Statewide Survey data file.
2. Demonstrate how to filter, sort, and trim data in an Excel file.
3. Calculate the survey response total, completion total, and completion rate for the HSTA Statewide survey.

If 11th or 12th graders need to work on their project have them do that instead of helping younger students. If the 11th or 12th graders are waiting on materials, data collection, etc., they can be paired up with a younger group and help them as they sort and trim HSTA state data.

Sort and Trim Data

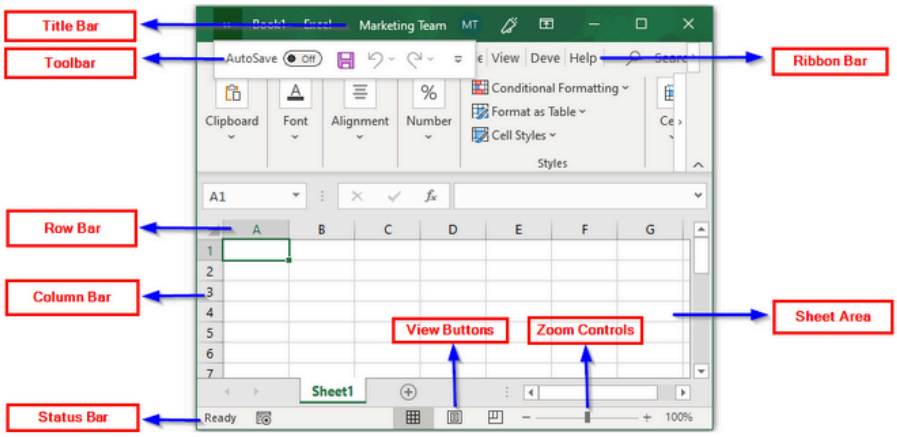
Students will learn how to sort and trim the state data. Before students start looking at data, have them check out how many surveys were completed by WV county. The link for this bar graph will be emailed in January. Show the bar graph on a large screen or have students pull it up. Use this opportunity to talk about reading a bar group and ask students the following questions: How many surveys did the county get? What county had the highest number of surveys? How many counties had 50 or more surveys?

Everyone needs to find a computer and open Excel. It is strongly encouraged that everyone have their own computer and an Excel file open. If they are working as a group, they can compare files and answers with each other.

HSTA teachers will email students a copy of the data file or post it on a Learning Management System as well as share the data file password.

Students should open the file and save the HSTA State Survey data file on their own device/folder. If students need a basic introduction to Excel and/or a review of how to use Excel here is video for Excel Beginners https://www.youtube.com/watch?v=wbJcJCkBcMg

After students save their file, make sure they can identify where the rows and columns are.



Each row, starting with the second row, represents the responses of one survey participant to the survey.

Each column of the file represents an individual HSTA State Survey question. From there, explain to students that the intersection of a row and a column in this file represents one respondent's response to one survey question.

Note: Counties with 49 or fewer survey responses will not display the county name to protect the privacy of individuals from smaller communities. All WV surveys will be categorized as either North or South if a county was chosen.

Now students will begin to sort and trim the Statewide Survey Data File. This means they only need the data that is related to their research project. Make sure students have saved the State Survey Data File to their computer/folder before beginning the filtering, sorting, and trimming process.

Note: The unfiltered, unsorted, and untrimmed file will be used later in this lesson to assist in calculating response data. Note: There are many ways to sort, filter, and trim data contained in Excel files. Teachers should utilize the sorting, filtering, and trimming techniques that they are most familiar with when assisting students through this process.

Step 1: Identify the **columns** that contain the data associated with the **independent variable or variable one**.

Students will begin by locating the column that contains the survey question that contains the data for their independent variable or variable one. Once located, students will then highlight (in light green) the column that contains the data for their independent variable.

Video Resource – Highlighting Columns in Excel:
https://youtu.be/QHeuG3209Bc?si=6jPnJF1CGqzPjS_M

Step 2: Identify the **columns** that contain the data associated with the **dependent variable or variable two**.

Students will begin by locating the column that contains the survey question that contains the data for their dependent variable. Once located, students will then highlight (in light blue) the column that contains the data for their independent variable.

Video Resource – Highlighting Columns in Excel:
https://youtu.be/QHeuG3209Bc?si=6jPnJF1CGqzPjS_M

Step 3: Identify the **column(s)** that contain data associated with the project's **inclusion criteria.**

The project may contain inclusion criteria that limit demographic characteristics for participants. Examples of such inclusion criteria include things like the participant's state or county of residence, age, gender, etc. If the research project did not include participant eligibility criteria, proceed to Step 4 below.

If the project contains inclusion criteria, locate the column(s) that contain the survey question(s) that contains the data associated with your inclusion criteria. Student projects may include more than one inclusion criterion. Once located, highlight (in yellow) the column that contains the data for the inclusion criteria.

Video Resource – Highlighting Columns in Excel:
https://youtu.be/QHeuG3209Bc?si=6jPnJF1CGqzPjS_M

Step 4: Trim the data file by deleting the **columns** that have not been highlighted in the file (these are the columns that do not contain data related to the research variables).

Video Resource – How to Remove Columns in Excel:
https://youtu.be/8OE4cGj1nk0?si=pHuUX4oLXdE90R_W

Step 5: Trim the data file to remove participants (**rows** of data) that did not answer the survey question that is related to the **independent variable or variable one**.

If students are unfamiliar with the procedure of how to filter data in Excel, show the video resource below. Once students know how to create a filter, they can then proceed to filtering and trimming their data file.

Video Resource: How to Create a Filter in Excel:
https://youtu.be/04_kOwCnyog?si=uKRE6rQEUmOy1opk

Once the filter has been created on the students' Excel files, have them locate the column (now highlighted light green) that contains the survey question that is related to their independent variable or variable one. Click on the filter icon that appears in the cell that contains their independent variable's survey question. In the drop-down box that appears, have students only check the boxes next to the survey options for "Blank" and "Skip", then click the OK button. This will filter the data to only include the participants who either did not answer this survey question (blank) or those who skipped the survey question (skip). Students will then proceed with deleting the rows of data for participants that did not answer this survey question or selected "Skip" as their answer.

Video Resource: How to Delete a Row in Excel:
https://youtu.be/xlwrRrVORKg?si=vmQ_CVBS0QHjHk-L

Once the rows have been deleted that contained data for participants who did not answer or skipped this survey question, they should click back on the filter button located on the top row that contains the survey question for their independent variable. When the filter drop-down box appears, students can check the "Select All" box and click the OK button, which will remove the filter for this column.

Step 6: Trim the data file to remove participants (**rows** of data) that did not answer the survey question that is related to your **dependent variable or variable two**.

Once the filter has been created on the students' Excel files, have them locate the column (now highlighted light blue) that contains the survey question that is related to their dependent variable. Click on the filter icon that appears in cell that contains their dependent variable's survey question. In the drop-down box that appears, have students only check the boxes next to the survey options for "Blank" and "Skip", then click the OK button. This will filter the data to only include the participants who either did not answer this survey question (blank) or those who skipped the survey question (skip). Students will then proceed with deleting the rows of data for participants who did not answer this survey question or selected "Skip" as their answer.

Video Resource: How to Delete a Row in Excel:
https://youtu.be/xlwrRrVORKg?si=vmQ_CVBS0QHjHk-L

Once the rows have been deleted that contained data for participants who did not answer or skipped this survey question, they should click back on the filter button located on the top row that contains the survey question for their independent variable. When the filter drop-down box appears, students can check the "Select All" box and click the OK button, which will remove the filter for this column.

Step 7: Trim your data file to remove participants (**rows** of data) whose demographic characteristics do not match their project's **inclusion criteria**. Note: If the project contains multiple inclusion criteria, the below trimming procedure must be completed separately for each inclusion criterion.

Once the filter has been created on the students' Excel files, have them locate the column (now highlighted yellow) that contains the survey question that is related to their project's inclusion criteria. Click on the filter icon that appears in the cell that contains their project's inclusion criteria survey question. In the drop-down box that appears, have students check the following boxes: the ones next to the survey options that DO NOT MATCH the specific inclusion criteria that must be possessed by each participant; the box for "Blank"; and the box for "Skip". Once these boxes are selected, click the OK button. This will filter the data to only include the participants' responses for those who did not meet the project's inclusion criteria, did not answer this survey question (blank) or those who skipped the survey question (skip). Students will then proceed with deleting these rows from their Excel file.

Video Resource: How to Delete a Row in Excel:
https://youtu.be/xlwrRrVORKg?si=vmQ_CVBS0QHjHk-L

Once the rows have been deleted that contained data for participants who did not answer or skipped this survey question, they should click back on the filter button located on the top row that contains the survey question for their independent variable. When the filter drop-down box appears, students can check the "Select All" box and click the OK button, which will remove the filter for this column.

Repeat Step 7 for each of the project's inclusion criteria.

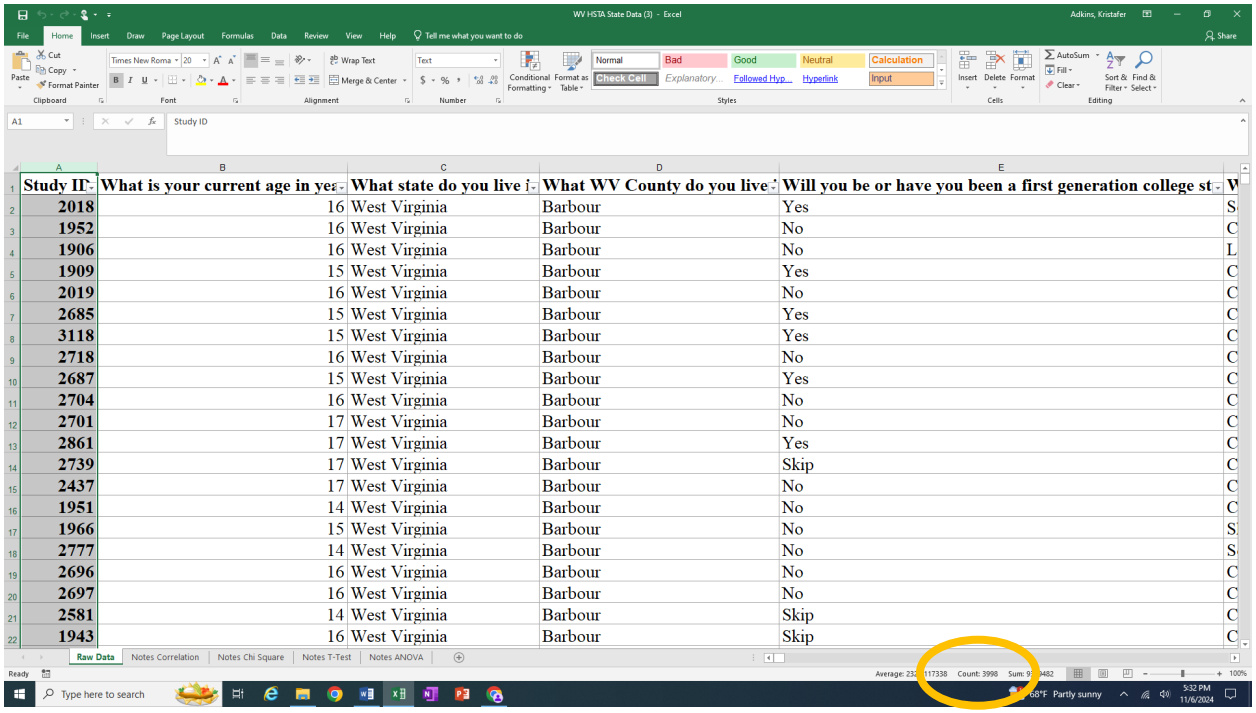
Step 8: Now, students should only have columns of data that are highlighted in light green, light blue, and yellow.

Step 9: Make sure students save the trimmed Excel data file to their computer/folder. Note: Students should name this file something different from the original file name, such as HSTA Survey Data 2025-2026 – Trimmed.

Calculate the Survey Response Total, Completion Total, and Completion Rate

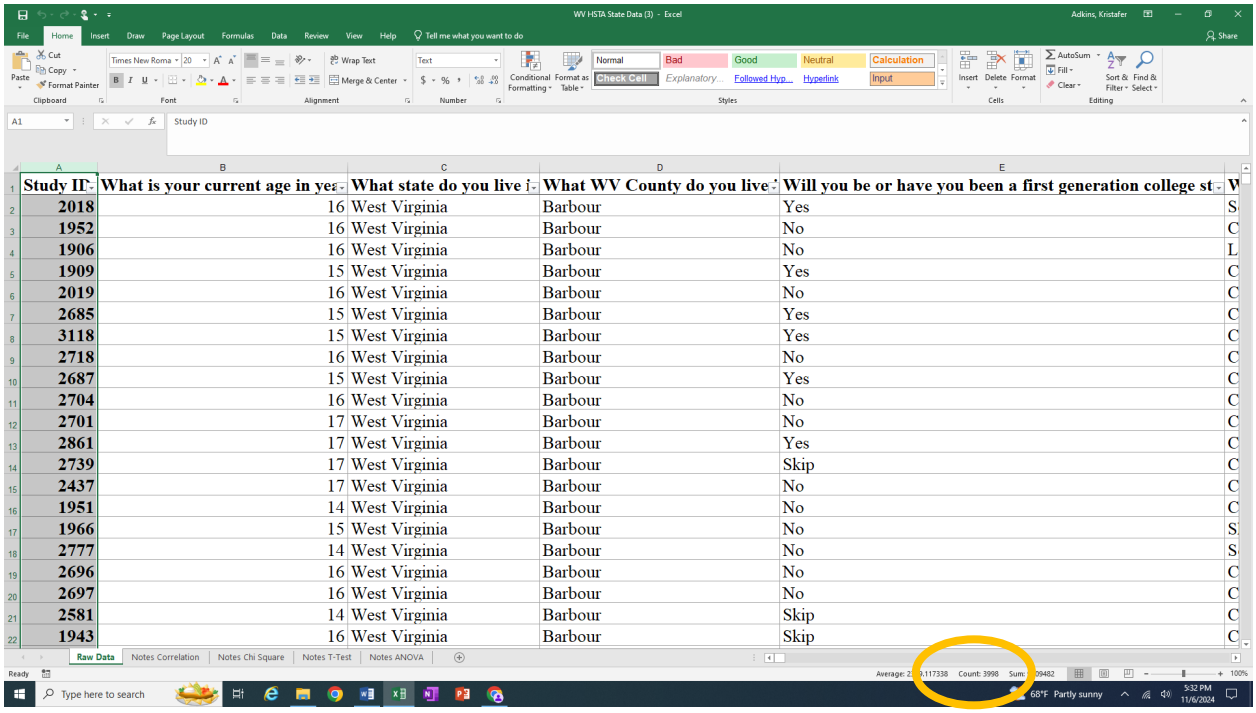
Survey participation is reported by researchers using response totals and response rates. Students will now use their *State Survey Data File* and their *HSTA Survey Data 2025-2026 – Trimmed* data file to determine the response total and response rate for their projects.

To begin, open the *State Survey Data File*. Click on the header for Column A that contains the Study ID to highlight the entire column. Once Column A has been highlighted, look in the bottom right-hand side of the Excel window. Students should see the word "Count:" with a number beside it (circled in the picture below). The number beside the word "Count:" is the number of rows of data that contain data within the highlighted column. **The survey response total will be the number beside the word "Count:" minus 1** (we subtract one because the first row of the Excel file does not contain participant data). Have students write down the survey response total, which will be reported in their presentation slides later. Note: The survey response total will be the same value for each HSTA project.



Study ID	What is your current age in yea	What state do you live i	What WV County do you live	Will you be or have you been a first generation college st	W
2018	16	West Virginia	Barbour	Yes	S
1952	16	West Virginia	Barbour	No	C
1906	16	West Virginia	Barbour	No	L
1909	15	West Virginia	Barbour	Yes	C
2019	16	West Virginia	Barbour	No	C
2685	15	West Virginia	Barbour	Yes	C
3118	15	West Virginia	Barbour	Yes	C
2718	16	West Virginia	Barbour	No	C
2687	15	West Virginia	Barbour	Yes	C
2704	16	West Virginia	Barbour	No	C
2701	17	West Virginia	Barbour	No	C
2861	17	West Virginia	Barbour	Yes	C
2739	17	West Virginia	Barbour	Skip	C
2437	17	West Virginia	Barbour	No	C
1951	14	West Virginia	Barbour	No	C
1966	15	West Virginia	Barbour	No	S
2777	14	West Virginia	Barbour	No	S
2696	16	West Virginia	Barbour	No	C
2697	16	West Virginia	Barbour	No	C
2581	14	West Virginia	Barbour	Skip	C
1943	16	West Virginia	Barbour	Skip	C

Now students will open their *HSTA Survey Data 2025-2026 – Trimmed* file. Click on the header for Column A to highlight the entire column. Once Column A has been highlighted, look in the bottom right-hand side of the Excel window. Students should see the word "Count:" with a number beside it (circled in the picture below). The number beside the word "Count:" is the number of rows of data that contain data within the highlighted column. **The number of surveys completed will be the number beside the word "Count:" minus 1** (we subtract one because the first row of the Excel file does not contain participant data). Have students write down the survey response total, which will be reported in their presentation slides later. Note: The survey completion total will be different for each HSTA project.



Study ID	What is your current age in yea	What state do you live i	What WV County do you live	Will you be or have you been a first generation college st	W
2018	16	West Virginia	Barbour	Yes	S
1952	16	West Virginia	Barbour	No	C
1906	16	West Virginia	Barbour	No	L
1909	15	West Virginia	Barbour	Yes	C
2019	16	West Virginia	Barbour	No	C
2685	15	West Virginia	Barbour	Yes	C
3118	15	West Virginia	Barbour	Yes	C
2718	16	West Virginia	Barbour	No	C
2687	15	West Virginia	Barbour	Yes	C
2704	16	West Virginia	Barbour	No	C
2701	17	West Virginia	Barbour	No	C
2861	17	West Virginia	Barbour	Yes	C
2739	17	West Virginia	Barbour	Skip	C
2437	17	West Virginia	Barbour	No	C
1951	14	West Virginia	Barbour	No	C
1966	15	West Virginia	Barbour	No	S
2777	14	West Virginia	Barbour	No	S
2696	16	West Virginia	Barbour	No	C
2697	16	West Virginia	Barbour	No	C
2581	14	West Virginia	Barbour	Skip	C
1943	16	West Virginia	Barbour	Skip	C

Now that students have determined the survey response total and the survey completion total, they can calculate the survey response rate using the formula below:

(Survey Completion Total/Survey Response Total) x 100 = Survey Response Rate

Students should write down the survey response rate on their results slide. Note: The survey completion total will be different for each HSTA project.

Next club meeting, students will use the trimmed data to learn about descriptive statistics.

Lesson 16: Descriptive Statistics: Measures of Central Tendency

Summary: Students will learn how to calculate measures of the central tendency of a dataset.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Introduce students to descriptive and inferential statistics.
2. Demonstrate how to calculate counts, frequencies, and percentages.
3. Demonstrate how to calculate measures of central tendencies (mean, median, and mode).
4. Apply descriptive statistical techniques to your HSTA research project.

If 11th or 12th graders do not have data to complete measures of central tendency, have them continue to work on their project. If they are waiting on materials, data collection, etc. they can be paired up with a younger group and help them as they find measures of central tendency for HSTA state data.

Underclassmen (9th and 10th graders; 11th and 12th graders partners) need to open their *State Survey Data File* and *HSTA Survey Data 2025-2026 – Trimmed* data files from last club meeting.

Before students start, have everyone watch the following video What Is Statistics: Crash Course Statistics #1. This video will introduce students to the concepts of descriptive and inferential statistics. The calculation of descriptive and inferential statistics requires the use of a dataset. The Statewide Survey Data File is an example of a dataset that HSTA students should be familiar with, whereby each row represents an individual research participant's responses/measurement and each column represents individual research variables. The organization of data in this format enables researchers to easily manipulate and analyze data. For more information on datasets, students can be shown the video What is a Dataset?

Calculating Frequencies

The organization of data into tables enables researchers to generate graphs, whereby data patterns may be recognized. During descriptive statistical analysis, researchers will create frequency distribution tables and frequency graphs, called histograms, to allow them to quickly analyze their data.

Frequency distribution tables are used to summarize how often a give observation is made within a dataset. They are structured to contain a column that indicates the range of values possible for your outcome of interest and the frequencies (*f*) for each observation that was made. Our frequency distribution table would therefore be structured like this:

Video Resource: How to Make an Ungrouped Frequency Table | Math with Mr. J
https://youtu.be/JX9moaEbEv0?si=YOemC-KNY0qXwwEq

Calculating Percentages

When a research study involves counting a number of a given observation, researchers often include percentages within their descriptive statistical summaries. The formula for this calculation is as follows: (part / whole) X 100 = percentage
Note: If the total percentages are added together, they should equal 100%, meaning that you have accounted for all observations in your dataset. Note: If the percentages you report are rounded, their summation may not equal exactly 100%.

Video Resource: Calculating Percentages/How to Find a Percent of a Number | Math with Mr. J
https://www.youtube.com/watch?v=73zfLP2FueY

How to Calculate Measures of Central Tendencies

There are three ways to describe the center of a dataset – mean, median, and mode. The mean of a dataset is the arithmetic average of the values of the entire dataset. The median is the middle value of an ordered dataset. The mode is the most frequently occurring value in a dataset. We will discuss the calculation of each of these measures of central tendency below. Watch this video https://www.youtube.com/watch?v=kn83BA7cRNM introducing the concept of the measures of central tendency.

Calculating the Mean of a Dataset

Video Resource: How to Find the Mean | Math with Mr. J
https://youtu.be/H7u0Zrra060?si=IrSVA45vSZHtAoDw

The mean is the mathematical average of the values included in a dataset. To calculate the mean of a dataset, add together the value of each observation of interest and divide this sum by the total number of observations.

To find the mean in a large dataset in Excel, highlight the column and look at the right. You will see the average.

Calculating the Median of a Dataset

Video Resource: How to Find the Median | Math with Mr. J
https://youtu.be/qglJSIp6n7M?si=JW9gcqTzi0xT-abB

The median is the middle number in an ***ordered*** dataset. When determining the median of a dataset, datapoint must be placed in numeric order from least to greatest. Each datapoint must be included in the ordered list, even if the value is repeated in the dataset. From the ordered dataset, the median can be identified by finding the number that exists in the center of the ordered dataset. When there is an odd number of datapoints included in the dataset, a single datapoint will serve as the median value. When there is an even number of datapoints included in the dataset, the median must be calculated by taking the mean of the two values that straddle the middle of the dataset.

To find the median in a large dataset in Excel, find a blank cell. Type in =MEDIAN(highlight the all the numbers you are looking at or enter the cell range. Then close the paratheses. The number that pops up will be the median.

Calculating the Mode of a Dataset

Video Resource: How to Find the Mode | Math with Mr. J
https://youtu.be/xObCUytIVMo?si=qa96LaSi8myZAa5-

The mode of a dataset is the value that occurs with the highest frequency. Datasets may have no mode (all datapoints in the dataset have the same frequency of occurrence), one mode (a single datapoint whose frequency of occurrence is greater than that of all other datapoints), or more than one mode (multiple datapoints whose share the highest frequency of occurrence that is greater than that of all other datapoints).

The easiest way to determine the mode is to look at the frequency distribution table that you create for the dataset. The value(s) that correspond to the highest frequency of occurrence for the observation of interest will serve as the mode(s) of your dataset.

To find the mode in a large dataset in Excel, find a blank cell. Type in =MODE(highlight the all the numbers you are looking at or enter the cell range. Then close the paratheses. The number that pops up will be the mode.

Apply Descriptive Statistical Techniques to the HSTA Research Project

Note: Some students may still be waiting to complete data collection at this point in the semester. Once these students have obtained their completed datasets, they will need to return to this lesson and complete their descriptive statistics report.

Students should spend the remaining time for this club meeting calculating the descriptive statistics for their research projects.

Descriptive statistics should be included in the final PowerPoint presentation on a slide at the beginning of the "Results" section of the presentation, before any inferential statistics are presented. All tables and figures need a title. The descriptive statistics table and resultant graph should be displayed on the same slide. Note: Additional descriptive statistics (range, standard deviation, and variance) will be covered in Lesson 17.

Descriptive Statistics for Two Quantitative Variables

An example descriptive statistics table is provided below for a project with two quantitative variables.

Table 1: Descriptive Statistics		
	Variable One Name (units of measure)	**Variable Two Name (units of measure)**
Number of Observations		
Mean		
Median		
Mode		
Minimum	*(Completed in Lesson 17)*	*(Completed in Lesson 17)*
Maximum	*(Completed in Lesson 17)*	*(Completed in Lesson 17)*
Range	*(Completed in Lesson 17)*	*(Completed in Lesson 17)*
Standard Deviation	*(Completed in Lesson 17)*	*(Completed in Lesson 17)*
Variance	*(Completed in Lesson 17)*	*(Completed in Lesson 17)*

Descriptive Statistics for One Qualitative Variable and One Quantitative Variable
An example of two descriptive statistics tables is provided below for a project with a qualitative independent variable and a quantitative dependent variable. Note if your independent variable has more than two responses, add another column/row.

Independent Variable	n (number of observations)	Percentage
Response #1		
Response #2		
Total		100%

		Dependent Variable Name (units of measure)							
		Mean	Median	Mode	Minimum	Max	Range	Standard Deviation	Variance
Independent Variable	**Response #1 Name (units of measure)**				*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*
	Response #1 Name (units of measure)				*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*
	Total (all observations)				*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*	*(Discussed in Lesson 17)*

Descriptive Statistics for Two Qualitative Variables

An example of three descriptive statistics tables is provided below for a project with two qualitative variables. Note if your variables have more than two responses, add another column/row.

Variable One	n (number of observations)	Percentage
Response #1		
Response #2		
Total		100%

Variable Two	n (number of observations)	Percentage
Response #1		
Response #2		
Total		100%

Count Table

	Variable One Response #1 =	Variable One Response #2 =	Total
Variable Two Response #1 =			
Variable Two Response #2 =			
Total			

Percentage Table

	Variable One Variable Response #1 =	Variable One Response #2 =	Total
Variable Two Response #1 =	%	%	
Variable Two Response #2 =	%	%	
Total			

Example Dataset with two qualitative variables.

Study ID	Variable One: Gender	Variable Two: Vaping Yes or No
0001	Female	Yes
0002	Female	No
0003	Male	Yes
0004	Female	Yes
0005	Male	No

Box 1: Variable One Response #1 and Variable Two Response #1
Box 2: Variable One Response #1 and Variable Two Response #2
Box 3: Variable One Response #1 and Variable Two Response #1
Box 4: Variable One Response #2 and Variable Two Response #2

	Variable One Response #1 = Female	Variable One Response #2 = Male	Total
Variable Two Response #1 = Yes	*BOX 1 = 2*	*BOX 3 = 1*	*3*
Variable Two Response #2 = No	*BOX 2 = 1*	*BOX 4 = 1*	*2*
Total	*3*	*2*	*5*

Make sure students save their files. They should create a slide in their PowerPoint so they can copy and paste the table(s) they created. Next club meeting, students will go over measures of dispersion.

Lesson 17: Descriptive Statistics: Measures of Dispersion

Summary: Students will learn how to calculate measures of dispersion of a dataset.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Demonstrate how to calculate range, standard deviation, and variance.
2. Apply descriptive statistical techniques to the HSTA research project.

If 11th or 12th graders do not have data to complete measures of dispersion, have them continue to work on their project. If they are waiting on materials, data collection, etc. they can be paired up with a younger group and help them as they find measures of dispersion for HSTA state data.

Underclassmen (9th and 10th graders; 11th and 12th graders partners) make sure count/frequencies and Measures of Central Tendencies (Mean, Median, and Mode) are complete. Next students will determine how to calculate the range, variance, and standard deviation for a dataset.

Watch the video to learn about Measures of Variability (Range, Standard Deviation, Variance)
https://www.youtube.com/watch?v=s7WTQ0H0Acc

Calculating the Range of a Dataset

To calculate the range of a dataset, the dataset must first be placed in numeric order, from least to greatest. Once the dataset is ordered, subtract the lowest (minimum) value in the dataset from the highest (maximum) value in the dataset. The result of this calculation is the range for the dataset.

Note: only quantitative variables will have a range.

Video Resource: Finding the Range | How to Find the Range of a Data Set
https://youtu.be/0HS1P3vhNBU?si=4xxuIWeFEJJgPwCf

Calculating the Variance for a Sample Dataset

The **variance** (s^2) tells how well the mean represents an entire data set. The larger the variance is to the mean, the more range the data set has. In other words, if there is a large variance, one could say the mean does not reflect the data set.

Watch the video on Variance to learn more.

To fine the variance, s^2, we will square the standard deviation.

Before moving on, watch the video How To Calculate The Sample Variance | Introduction to Statistics, which will explain what variance is and why it is calculated for a dataset.

Note: only quantitative variables will have a variance.

The variance for a sample dataset can easily be completed by hand for small datasets. However, it would be tedious to attempt to do so for large datasets like we see with the HSTA State Survey Data. When working with large datasets, one can use Excel to easily calculate the variance of the dataset.

Now watch this video, How to find sample variance in excel in under 2 minutes!, which demonstrates how to calculate sample variance using Excel.

Calculating the Standard Deviation for a Sample Dataset

The **standard deviation** (s or SD) is the average amount of variation or dispersion among the data. Standard deviation tells us, on average, how far each data value is from the mean. The bigger the standard deviation is the more spread out the data set.

Watch the following video to learn more about Standard Deviation.

As always, one can find the standard deviation in excel. Watch the video about Standard Deviation in Excel to learn how to find the standard deviation in excel.

Note: only quantitative variables will have a standard deviation.

The standard deviation of a sample dataset cannot be calculated without knowing the variance of the sample dataset. The standard deviation of a given dataset is calculated by taking the square root of the variance of the same sample dataset.

Percent Change
Use percent change to find the difference between the starting value and the final value. The percent change formula is:

$$\text{Percentage Change} = \frac{\Delta V}{|V_1|} \times 100$$

$$= \frac{(V_2 - V_1)}{|V_1|} \times 100$$

V_1 = Starting Value
V_2 = Final Value
If the result is positive, it is an increase.
If the result is negative, it is a decrease.

Apply Descriptive Statistical Techniques to the HSTA Research Project

Note: Some students may still be waiting to complete data collection at this point in the semester. Once these students have obtained their completed datasets, they will need to return to this lesson and complete their descriptive statistics report.

Students should spend the remaining time for this club meeting calculating the descriptive statistics for their individual research projects.

Descriptive statistics should be included in the final PowerPoint presentation on a slide at the beginning of the "Results" section of the presentation, before any inferential statistics are presented. All tables and figures need a title. The descriptive statistics table and resultant graph should be displayed on the same slide.

Descriptive Statistics for Two Quantitative Variables

An example descriptive statistics table is provided below for a project with two quantitative variables.

Table 1: Descriptive Statistics		
	Variable One Name (units of measure)	**Variable Two Name (units of measure)**
Number of Observations	*(Completed in Lesson 16)*	*(Completed in Lesson 16)*
Mean	*(Completed in Lesson 16)*	*(Completed in Lesson 16)*
Median	*(Completed in Lesson 16)*	*(Completed in Lesson 16)*
Mode	*(Completed in Lesson 16)*	*(Completed in Lesson 16)*
Minimum		
Maximum		
Range		
Standard Deviation		
Variance		

Descriptive Statistics for One Qualitative Variable and One Quantitative
An example of two descriptive statistics table are provided below for a project with a qualitative independent variable and a quantitative dependent variable. Note if your independent variable has more than two responses, add another column/row.

		Dependent Variable Name (units of measure)							
		Mean	Median	Mode	Minimum	Max	Range	Standard Deviation	Variance
Independent Variable	**Response #1 Name (units of measure)**	*(Completed in Lesson 16)*	*(Completed in Lesson 16)*	*(Completed in Lesson 16)*					
	Response #1 Name (units of measure)	*(Completed in Lesson 16)*	*(Completed in Lesson 16)*	*(Completed in Lesson 16)*					
	Total (all observations)	*(Completed in Lesson 16)*	*(Completed in Lesson 16)*	*(Completed in Lesson 16)*					

If you are working with pre/post data, complete Percent of Change.

Descriptive Statistics for Two Qualitative Variables
An example of three descriptive statistics tables is provided below for a project two qualitative variables. Note if your variables have more than two responses, add another column/row.

Note: Minimum, maximum, range, standard deviation, and variance **cannot** be calculated for qualitative variables.

Make sure students save their files. They should create a slide in their PowerPoint so they can copy and paste the table(s) they created.

Next club meeting, students will go over graphing.

Lesson 18: Graphing Data

Summary: Students will learn how to graph data.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Demonstrate how to graph data.
2. Graph data for HSTA research project.
3. Complete HOA #10.

If 11th or 12th graders do not have data to graph, have them continue to work on their project. If they are waiting on materials, data collection, etc. they can be paired up with a younger group and help them graph HSTA state data.

HOA #10: Graphing

For this HOA, have students do a lab that allows them to practice graphing.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Underclassmen (9th and 10th graders; 11th and 12th graders partners) make sure your Measures of dispersion (Range, Standard Deviation, and Variance) are complete before students move onto graphing.

How to Graph Data

The best advice that a statistician can give a young researcher is to always graph data. The visual presentation of the data will give a better understanding of the relationships between variables and/or groups compared to a data table. The type of graph that one will use to display data is controlled by the type of variables that are used in the research study. Have students read over the chart below to discover what type of graph they should complete based on their research variables.

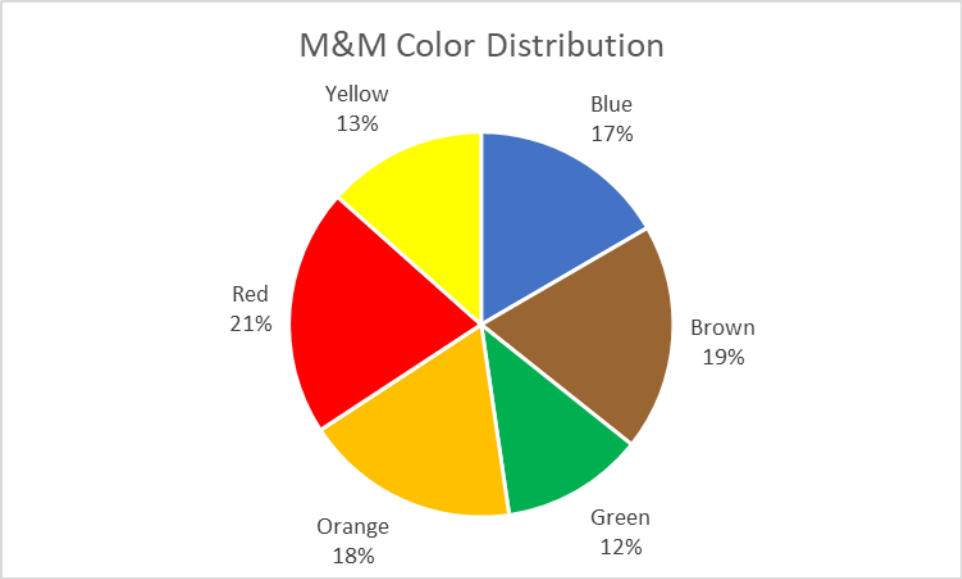
Independent Variable or Variable One is ____ and it is *qualitative or quantitative*. (Circle One)

Dependent Variable or Variable Two is ____ and it is *qualitative or quantitative*. (Circle One)

	Dependent Variable or Variable Two is *qualitative*	**Dependent Variable or Variable Two is** *quantitative*
Independent Variable or Variable One is *qualitative*	Data should be displayed using a **pie chart**. *Students will evaluate the relationship with a **chi-square**.*	Data should be displayed using a **bar graph**. *Students will evaluate the difference with a **t-test** (two groups) or **ANOVA** (three or more groups).*
Independent Variable or Variable One is *quantitative*		Data should be displayed using a **scatterplot** or **line graph**. *Students will evaluate the relationship with a **correlation**.*

Continue reading the next few pages and find the directions for completing each graph. NOTE: This is in no way a comprehensive list of charts and graphs. There are others that may be used to describe statistics. Make sure to tell students **it is important they select the one that is appropriate for their data set(s).**

Pie Chart

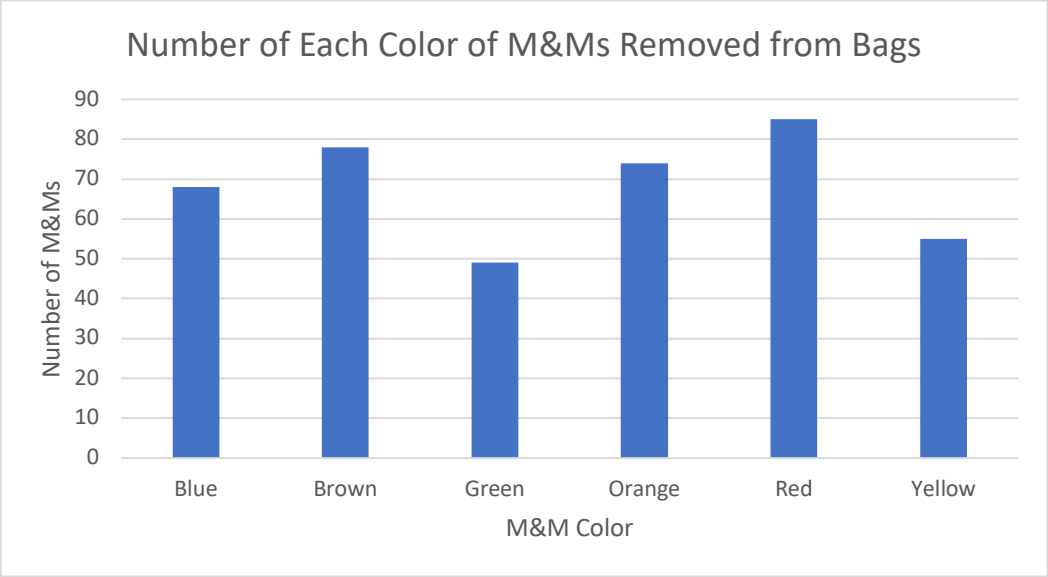


Pie charts are best suited when the researcher wishes to graphically represent ***percentage data*** for ***qualitative variables*** (variables whose measurements contain text as opposed to numbers). Commonly used nominal or categorical variables in HSTA projects include gender (male/female), high school class level (freshman/sophomore/junior/senior), and whether or not a research participant meets a given study inclusion criteria (yes/no).

Watch this video to learn How to Make a Pie Chart in Excel.

Important characteristics of a pie chart that should always be present include: 1) a name for the pie chart that clearly describes the data being represented, 2) a key/legend identifying the nominal or categorical variable each slice of the pie represents (if you are not individually labeling your pie slices), and the valuation (percentage) that each slice of the pie represents. Note: When using a pie chart, the sum of all of the percentages must equal 100%.

Bar Graph

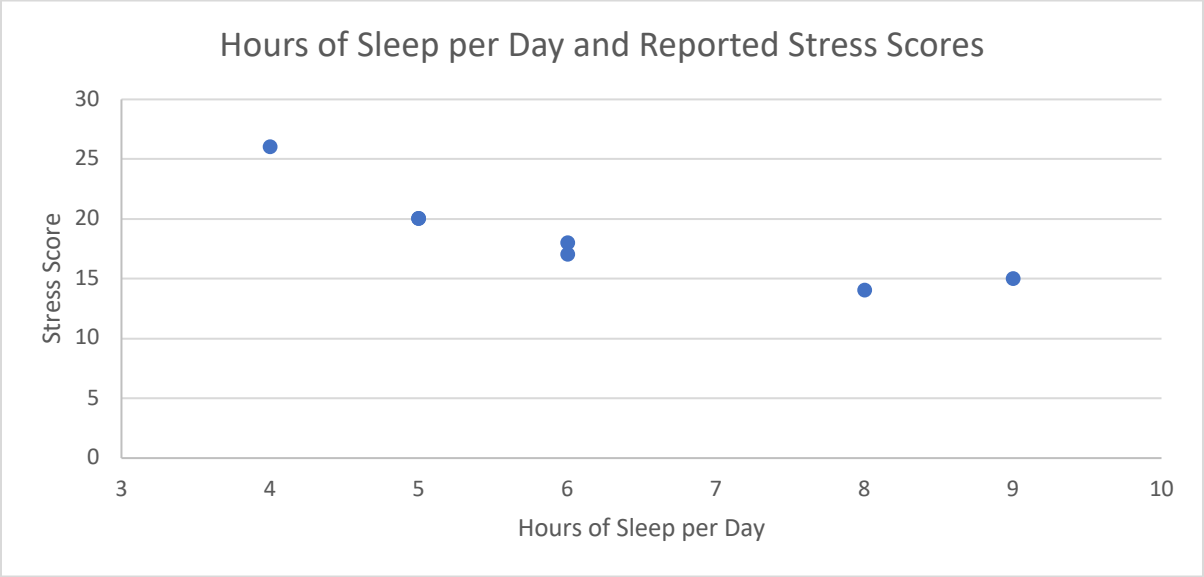


Bar graphs are best suited when the researcher wishes to graphically represent ***count data or data representing the mean of a dataset*** for ***qualitative variables*** (variables whose measurements contain text as opposed to numbers). Commonly used nominal or categorical variables in HSTA projects include gender (male/female), high school class level (freshman/sophomore/junior/senior), whether or not a research participant meets a given study inclusion criteria (yes/no), and counties of residence (Monongalia/Kanawha/McDowell/Berkeley).

Have students watch this video to learn How to Make a Bar Graph in Excel.

Important characteristics of a bar graph that should always be present include: 1) a name for the bar graph that clearly describes the data being represented, 2) a label for the x-axis (indicating the independent variable values), 3) a label for the y-axis (indicating the values possible for the dependent variable, in this case, counts), and 4) a key/legend if the independent variable contains sub-groups (i.e. diabetic males, diabetic females, non-diabetic males, non-diabetic females), such as would be the case for data that will be analyzed using either an ANOVA or a Chi-square test. Note: Provided that the x-axis is properly labeled with the independent variable names, a key/legend would not be necessary to be included when sub-groups are not being compared (i.e. studies that will be using a t-test to two compare groups). Note: When bar graphs are used to display mean values for the dependent variable of the dataset, individual data bars may also include either an error bar or standard deviation bar. See this video, Creating a Bar Graph with SD Error Bars in Excel, for more information on adding standard deviation bars to your bar graphs, if needed. One adjustment to what this video recommends – specify both the positive and the negative values of the standard deviation bars when prompted and leave the direction as "both".

Scatter Plot Graph

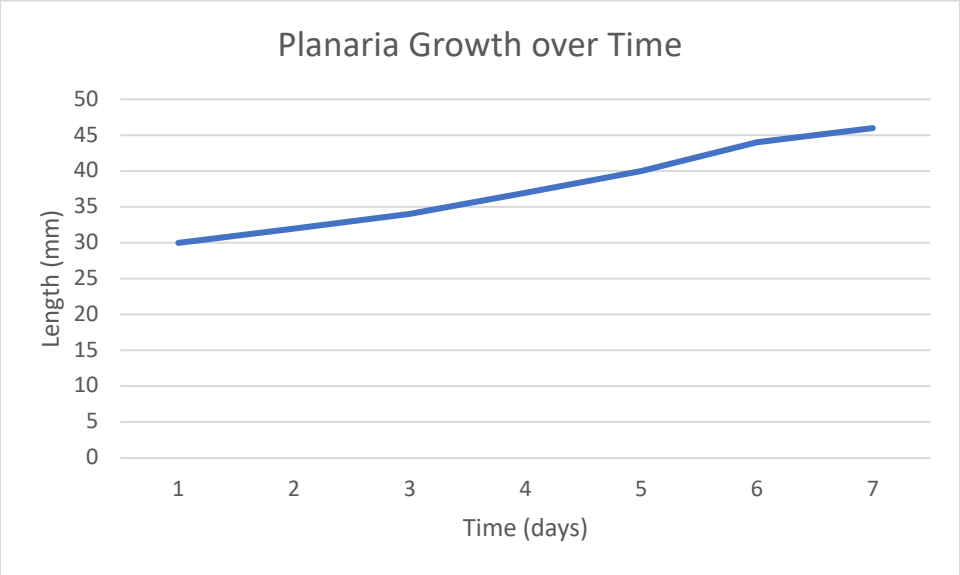


Scatter plot graphs are best suited when the researcher wishes to graphically represent ***quantity data*** for ***quantitative variables***. Scatter plot graphs are most appropriate when displaying data for correlational studies. Commonly used interval/ratio variables in HSTA projects include stress scores, hours per day participants sleep, screen time, and mental health ratings.

Have students watch this video, How to Make a Scatter Plot in Excel.

Important characteristics of a scatter plot graph that should always be present include: 1) a name for the scatter plot graph that clearly describes the data being represented, 2) a label for the x-axis (indicating the values for variable one), and 3) a label for the y-axis (indicating the values for variable two). Note: When using a scatter plot graph, data points are not connected to one another by a continuous line.

Line Graph



Line graphs are best suited when the researcher wishes to graphically represent quantity data for quantitative variables (variables whose measurements are numerical). Line graphs are most appropriate when displaying data that is presented as a part of a time series (changes in a variable over time).

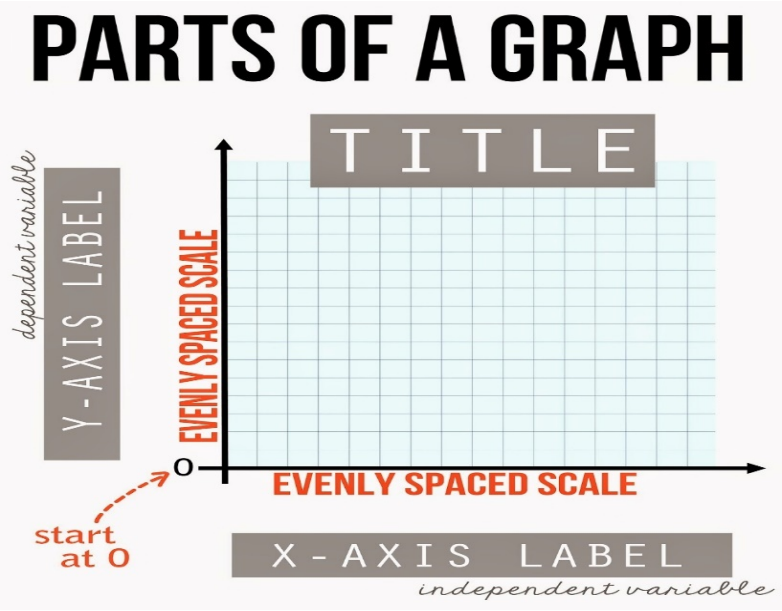
Have students watch this video to learn How to Make a Line Graph in Excel (Quick and Easy).

Important characteristics of a line graph that should always be present include: 1) a name for the line graph that clearly describes the data being represented, 2) a label for the x-axis (indicating the independent variable values), and 3) a label for the y-axis (indicating the values possible for the dependent variable). Note: Data points on a line graph are connected by a continuous line.

Create a Graph of your Descriptive Statistics for HSTA Research Project

Students should spend the remaining time for this club meeting creating a graphical summary of your data to include on your presentation slides. Make sure students have identified the appropriate type of graph for displaying the type(s) of data they wish to display.

The image below is a basic review of how to label a graph.



Make sure students save their files. They should create a slide in their PowerPoint so they can copy and paste the graphs/tables(s) they created.

Next club meeting, students will go over p-values and hypothesis testing with t-test and ANOVA.

Lesson 19: Probability (p-values) and hypothesis testing with t-test and ANOVA

Summary: Students will be introduced to the concept of p-values and learn to conduct and interpret a t-test and an ANOVA.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Introduce students to the concept of probability.
2. Introduce students to the concept of hypothesis testing.
3. Demonstrate how to conduct a t-test.
4. Demonstrate how to conduct an ANOVA.
5. Complete an activity reviewing scientific notation HOA #11
6. Conduct the t-test or ANOVA on your HSTA project data (if applicable).

If 11^{th} or 12^{th} graders should be close to completing their data collection. If they do not have data to complete hypothesis testing, have them continue to work on their project. If they are waiting on materials, data collection, etc. they can be paired up with a younger group and help them as they complete hypothesis testing for HSTA state data.

HOA #11 STEM: Exponential Notation/ Scientific Notation

To access HOA #11 supporting documents visit https://health.wvu.edu/hsta/resources/teachers/

This HOA is about exponents. Why do we care about exponents? To answer research questions, we will conduct inferential statistics. The result of the inferential statistics will give us a p-value. This p-value (discussed later in the lesson) may be presented in scientific notation. It is your task to understand this number and determine what it means. Before we discuss p-values, we will review how to read and write numbers in scientific notation.

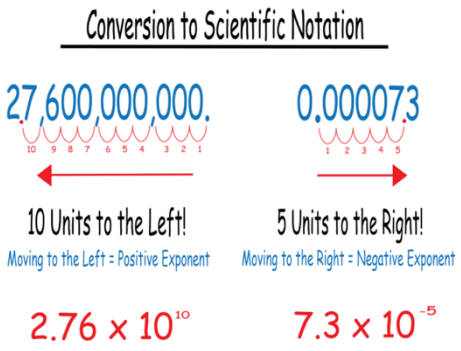
Review Notes:

- Exponential notation is an alternative method of expressing numbers.
- Exponential numbers take the form a^n, where a is multiplied by itself n times.
  - a^n
    - where a is the base and ^{n} is the power or exponent.
  - Example is $3^4=3\times3\times3\times3=81$.
- Scientific notation is a specific example of exponential numbers, 10 is almost always used as the base number.
  - 10^3 means $10\times10\times10$, while
  - 10^{-3} means the notation for the reciprocal of 10^3 namely 1/1000.

- Expressing numbers that are not whole powers of 10 in scientific notation often requires a further multiplier, termed the **coefficient** (C), giving the expression in the form $C \times 10^n$. Where C is between 1 and 10 and followed by an appropriate power of 10.
    - **Examples**

Standard	Scientific Notation
0.0035	3.5×10^{-3}
3.5	3.5×10^{0}
35,000	3.5×10^{4}
-35,000	-3.5×10^{4}
-0.000035	-3.5×10^{-5}

- To convert numbers into scientific notation you will move the decimal point so that the first number if greater than or equal to 1 but less than 10.



- You should use such scientific notation whenever you express very large or very small numbers - it is a recognized form of "shorthand", and it avoids spurious accuracy e.g. writing 9 000 000 suggests that the number is exactly 9 million, in contrast to 9.0×10^6 which suggests no such accuracy beyond the first decimal place of the coefficient.

Let's play a game of Kahoot! to practice reading scientific notation.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Probability and Hypothesis Testing

Underclassmen (9th and 10th graders; 11th and 12th graders partners) make sure graphs are complete. Next students will determine how to calculate the range, variance, and standard deviation for a dataset. To begin, we will watch the following video, Math Antics - Basic Probability, which introduces us to the basic concepts of probability.

When conducting research, two hypotheses are generated that predict the answer to the research question:

1. Null hypothesis (H_0)
    a. This is a statement of no difference in the dependent variable and the independent variable.
2. Alternative hypothesis (H_1 or H_a):
    a. This is a statement of the existence of a difference in the values of the dependent variable and the independent variable.

Only one of the two possible hypotheses can be correct concerning the predicted outcomes of a research study. Inferential statistical tests are used to help us determine which hypothesis is correct. Hypothesis testing uses inferential statistical tests, such as the t-test, an ANOVA test, and the Chi-square test, to measure the probability (*p*) of the ***NULL HYPOTHESIS BEING TRUE***. Researchers use the p-value obtained from an inferential statistical test to determine whether or not a statistically significant difference exists in the values of the dependent variable between research groups. The p-value that corresponds to whether or not a level of significance is achieved is set by the researcher; however, the gold standard is to use a p-value of 0.05 when determining statistical significance. HSTA students should use a p-value of 0.05 as their predetermined statistical significance level. When reporting the p-value that is produced by your selected hypothesis test, only report the p-value rounded to a maximum of 3 decimal places.

1. When the p-value is less than 0.05:
    a. Researchers ***REJECT*** the null hypothesis (H_0) (the statement that no difference exists is false)
    b. Researchers ***ACCEPT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
    c. Researchers state that there is a statistically significant difference in the dependent variable values between independent variable values because there is less than a 5% chance that the null hypothesis is true.
2. When the p-value is greater than or equal to 0.05
    a. Researchers ***ACCEPT*** the null hypothesis (H_0) (the statement that no difference exists is false)
    b. Researchers ***REJECT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
    c. Researchers state that there is not a statistically significant difference in the dependent variable values between independent variable values because there is a 5% chance or greater that the null hypothesis is true.

Selection of the Inferential Statistical Test for Testing Null Hypothesis

The type of inferential statistical test students will use to determine the probability that the null hypothesis is true will depend on the types of variables used in your study. Identify the types of variables you have selected for your independent variable (*qualitative or quantitative*) and dependent variable (*qualitative or quantitative*). Using the table below, find the intersection of the types of variables that students have selected for their research variables to determine which inferential statistical test they should use to test their null hypothesis.

Independent Variable or Variable One is ____ and it is *qualitative or quantitative*. (Circle One)

Dependent Variable or Variable Two is ____ and it is *qualitative or quantitative*. (Circle One)

On the following pages, read over the directions to conduct a t-test or ANOVA.

If the test is a chi-square or correlation, we will discuss both tests at the next club meeting.

It is suggested HSTA Teachers take an example research question or a group research question and do a t-test and ANOVA with the club. Everyone can follow along on their computers and practice each test.

	Dependent Variable or Variable Two is *qualitative*	**Dependent Variable or Variable Two is** *quantitative*
Independent Variable or Variable One is *qualitative*	*Students will evaluate the relationship with a* ***chi-square****.*	*Students will evaluate the difference with a* ***t-test*** *(two groups) or* ***ANOVA*** *(three or more groups).*
Independent Variable or Variable One is *quantitative*		*Students will evaluate the relationship with a* ***correlation****.*

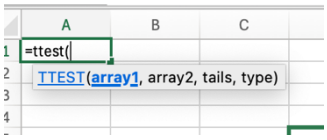
How to Conduct a T-Test

The t-test is the appropriate inferential statistical test for use in testing a null hypothesis when a researcher wishes to compare numerical dependent variable data across two groups from single independent variable that contains categorical data. The t-test can easily be performed in Microsoft Excel or in Google Sheets using the TTEST function. This video, How To Perform T-Tests In Microsoft Excel, demonstrates how to run a t-test in Microsoft Excel and Google Sheets.

General directions follow as:

IV-1	IV-2
DV	DV
DV	DV

1. Open Excel
2. Create a chart like the below labeling column one as independent variable response 1 and the second column as dependent variable response 2. Then list all the dependent variable values under the correct independent variable response column.
3. Click on a blank cell where you want to have the t-test appear.
4. Click on 'Formulas', 'More Functions,' 'Statistical,' and then 'TTest' or type in =ttest(



5. You will see the formula below populate in the cell.
6. For 'Array 1' highlight the first column of the numbers
7. For 'Array 2' highlight the second column of the numbers
8. For 'Tails'
    - Type in 2 (You will almost always be doing a two-tailed test, meaning your data goes in two directions - higher or lower, as opposed to one direction)
9. For 'Type'
    - Choose "1" (paired t-test) if you are comparing a pre and post-measurement taken on the same group
    - Choose "2" if you are comparing one measurement taken on two different groups
    - Choose "3" if you have unpaired, unequal variance
10. Hit enter and the number that appears in the cell will be your p-value for the t-test.

When the p-value is less than 0.05:

- Researchers ***REJECT*** the null hypothesis (H_0) (the statement that no difference exists is false)
- Researchers ***ACCEPT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
- Researchers state that there is a statistically significant difference in the dependent variable values between independent variable values because there is less than a 5% chance that the null hypothesis is true.

When the p-value is greater than or equal to 0.05

- Researchers ***ACCEPT*** the null hypothesis (H_0) (the statement that no difference exists is false)
- Researchers ***REJECT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
- Researchers state that there is not a statistically significant difference in the dependent variable values between independent variable values because there is a 5% chance or greater that the null hypothesis is true.

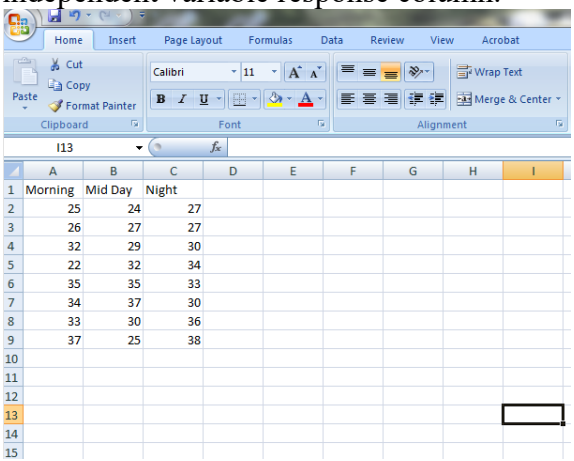
How to Conduct an ANOVA

The ANOVA test is the appropriate inferential statistical test for use in testing a null hypothesis when a researcher wishes to compare numerical dependent variable data across three or more groups from single independent variable that contains categorical data. The ANOVA test can easily be performed in Microsoft Excel using the Data Analysis add-in. This video, How To Perform A One-Way ANOVA Test In Excel, demonstrates how to install the Data Analysis add-in for Microsoft Excel and how to use it to run an ANOVA test. If you do not have access to Microsoft Excel, we recommend that you use an online ANOVA calculator, such as the one available at http://vassarstats.net/anova1u.html.

Regardless of the means by which an ANOVA test is conducted, the results will always be communicated through an ANOVA table, which will contain the F-statistic, the degrees of freedom, and the p-value. It is important to note that if $p<0.05$, this only indicates that there is a difference in the mean values of the dependent variable across the independent variable groups. The p-value that is produced as a result of an ANOVA test does not specify for which groups the mean dependent variable values are significantly different – this would require post hoc statistical testing, which will not be covered here. When a student obtains an ANOVA test result with $p<0.05$, they are asked to interpret this as meaning that a significant difference does exist for the dependent variable values across the independent variable groups.

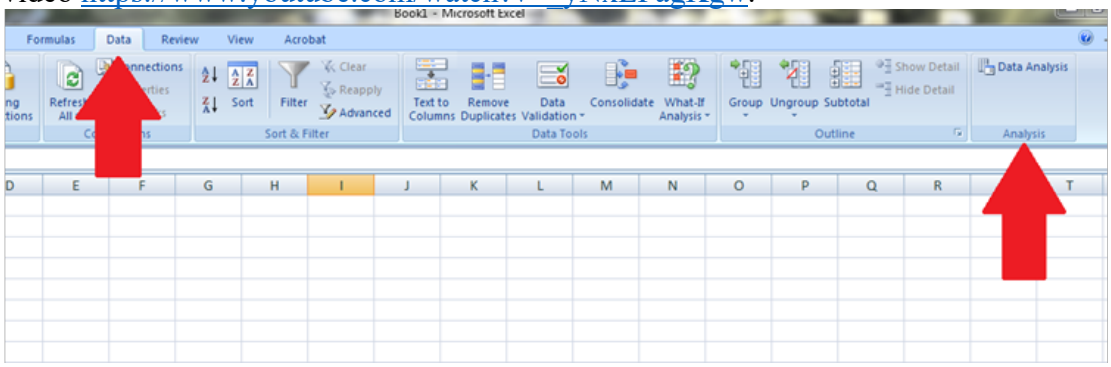
General directions follow as:
1. Open Excel.

2. Enter Data. Create a chart like the below labeling column one as independent variable response 1, the second column as dependent variable response 2, and the third column as dependent variable response 2. Then list all the dependent variable values under the correct independent variable response column.

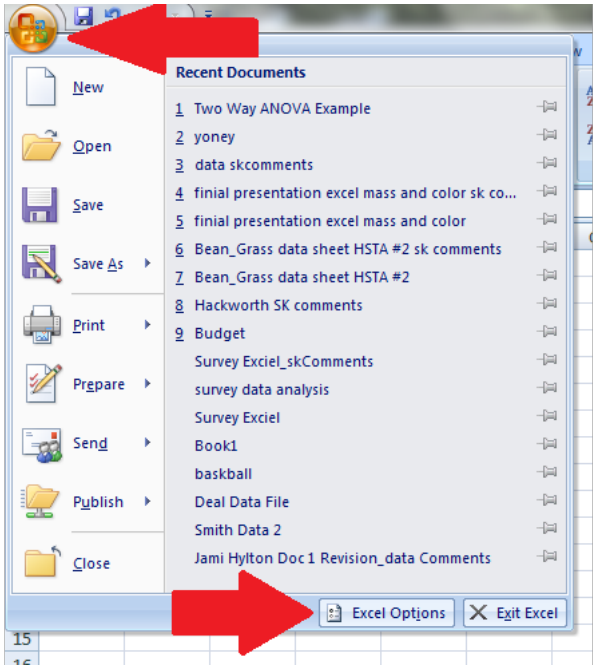


	A	B	C	D	E	F	G	H	I
1	Morning	Mid Day	Night						
2	25	24	27						
3	26	27	27						
4	32	29	30						
5	22	32	34						
6	35	35	33						
7	34	37	30						
8	33	30	36						
9	37	25	38						
10									
11									
12									
13									
14									
15									

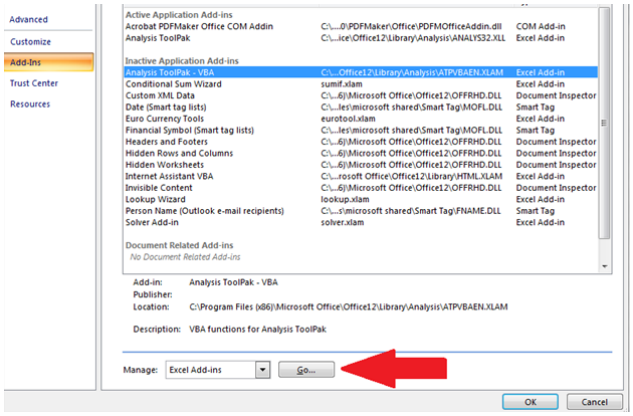
3. Looking at the top ribbon on excel, click on Data . Look at the right side of the screen - Is there a Data Analysis icon? If yes, skip to step 9. If no, continue to step 4 for Excel or watch this video https://www.youtube.com/watch?v=_yNxLFagKgw.



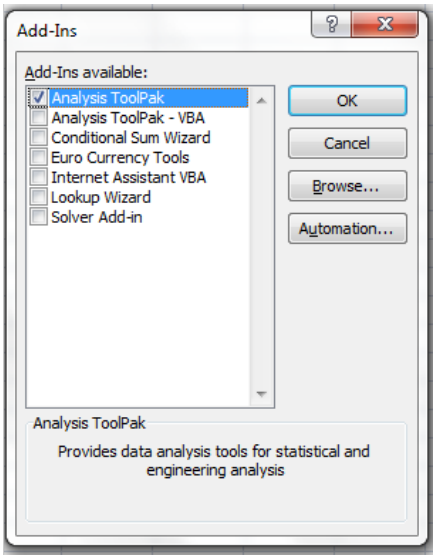
4. If not, click on the Start Button and then Excel Options.



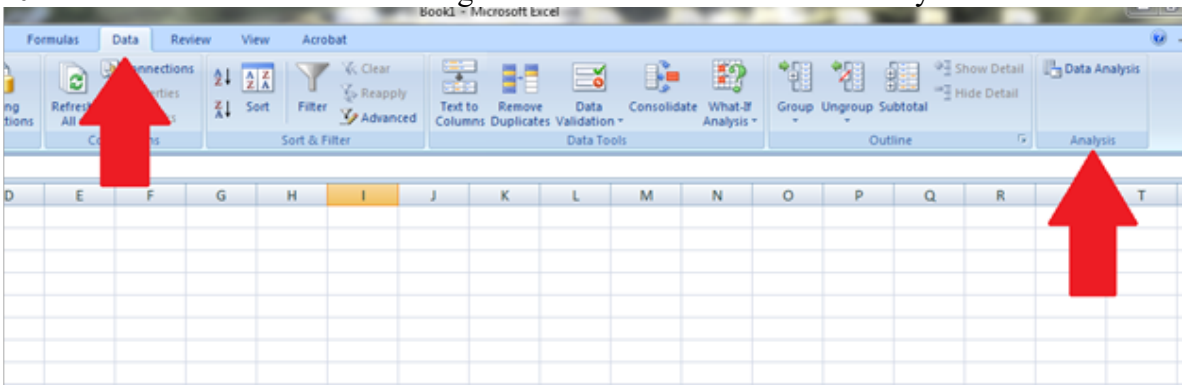
6. Click Add Ons
7. Click on Analysis ToolPak
8. Click on Go



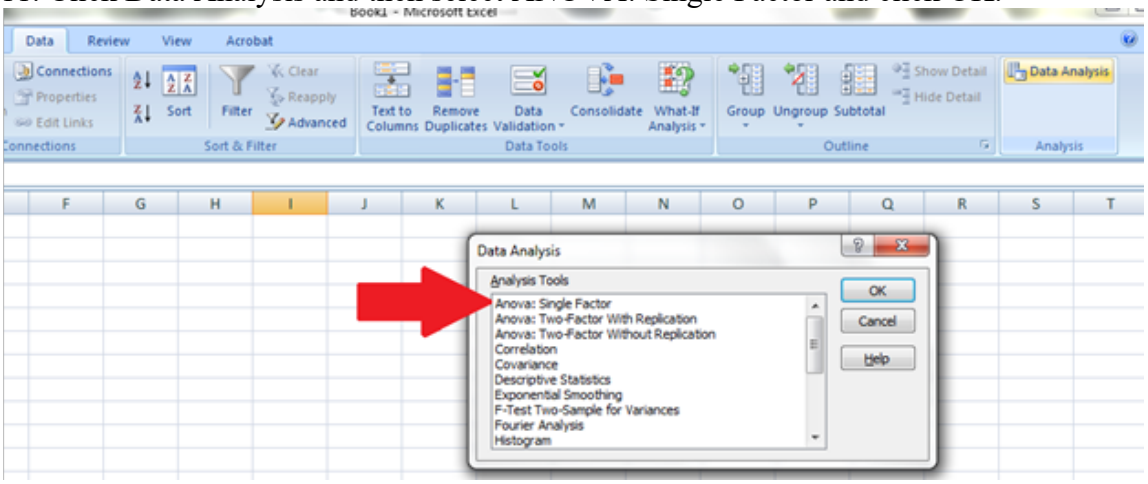
9. Make sure the Analysis TookPak is selected and click ok.



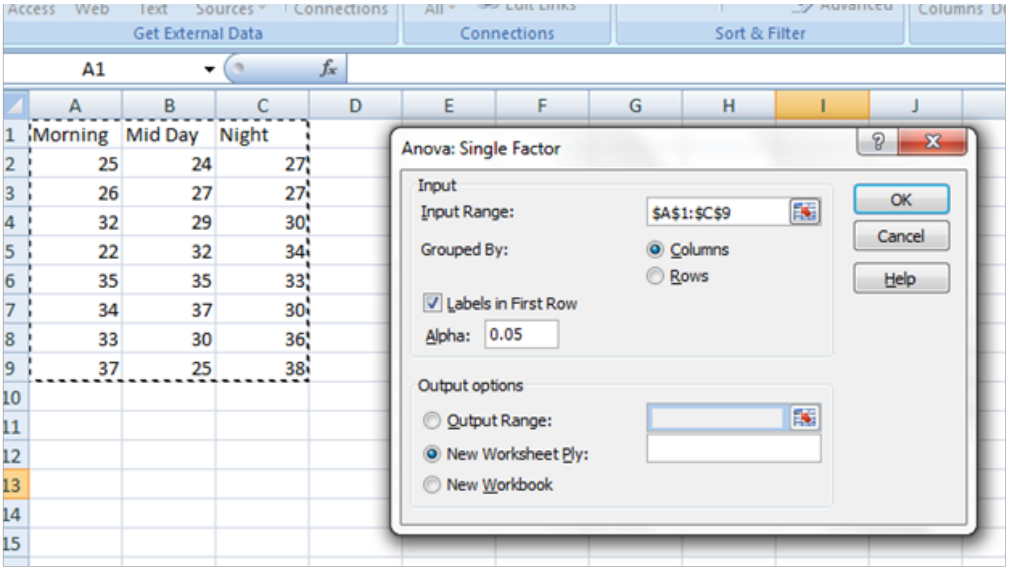
10. Now click on Data and on the right side of the screen the Data Analysis icon will be there.



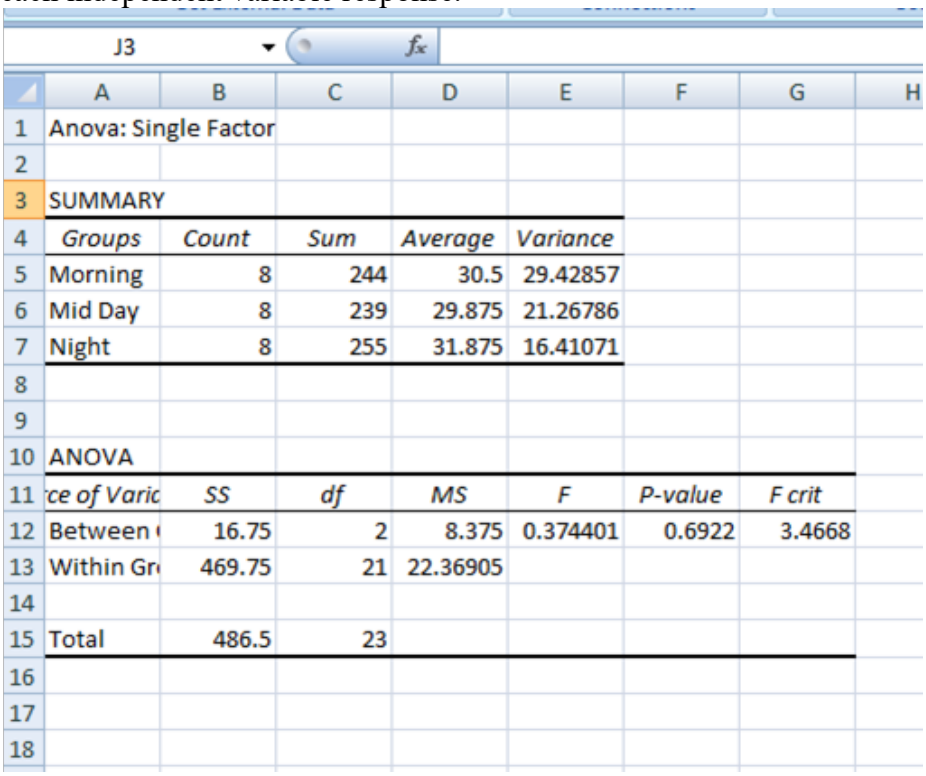
11. Click Data Analysis and then select ANOVA: Single Factor and click OK.



12. Once the ANOVA: Single Factor box pops up
    - Highlight all columns including the labels.
    - Click Labels in First Row.
    - Under Output options, you can click Output Range (then highlight a blank space on your Excel page) or New Worksheet Ply (this will place your ANOVA table on another tab within your Excel file).
    - Click Ok.



13. An ANOVA chart will appear. This table will give you the sum, average, and variance for each independent variable response.



	A	B	C	D	E	F	G
1	Anova: Single Factor						
2							
3	SUMMARY						
4	*Groups*	*Count*	*Sum*	*Average*	*Variance*		
5	Morning	8	244	30.5	29.42857		
6	Mid Day	8	239	29.875	21.26786		
7	Night	8	255	31.875	16.41071		
8							
9							
10	ANOVA						
11	*ce of Varic*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
12	Between	16.75	2	8.375	0.374401	0.6922	3.4668
13	Within Gr	469.75	21	22.36905			
14							
15	Total	486.5	23				
16							
17							
18							

14. Now look at the p-value
When the p-value is less than 0.05:

a. Researchers ***REJECT*** the null hypothesis (H_0) (the statement that no difference exists is false)
b. Researchers ***ACCEPT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
c. Researchers state that there is a statistically significant difference in the dependent variable values between independent variable values because there is less than a 5% chance that the null hypothesis is true.

When the p-value is greater than or equal to 0.05

a. Researchers ***ACCEPT*** the null hypothesis (H_0) (the statement that no difference exists is false)
b. Researchers ***REJECT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
c. Researchers state that there is not a statistically significant difference in the dependent variable values between independent variable values because there is a 5% chance or greater that the null hypothesis is true.

15. Now look at F and compare it to F Crit. If F is larger than F Crit you have a significant difference.

16. Remember this test just tells you there is a difference, not where the difference is.

Note: For Google Sheets click here to download XLMiner Analysis Toolpak.
https://workspace.google.com/marketplace/app/xlminer_analysis_toolpak/600284989882

Here is a YouTube video about the ToolPak in Google Sheets
https://www.youtube.com/watch?v=wW7D1rSxbds and
https://www.youtube.com/watch?v=JHXsKwcRdRw.

Apply t-test or ANOVA to HSTA Research Project (if applicable)

If a t-test or ANOVA is applicable to student's data, complete the test now. Students should be able to communicate with their HSTA teacher if the results of their t-test/ANOVA indicate the presence of a statistically significant difference and they are rejecting or accepting their null hypothesis.

Scoring Rubric for Data Analysis – 4 points

1. Data analysis included a statistical test used to test the hypotheses.
2. Data analysis included an explanation of why the statistical test was used.
3. Data analysis included a p-value.
4. Data analysis included an explanation of the statistical significance of the statistical test.

The following format is provided for the PowerPoint slide:

- The statistical test used:
- Why was the statistical test used:
- p-value =
- The interpretation of the p-value was ____. {***Pick A or B based on your p-value. You need to have all three bullet points under the p-value.***}

    - When the p-value is less than 0.05:
        - Researchers ***REJECT*** the null hypothesis (H_0) (the statement that no difference exists is false)
        - Researchers ***ACCEPT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
        - Researchers state that there is a statistically significant difference in the dependent variable values between independent variable values because there is less than a 5% chance that the null hypothesis is true.

    OR

    - When the p-value is greater than or equal to 0.05
        - Researchers ***ACCEPT*** the null hypothesis (H_0) (the statement that no difference exists is false)
        - Researchers ***REJECT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
        - Researchers state that there is not a statistically significant difference in the dependent variable values between independent variable values because there is a 5% chance or greater that the null hypothesis is true.

Make sure students save their files. They should create a slide in their PowerPoint so they can copy and paste the information they created.

Next club meeting, students will go over p-values and hypothesis testing with chi-square and correlation.

Lesson 20: Hypothesis Testing with Chi-square and Correlation

Summary: Students will learn how to conduct and interpret chi-square and correlation tests.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Demonstrate how to conduct a chi-square and correlation test.
2. Conduct a chi-square or correlation test on HSTA project data (if applicable).

If 11th or 12th graders should be close to completing their data collection. If they do not have data to complete hypothesis testing, have them continue to work on their project. If they are waiting on materials, data collection, etc. they can be paired up with a younger group and help them as they complete hypothesis testing for HSTA state data.

Selection of the Inferential Statistical Test for Testing Null Hypothesis

The type of inferential statistical test students will use to determine the probability that the null hypothesis is true will depend on the types of variables used in your study. Identify the types of variables you have selected for your independent variable (*qualitative or quantitative*) and dependent variable (*qualitative or quantitative*). Using the table below, find the intersection of the types of variables that students have selected for their research variables to determine which inferential statistical test they should use to test their null hypothesis.

Independent Variable or Variable One is ____ and it is *qualitative or quantitative*. (Circle One)

Dependent Variable or Variable Two is ____ and it is *qualitative or quantitative*. (Circle One)

On the following pages, read over the directions to conduct chi-square or correlation.

It is suggested HSTA Teachers take an example research question or a group research question and do a chi-square or correlation with the club. Everyone can follow along on their computers and practice each test.

	Dependent Variable or Variable Two is *qualitative*	**Dependent Variable or Variable Two is** *quantitative*
Independent Variable or Variable One is *qualitative*	*Students will evaluate the relationship with a* ***chi-square****.*	*Students will evaluate the difference with a* ***t-test*** *(two groups) or* ***ANOVA*** *(three or more groups).*
Independent Variable or Variable One is *quantitative*		*Students will evaluate the relationship with a* ***correlation****.*

How to Conduct a Chi-Square Test

The Chi-square test is the appropriate inferential statistical test for use in testing a null hypothesis when a researcher wishes to compare count data for a categorical dependent variable and a categorical independent variable. The Chi-square test can easily be performed in Microsoft Excel, but it does require a little bit of work. This video, How to Perform a Chi-Square Test Of Independence In Excel (Including P Value!), demonstrates how to run a Chi-square test in Microsoft Excel or Google Sheets. The use of an online Chi-square test calculator will likely be easier for students to use than by trying to run the test in Microsoft Excel or Google Sheets. A simple Chi-square test calculator can be found at https://www.standarddeviationcalculator.io/chi-square-calculator or https://www.socscistatistics.com/tests/chisquare2/default2.aspx.

The results of a Chi-square test will include the reporting of the Chi-square statistic (χ^2), the degrees of freedom, and the resultant p-value. It is important to note that if $p<0.05$, this only indicates that there is a difference in the values for each combination of dependent variable and independent variable groups. The p-value that is produced as a result of a Chi-square test does not specify for which groups the values of the dependent variable and independent variable combination are significantly different – this would require post hoc statistical testing, which will not be covered here. When a student obtains a Chi-square test result with $p<0.05$, they are asked to interpret this as meaning that a significant difference does exist across dependent variable and independent variable combination groups.

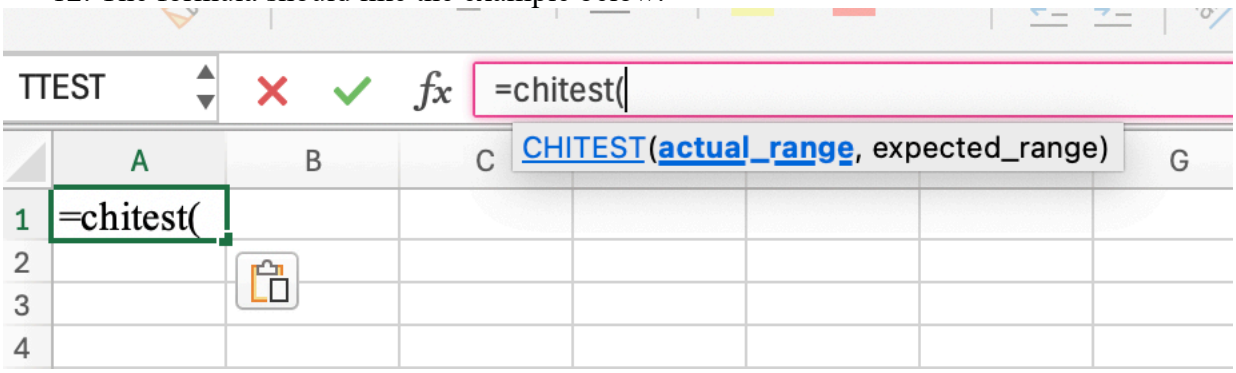
General directions follow as:

Observed Results			
	Variable 2		
Variable 1	Response 1	Response 2	Row Total
Response 1	a	b	a+b
Response 2	c	d	c+d
Column Total	a+c	b+d	a+b+c+d

1. Set up a chart like the one above and give the chart a title called Observed Results. Fill in your variable and response information. Add more responses if you need them.
2. Then count the number of observations that fit the intersection of each response.
3. For example: For 'a' count the number of observations that are both Variable 1/Response 1 AND Variable 2/Response 1.
4. Calculate the totals for the columns, rows, and grand total.
5. Remember first chart are the observed results.
6. Now copy and paste the same chart you just created and label it Expected Results.
7. You should have two charts now.
8. In the expected chart delete all the observed results and leave all the total results.
9. Next calculate the expected results using the following formulas in each box:

Expected Results			
	Variable 2		
Variable 1	Data Type 1	Data Type 2	Row Total
Category 1	[(a+c)(a+b)]/(a+b+c+d)	[(b+d)(a+b)]/(a+b+c+d)	(a+b)
Category 2	[(a+c)(c+d)]/(a+b+c+d)	[(b+d)(c+d)]/(a+b+c+d)	(c+d)
Column Total	(a+c)	(b+d)	(a+b+c+d)

10. Now you have all the expected values.
11. Next in excel you need to click in an empty cell and type in =chitest(
12. The formula should like the example below.



13. Highlight only the actual range (no total numbers) then add a coma.
14. Highlight only the expected range (no total numbers).
15. Close the formula with a parenthesis.
16. Hit enter.
17. This will give you a p-value.

When the p-value is less than 0.05:

a. Researchers ***REJECT*** the null hypothesis (H_0) (the statement that no difference exists is false)
b. Researchers ***ACCEPT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
c. Researchers state that there is a statistically significant difference in the dependent variable values between research groups, because there is less than a 5% chance that the null hypothesis is true.

When the p-value is greater than or equal to 0.05

a. Researchers ***ACCEPT*** the null hypothesis (H_0) (the statement that no difference exists is false)
b. Researchers ***REJECT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
c. Researchers state that there is not a statistically significant difference in the dependent variable values between research groups, because there is a 5% chance or greater that the null hypothesis is true.

How to Conduct a Correlation Test

The correlation test is the appropriate inferential statistical test for use in testing a null hypothesis when a researcher wishes to compare data for a numeric dependent variable and a numeric independent variable to see if/how the dependent variable changes in response to changes in the independent variable. The correlation test can easily be performed in Microsoft Excel or in Google Sheets. This video, Calculating Correlation Coefficient Excel, demonstrates how to run a correlation test in Microsoft Excel or Google Sheets. Students may also choose to use an online correlation calculator to analyze their data, such as the one found at https://www.socscistatistics.com/tests/pearson/default2.aspx.

The results of a correlation test will include the reporting of the correlation coefficient (r), the degrees of freedom (df), and the resultant p-value, in the format of $r(df) = 0.##$, $p = 0.###$. Note: The degrees of freedom for a correlation test is equal to the total number of data points minus 2. The p-value for a correlation test can be calculated using an online calculator, such as the one available at https://www.danielsoper.com/statcalc/calculator.aspx?id=44, once you have calculated the value of the correlation coefficient and know the number of data points included in your dataset. If $p<0.05$, it indicates that the relationship between the dependent variable and independent variable is statistically significant.

Interpreting the Direction and Strength of the Correlation Coefficient

The value of the correlation coefficient (r) determines the direction and strength of the relationship between the independent variable and the dependent variable, see the table below:

Lower Bound	Upper Bound	Strength	Direction
-1.00	-0.70	Strong	Negative
-0.69	-0.30	Moderate	Negative
-0.29	-0.01	Weak	Negative
0		No correlation	
+0.01	+0.29	Weak	Positive
+0.30	+0.69	Moderate	Positive
+0.70	+1.00	Strong	Positive

When reporting the value of the correlation coefficient in your results, students should specify whether there is a strong negative, moderate negative, weak negative, weak positive, moderate positive, strong positive, or no correlation between their variables.

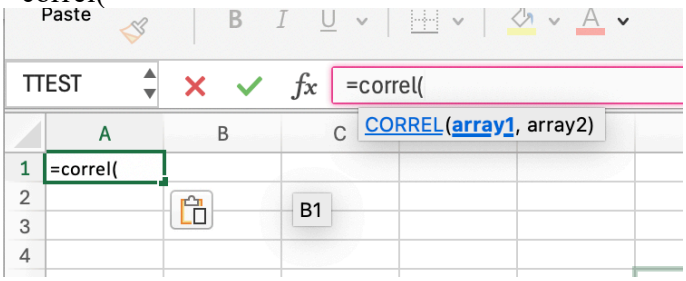
Positive correlations indicated that the directional change in the value of one variable moves in the same direction as the other variable (both variables increase in value or both variables decrease in value). Negative correlations indicate that the directional change in the value of one variable produces a change in value for the other variable in the opposite direction (one variable increases in value while the other variable decreases in value).

General directions follow as:
Excel direction video: https://www.youtube.com/watch?v=vFcxExzLfZI

1. Open Excel
2. Create a chart like the below

	A	B
1	**Values 1**	**Values 2**
2	2	6
3	3	2
4	5	8
5	4	7
6	0.2	4
7	0.5	0.11
8	8	1.66
9	1	2.88
10	0.6	1.99
11	0.2	1.55
12		

3. Fill in the columns with results.
4. Click on a blank cell where you want to have the correlation appear.
5. Click on 'Formulas', 'More Functions,' 'Statistical,' and then 'CORREL' or in a blank cell type =correl(



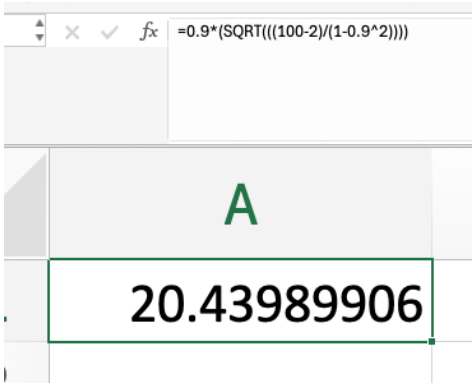
6. For 'Array 1' highlight the first column of numbers, only the numbers
7. For 'Array 2' highlight the second column of the numbers, only the numbers
8. Click OK and the correlation result will appear. This number is the *Correlation Coefficient (r).*
9. Now that you have a correlation coefficient you need to computer a p-value to represent the probability that this data would have arisen if the null hypothesis were true.
First you need to find t from the following formula:

$$t = r\sqrt{\frac{n-2}{1-r^2}}$$

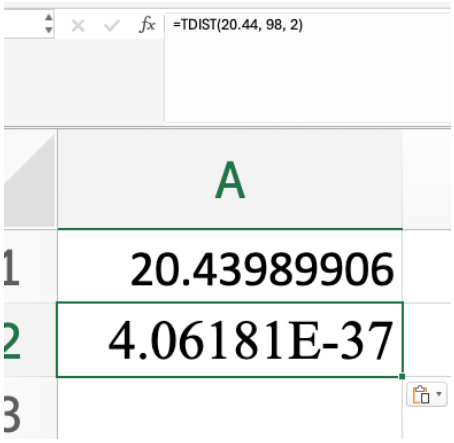
where r = coefficient of correlation n = total number of variants, (n-2) = degree of freedom.

1. Copy this formula into excel
   =r*(SQRT(((n-2)/(1-r^2))))

2. Before you copy the formular into excel, replace r and n with your real numbers.
3. Example if r = 0.9 and n = 100, then the formula you would copy and paste in a blank cell in Excel would be =0.9*(SQRT(((100-2)/(1-0.9^2)))) and the tdist value would be 20.44



4. Then you need to find tdist in excel.
   - Type =tdist(t vaule, df, 2) in a blank cell in excel *where t value is calculated in step 9.1, df = degree of freedom (n-2), 2 is just the number two to represent a two tailed test.*
   - Using the example above, tdist = 20.44 and df (degree of freedom) = (n-2) which is 100-2 = 98
   - You could type in =tdist(20.44, 98, 2)
   - The p-value will appear.



When the p-value is less than 0.05:

d. Researchers ***REJECT*** the null hypothesis (H_0) (the statement that no difference exists is false)
e. Researchers ***ACCEPT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
f. Researchers state that there is a statistically significant difference in the dependent variable values between independent variable values because there is less than a 5% chance that the null hypothesis is true.

When the p-value is greater than or equal to 0.05

d. Researchers ***ACCEPT*** the null hypothesis (H_0) (the statement that no difference exists is false)
e. Researchers ***REJECT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
f. Researchers state that there is not a statistically significant difference in the dependent variable values between independent variable values because there is a 5% chance or greater that the null hypothesis is true.

Apply chi-square or correlation to HSTA Research Project (if applicable)

If a chi-square or correlation applies to the data, complete the test now. Students should be able to communicate with their HSTA teacher if the results of their chi-square/correlation indicates the presence of a statistically significant difference and they are rejecting or accepting their null hypothesis.

Scoring Rubric for Data Analysis – 4 points

1. Data analysis included a statistical test used to test the hypotheses.
2. Data analysis included an explanation of why statistical test was used.
3. Data analysis included a p-value.
4. Data analysis included an explanation of the statistical significance of statistical test.

The following format is provided for the PowerPoint slide:

- The statistical test used:
- Why was the statistical test used:
- r value = (*just for a correlation*)
    - The interpretation of the r value was ___. ***{name strength and direction; see chart above}***
- p-value =
    - The interpretation of the p-value was ____. ***{Pick A or B based on your p-value. You need to have all three bullet points under the p-value.}***

A. When the p-value is less than 0.05:
    - Researchers ***REJECT*** the null hypothesis (H_0) (the statement that no difference exists is false)
    - Researchers ***ACCEPT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
    - Researchers state that there is a statistically significant difference in the dependent variable values between independent variable values because there is less than a 5% chance that the null hypothesis is true.

OR

B. When the p-value is greater than or equal to 0.05
    - Researchers ***ACCEPT*** the null hypothesis (H_0) (the statement that no difference exists is false)
    - Researchers ***REJECT*** the alternative hypothesis (H_1 or H_a) (the statement that a difference exists is true)
    - Researchers state that there is not a statistically significant difference in the dependent variable values between independent variable values because there is a 5% chance or greater that the null hypothesis is true.

Make sure students save their files. They should create a slide in their PowerPoint so they can copy and paste the information they created. Next club meeting, students will go over p-values and hypothesis testing with chi-square and correlation.

Lesson 21: Guest Speaker

Summary: Students will engage with a guest speaker from the community.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Engage with a guest speaker from the community.

If 11th or 12th graders should be wrapping up their data collection and complete their results slides. Younger students should have completed their result slides.

HOA #12: Guest Speaker

This HOA is designed for a guest speaker to create and facilitate the activity.

Invite a guest speaker from the community to present for approximately 30 to 45 minutes. Potential speakers could include Dr. Epps, HSTA alumni, Rural Health Scholars from AHEC, or representatives from colleges and universities. Coordinate with the Field Site Coordinator to connect with community members. Encourage the speaker to incorporate a hands-on activity, or, if presenting online, to provide clear instructions for an activity students can complete during the club meeting.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Lesson 22: Conclusion and Presentation Preparation

Summary: Students will interpret the results of their statistical tests and write a concluding statement.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Write a conclusion based on the interpretation of the statistical test results.
2. Prepare a completed draft of project presentation slides.

Conclusion

The conclusion to the project should include five components: 1) a brief summary of the project, 2) an interpretation of the data to conclude if it supported or rejected null hypothesis, 3) confirmation that students have answered the research questions, 4) a discussion of limitations to the study and what their impact may be, and 5) a discussion on how students would implement change or bring awareness of their results to their community.

- ***Brief Summary of the Project*** This may be as simple as reminding the audience of the research question, the variables used in the project, and repeating the null hypothesis.

- ***Interpretation of the Data to Conclude if it Supported or Rejected Null Hypothesis*** Provide a very brief summary of the data. If students compared two or more groups, report values of central tendency to describe outcomes. Identify the statistical testing procedure being used and identify the resultant p-value. Note the compared p-value against a predetermined significance level of 0.05. If the p-value was less than 0.05, reject the null hypothesis; if the p-value was 0.05 or greater, accept null hypothesis.

- ***Confirm that students Have Answered Research Question*** Ensure that the variables used and the data analyzed were appropriate for answering the research question. Did the conclusion answer the research question?

- ***Discuss Limitations*** Every research study has limitation. As a researcher, students should be aware of and communicate what these limitations are and how they may impact the interpretation of results. Students should identify at least one limitation for their HSTA project.

- ***Identify How to Implement Change and/or Bring Awareness of Results to the Community*** Lastly, results from research are not useful if they are not shared. Identify how students would share their results with their community, what changes should be implemented based on the results, and how students would go about implementing these changes in the community.

Conclusion Scoring Rubric – 5 points

1. Conclusion included a brief summary of the project.
2. Conclusion interpreted the data to conclude if it supported/rejected hypotheses.
3. Conclusion answered the research question.
4. Conclusion discussed limitations.
5. Conclusion discussed how student(s) would implement change and/or bring awareness to their community.

Utilize the remaining time for today's club meeting to finish preparing a completed draft of the presentation slides. At the next club meeting, students will be presenting their slides, scoring each other's presentations, and providing one another feedback on how to improve presentations.

If students plan to utilize notecards for their presentation, they should prepare them before the next club meeting.

All students are required to upload a final presentation to REDCap. The final presentation needs to be submitted by April 24, 2026 5PM.

If the group is ready to submit their final research presentation, upload it to REDCap. If they are not ready, no worries. Continue to work on edits and submit next club meeting.

Remember that all students are required to individually upload a final presentation to REDCap. The final presentation needs to be submitted by April 24, 2026 5PM.

The REDCap email has been sent to all students individually. If you need another link, reach out to your CRA or Field Site. The email will be from slkuhn@hsc.wvu.edu and/or your Field Site/CRA.

Name your file with high school and the name of everyone on the project.
Example: High School_Last Name_Last Name_Last Name
Example: Shady Spring_Morton_Adkins_Kuhn

Lesson 23: Initial Presentation Practice and Peer feedback

Summary: Students will provide feedback on colleague presentations.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Deliver a practice presentation for classmate review.
2. Provide peer feedback on classmate presentations using the Symposium scoring rubric.

Deliver a Practice Presentation

This will be the first opportunity for students to practice their presentations in front of an audience. Students should focus on speaking loud enough for everyone in audience to hear them clearly and at a pace that is appropriate. Students should be encouraged to interact with their presentation slides, especially when presenting their data. A summary of the presentation skill scoring rubric components is provided below.

Presentation Skills Scoring Rubric – 7 points

1. Student(s) spoke clearly during the presentation.
2. Student(s) could answer questions with confidence.
3. Student(s) didn't read slides word for word.
4. Student(s) presented slides in the correct order.
5. Presentation had limited spelling/grammar errors.
6. Presentation's background (color/animation) was not distracting.
7. Presentation's text size/font were consistent.

Provide Peer Feedback

Students should be given copies of the Symposium Scoring Sheet to use to evaluate classmate presentations. Encourage students to provide constructive feedback on the scoring rubric forms. Completed scoring rubrics should be collected and given to each presentation group for review. Feedback should be considered and applied before the next HSTA club meeting.

All students are required to upload a final presentation to REDCap. The final presentation needs to be submitted by April 24, 2026 5PM.

If the group is ready to submit their final research presentation, upload it to REDCap. If they are not ready, no worries. Continue to work on edits and submit next club meeting.

Remember that all students are required to individually upload a final presentation to REDCap. The final presentation needs to be submitted by April 24, 2026 5PM.

The REDCap email has been sent to all students individually. If you need another link, reach out to your CRA or Field Site.The email will be from slkuhn@hsc.wvu.edu and/or your Field Site/CRA.

Name your file with high school and the name of everyone on the project.
Example: High School_Last Name_Last Name_Last Name
Example: Shady Spring_Morton_Adkins_Kuhn

Lesson 24: Final Presentation Practice and Peer Feedback

Summary: Students will provide feedback on colleague presentations.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Deliver a practice presentation for classmate review.
2. Provide verbal peer feedback on classmate presentations.

Deliver a Practice Presentation for Classmate Review

This will be the first opportunity for students to practice their presentations in front of an audience. Students should focus on speaking loud enough for everyone in audience to hear them clearly and at a pace that is appropriate. Students should be encouraged to interact with their presentation slides, especially when presenting their data. A summary of the presentation skill scoring rubric components is provided below.

Presentation Skills Scoring Rubric – 7 points

1. Student(s) spoke clearly during the presentation.
2. Student(s) could answer questions with confidence.
3. Student(s) didn't read slides word for word.
4. Student(s) presented slides in the correct order.
5. Presentation had limited spelling/grammar errors.
6. Presentation's background (color/animation) was not distracting.
7. Presentation's text size/font were consistent.

All students are required to upload a final presentation to REDCap. The final presentation needs to be submitted by April 24, 2026 5PM.

If the group is ready to submit their final research presentation, upload it to REDCap. If they are not ready, no worries. Continue to work on edits and submit next club meeting.

Remember that all students are required to individually upload a final presentation to REDCap. The final presentation needs to be submitted by April 24, 2026 5PM.

The REDCap email has been sent to all students individually. If you need another link, reach out to your CRA or Field Site. The email will be from slkuhn@hsc.wvu.edu and/or your Field Site/CRA.

Name your file with high school and the name of everyone on the project.
Example: High School_Last Name_Last Name_Last Name
Example: Shady Spring_Morton_Adkins_Kuhn

Lesson 25: HSTA Wrap-Up

Summary: Students will get symposium feedback on research presentations.

Click on the hyperlink to access information about this lesson
https://health.wvu.edu/hsta/resources/teachers/curriculum/

Objectives:

1. Read over symposium score sheets.
2. Take annual evaluation.

Notes:

- Give students their score sheets from the symposium.
- Have students take the annual evaluation.
- Ask FSC to bring pizza.
- Feel free to do a hands-on activity.
- Talk about summer camp plans.


HEALTH SCIENCES & TECHNOLOGY ACADEMY