HSTA Spring 2025
Teacher Guide

TABLE OF CONTENTS

LIST OF LESSONS FOR SPRING 2025

Lesson Number	Lesson Title	Hands-on Activity
13	Review of Ethics and Lab Safety; Project Title Selection	Lab Safety Activity/Demonstration
14	Final Project Proposal Approval	Engineering Kit
15	Exploring and Trimming Data	Excel Work Engineering Kit
16	Descriptive Statistics: Measures of Central Tendency	Excel Work Engineering Kit
17	Descriptive Statistics: Measures of Dispersion	Excel Work
18	Graphing Data	Computer – Graphing Lab 1 of Clean Water Kit
19	Probability (p-values) and Hypothesis Testing with t-Test and ANOVA	Excel Work Kahoot! Game
20	Hypothesis Testing with chi-square and correlation	Excel Work Lab 2 of Clean Water Kit
21	Guest Speaker	Activity from Guest Speaker
22	Conclusion and Presentation Preparation	Excel Work Lab 3 of Clean Water Kit
23	Initial Presentation Practice and Peer Feedback	Peer Feedback
24	Final Presentation Practice and Peer Feedback	Final Feedback Project Submission
25	Wrap Up	Extra activity

Materials List

Lesson #13

- If the teacher is doing a lab safety lab or demonstration, they will need materials. The teacher will have information.

Lesson #14

- Engineering kit suggestions (may need extra materials not included in kit)
  - https://www.amazon.com/dp/B0CB7SM737/ref=sspa_dk_detail_2?psc=1&pd_rd_i=B0CB7SM737&pd_rd_w=uvmZM&content-id=amzn1.sym.7446a9d1-25fe-4460-b135-a60336bad2c9&pf_rd_p=7446a9d1-25fe-4460-b135-a60336bad2c9&pf_rd_r=ZTG24CHC7ERRDV40G640&pd_rd_wg=eZE2F&pd_rd_r=a5ebd524-d11a-43ee-bbf7-30dfca4e5344&s=toys-and-games&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWw
  - https://www.amazon.com/Science-Experiment-Projects-Building-Educational/dp/B0986RXG42?psc=1&pd_rd_w=A1ljE&content-id=amzn1.sym.55c0153f-1fb7-42ff-8241-d1c0f3732289&pf_rd_p=55c0153f-1fb7-42ff-8241-d1c0f3732289&pf_rd_r=VCY4QQ2A80J2K0XD4F1E&pd_rd_wg=aIesI&pd_rd_r=badc0f3f-709b-4dfb-8652-f043e29a7be6&ref_=sspa_dk_detail_img_1&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWxfdGhlbWF0aWM=
  - https://www.amazon.com/Projects-Puzzles-Building-Educational-Birthday/dp/B0C1GFB5N1?psc=1&pd_rd_w=A1ljE&content-id=amzn1.sym.55c0153f-1fb7-42ff-8241-d1c0f3732289&pf_rd_p=55c0153f-1fb7-42ff-8241-d1c0f3732289&pf_rd_r=VCY4QQ2A80J2K0XD4F1E&pd_rd_wg=aIesI&pd_rd_r=badc0f3f-709b-4dfb-8652-f043e29a7be6&ref_=sspa_dk_detail_img_2&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWxfdGhlbWF0aWM=
  - https://www.amazon.com/TEACHER-CREATED-RESOURCES-TCR20881-STARTERS/DP/B07NHQ8PN3?TH=1&th=1
  - https://www.amazon.com/Stem-Starters-Getting-Started-Kit/dp/B07TM1GLDB?ref_=ast_sto_dp

---

Lesson #15 None

Lesson #16 None

Lesson #17 None

Lesson #18

- Clean Water Kit suggestions (may need extra materials not included in kit)
  - https://www.amazon.com/4M-4572-Clean-Water-Science/dp/B002JCOU9Y/ref=asc_df_B002JCOU9Y?mcid=c3b91d316cd031be9f2c3553532be84d&tag=hyprod-20&linkCode=df0&hvadid=693127141859&hvpos=&hvnetw=g&hvrand=2612154440364529034&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9009439&hvtargid=pla-523025736934&psc=1
  - https://www.homesciencetools.com/product/4m-clean-water-science-kit/

Lesson #19 None

Lesson #20

- Clean Water Kit suggestions (may need extra materials not included in kit)

Lesson #21

- Guest speaker and teacher will plan the hands-on activity. The teacher will have information.

Lesson #22

- Clean Water Kit suggestions (may need extra materials not included in kit)

Lesson #23 None

Lesson #24 None

Lesson #25

- Teachers may do an extra hands-on activity. The teacher will have information.

Major Dates for HSTA

- Spring Training for Teachers January 11, 2025
- January 13th – 17th: Final comments
- Senior Waiver Application February 1, 2025
- Sara Spencer and Hostler Essays Due (FSC will have local deadlines)
- January 17, 2025 (Final day to have an approved project)
- Recruitment starts January 2025 (FSC will have local deadlines)
- Summer camp applications open March 1st – close March 31st
- April 11, 2025, symposium excuses for students due. Speak with FSC.
- April 25, 2025 by 5PM Final Symposium Projects are uploaded in REDCap
- April 26, 2025, *Southern WV*
    - *Kanawha, Greenbrier/Fayette, Raleigh/Mercer, Mingo/Logan, McDowell, Cabell/Lincoln/Boone*
- May 3, 2025, *Northern WV*
    - *BWRC, Eastern Panhandle, Mountain HSTA, Ohio/Marshall, Harrison/Monongalia/Marion*

Lesson #13: Review of Ethics and Lab Safety; Project Title Selection

Summary:
Students will review ethical principles of research, lab safety protocols, and develop their research project question. If students are ready to submit their final research proposal draft, have them upload it to REDCap.

Objectives:
1. Review ethical principles of research.
2. Review lab safety protocols.
3. Develop a title for your HSTA research project.

Materials:
1. Internet access
2. Computer
3. Projector/screen/TV monitor (for viewing online videos)
4. Pencil/pen

HOA:
1. Lab Safety Lab Activity/Demonstration

Welcome Back

We are halfway through the HSTA year, gearing up for data collection and symposium. As a reminder, you are most successful when you're consistently engaged and participating.

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 afterschool 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 in to 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. Seniors should have a total of 75 hours by now. If not, they need to follow up with their Field Site.

***HSTA Community Research Project* –** As a HSTA student, you are required to conduct a community research project that sets out to improve the well-being 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. Your HSTA teacher, peers, Field Site Coordinator, and Community Research Associate (CRA) will assist you in completing the project. Make sure you have an approved project and 40 points by January 17, 2025. Once approved you can start data collection and/or data analysis.

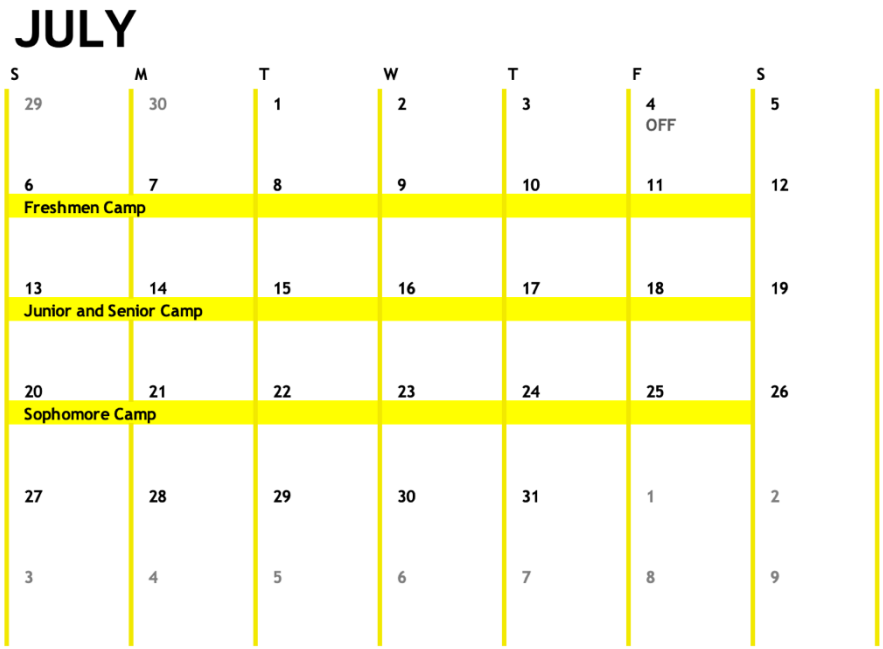
***Attendance at Symposium* –** This is a mandatory event. You will come together with HSTA peers and share your final research presentation. Presentations will be judged by community members, teachers, and STEM+M or other healthcare experts.

- April 26, 2025, *Southern WV*
    - *Kanawha, Greenbrier/Fayette, Raleigh/Mercer, Mingo/Logan, McDowell, Cabell/Lincoln/Boone*
- May 3, 2025, *Northern WV*
    - *BWRC, Eastern Panhandle, Mountain HSTA, Ohio/Marshall, Harrison/Monongalia/Marion*

***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. If you have problems, communicate with your HSTA teacher and field site.

***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/media/16789/waiver-quick-guide-2021.pdf
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.

Review Ethical Principles of Research

Before we start data analysis and collection, we will review ethical research principles and lab safety.

We will start with a review of ethical research principles by watching a short video. Click on the link and watch the video: https://youtu.be/mtLPd2u4DiA?si=nBmtzFKRaIQ1dZBR.

Ask students to identify the three main ethical principles included in the Belmont Report. There are three main ethical principles: We want to remind all students about their CITI training before 11th and 12th graders start to collect data. (Resource for the information below http://www.nwabr.org.)

- **RESPECT** – Ask students to define the principle of respect. The first principle focuses on respect of individuals. Part of respecting an individual has to do with respecting their autonomy. The word autonomy comes from the Greek autos (self) and nomos (governance). Autonomy emphasizes the responsibility individuals have for their own lives. Individuals have the right to self-determination and to make their own decisions and choices.

- **BENEFICENCE** (Do good) – Ask students to define the principle of beneficence. The second principle stresses directly helping others, acting in their best interest, and being a benefit to them. It requires positive action. Do No Harm, nonmaleficence, relates to one of the most traditional medical guidelines, the Hippocratic Oath (First of all, do no harm). It required individuals to not intentionally or directly inflict harm upon others.

- **JUSTICE** (Be fair) – Ask students to define justice. The third principle relates to "Giving to each that which is his due." (Aristotle). It dictates that persons who are equals should qualify for equal treatment, and that resources, risks, and costs should be distributed equitably.

At this point in the year, all students should have completed the "Ethics Contract 2024". Below is a copy of the statements included on this year's ethics contract. Read each statement included on the ethics contract to students. Remind students that by completing the "Ethics Contract 2024" they have agreed to follow the ethical principles contained within.

1. I understand and will put into practice as all times the Belmont Principles.
2. As a researcher or investigator, I will conduct my research with integrity and safeguard my research participants/subjects and any data I may gather.
3. I will protect all participants/subjects and adhere to the research standards set forth in state and federal code.
4. I will design my research to be fair and provide the same opportunity to all subjects. I will adhere to my approved research protocol.
5. When recruiting participants/subjects I will explain:
    a. What the research is about,
    b. Why it is being conducted,
    c. Why I want them to participate,
    d. What they will be asked to do,
    e. How and when they will be asked to do it.
6. I will explain how the research data will be measured and collected and the plan to protect their privacy and information.
7. Furthermore, I will explain to the participant/subject how the knowledge learned from the research may be of benefit to them or others.
8. I will explain any possible harm that may occur during the research and the safeguards in place to prevent such harm.
9. I will assure participants/subjects that they may chose not to participate or may opt out of participation at any time with no repercussions.
10. I understand the importance of research and will conduct my research with honor and integrity.

Review Lab Safety Protocols

Now we will review lab safety with a short video. Click on the link and watch the video: https://www.youtube.com/watch?v=BRDApYgvDqQ. There are other videos available online that also discuss lab safety. While lab safety videos are written to be funny and may be uncomfortable to watch, the goal is to ensure that everyone is safe in the lab. Re-read each statement of the safety contract that you signed in the fall. By signing that contract you agreed to follow the lab safety protocols that are contained within.

1. I have read over the Lab Safety PowerPoint presentation and have watched the lab safety video.
2. I will conduct myself in a responsible manner at all times 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 eye wear.
5. I will not eat food, drink beverages, or check 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 or safety shower for at least 20 minutes. I will also notify my teacher immediately.
10. I will dispose of all chemical waste properly. (Refer to the Flinn Safety website: http://www.flinnsci.com/homepage/sindex.html.)
11. I will wash my hands with soap and water after performing all experiments.
12. I will always use caution when using 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.
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.
17. My allergies are (please list your allergies or write in NA if you do not have allergies).
18. I will cooperate to the fullest extent to maintain a safe lab environment.

Next year, we will have a lab safety activity. Something fun and messy that will help students practice their lab safety. Due to a late release of lessons 13-25, we did not include this activity. If you have time and the materials, please feel free to do an activity that helps students practice lab safety. An easy activity would be Mentos and Diet Coke. Seems simple, but this activity allows for a quick review of basic lab safety. You may also want to do a lab demonstration with Dry Ice or another *WOW* activity to get students talking about lab safety.

Hands-on Activity #1 Lab Safety

Lab Safety Activity/Demonstration

Develop a Title for your HSTA Research Project

Now that we have completed our review of ethics research principles and lab safety protocols, we can turn our attention to student research projects. We will start with developing our titles for research projects. Take two and half minutes and watch the following video https://youtu.be/-fjq7LdqsiQ?si=jIaZ9S8kCv9wYDK_. Even if your CRA and HSTA teacher have reviewed your title, read the following information to see if your title could be stronger. The title is the name of your presentation. It tells what your project is about, your name/group member names, grade level, HSTA teacher(s), and where you are from. Read the information below about the title slide to be included in your research presentation.

Score Sheet – Title Slide – Worth 3 Points

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

Tips for Writing Titles

1. Brainstorm ideas and phrases.
    a. Write down on paper some thoughts and ideas of what your title could be.
2. Match the project content to the title.
    a. Your title has to be descriptive.
    b. It needs to clue your audience in to what your project if about (Look at your Research Question).
3. Use what you have.
    a. May find a title buried in your project.
    b. Copy down any sentence that may work for a title.
    c. Shorten it to make it more useful.
4. Take some time to play with the title.
    a. Try to rearrange and play around with it to get the best title.
    b. Trade in less specific words for more specific words.
5. Make sure you include your main point.
    a. When you're writing your title, it's good to include at least an indication of your conclusion in your title.
    b. Make sure you include the keywords.
6. Consider your audience.
    a. Tailor the language and complexity of the title to your intended audience.

Characteristics of a Good Research Project Title Slide

The research project title should:

- Match your research question (i.e. identify the relationship to be examined between the independent and dependent variables).
- Condense the project's content into a complete statement and/or question.
- Not contain spelling errors, abbreviations, or technical jargon.
- Clearly define the purpose of your project.

Your research PowerPoint presentation title slide should also include:

- First and last name (all students in the group)
- Name of your high school
- Name of your HSTA region
- Name(s) of your HSTA teacher(s)

Activity – Develop a Title for your HSTA Research Project

Students will work to develop a title for their HSTA research project. Show students the below structural templates for writing a research project title. Have students compose two or three variations of a title for their research project. Once students have generated two or three variations of a title for their research project, have them present each variation to the entire HSTA club. Students may work together as a club to assist one another in selecting a research title that best fits each project.

Follow the structural templates and compost two or three variations of your title. Then share your titles with peers and have them give you feedback. Make sure your title slide includes all student names with grade levels, your HSTA teacher's name, your high school, and your HSTA county.

Research Project Title Structural Templates

1. The Effect of [*Independent Variable*] on [*Dependent Variable*] in [*Specific Context*]
    a. Example
        i. The Effect of Sleep Quality on Academic Performance in College Students
2. Exploring [*Concept/Theme*]: A Study of [*Specific Aspect*] in [*Population/Setting*]
    a. Example
        i. Exploring Resilience: A Study of Coping Strategies in Urban Adolescents
3. [*Adjective/Descriptor*] [*Noun*] of [*Subject/Topic*] in [*Context*]
    a. Example
        i. The Impact of Climate Change on Coastal Biodiversity in the Gulf of Mexico
4. [*Question Format*]
    a. Example
        i. How Does Urbanization Affect Local Wildlife Populations?
5. [*Noun Phrase*]: [*Subheading/Additional Detail*]
    a. Example
        i. Social Media Usage: Implications for Mental Health Among Teens

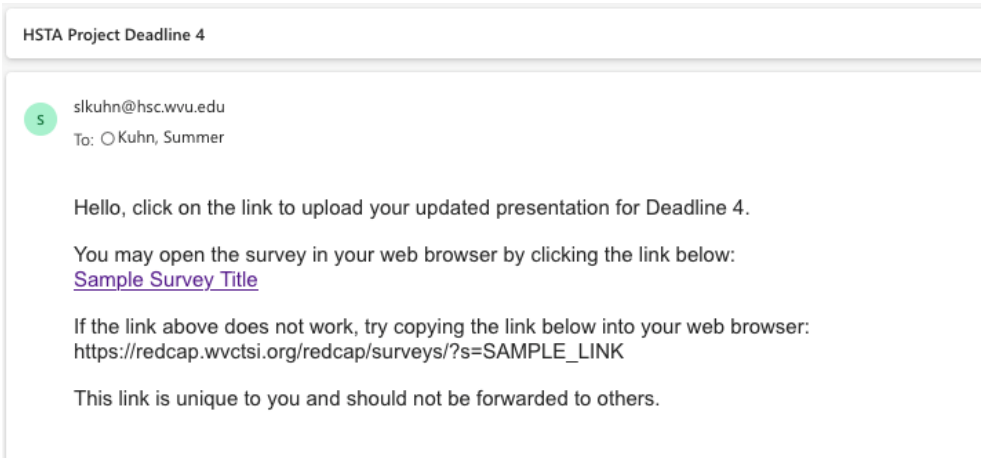
Research Project Title Worksheet

	Research Project Title
Version #1	
Version #2	
Version #3	

Final Draft of Research Proposal

If you/your group are ready to submit your final research proposal draft, upload it to REDCap. If you are not ready, no worries. Continue to work on edits and submit next club meeting.

Find the REDCap email and submit your project. The REDCap email has been sent to the first student listed on the project. If you need another link, reach out to your CRA or Field Site. The email will look like the sample below. The email will be from slkuhn@hsc.wvu.edu and/or your Field Site/CRA.


HSTA Project Deadline 4

S slkuhn@hsc.wvu.edu

To: Kuhn, Summer

Hello, click on the link to upload your updated presentation for Deadline 4.

You may open the survey in your web browser by clicking the link below:
Sample Survey Title

If the link above does not work, try copying the link below into your web browser:
https://redcap.wvctsi.org/redcap/surveys/?s=SAMPLE_LINK

This link is unique to you and should not be forwarded to others.

Next club meeting we need to submit completed projects to be approved.

Lesson #14: FINAL PROJECT PROPOSAL APPROVAL

Summary:
Students will complete and submit their research project proposal slides for CRA review. If students are done with their proposal and/or waiting on comments, have them start on the engineering hands-on activity and/or another hands-on activity.

Objectives:
1. Complete and submit research project proposal slides for CRA review.
2. Start on the engineering hands-on activity or another hands-on activity.

Materials:
1. Internet access
2. Computer

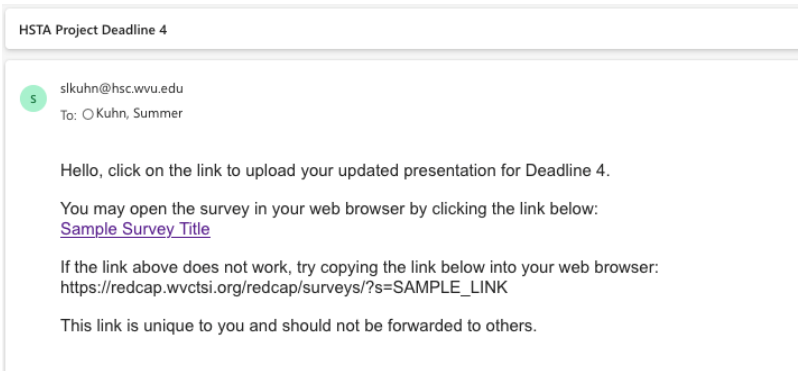
HOA:
1. Engineering hands-on activity

Complete and Submit Research Project Proposal Slides for CRA Review

Everyone should work to complete and submit their research project proposal slides for the final CRA review by the conclusion of this club meeting. You should ensure that all previous CRA feedback has been fully incorporated into their research project proposal slides prior to submitting for CRA review. Have your peers and/or HSTA teacher review your proposal slides prior to them being submitted for CRA review.

- No data will be submitted.
- If you are 9th and 10th grader (or 11th or 12th grader who is partnering with a 9th and 10th grader), you will start data analysis after your project is approved.
- If you are a 11th or 12th grader, you will start data collection after your project is approved.

Next, find the REDCap email and submit your project. The REDCap email has been sent to the first student listed on the project. If you need another link, reach out to your CRA or Field Site. The email will like the sample below. The email will be from slkuhn@hsc.wvu.edu and/or your Field Site/CRA.


HSTA Project Deadline 4

slkuhn@hsc.wvu.edu
To: Kuhn, Summer

Hello, click on the link to upload your updated presentation for Deadline 4.

You may open the survey in your web browser by clicking the link below:
Sample Survey Title

If the link above does not work, try copying the link below into your web browser:
https://redcap.wvctsi.org/redcap/surveys/?s=SAMPLE_LINK

This link is unique to you and should not be forwarded to others.

Hands-on Activity #2 Engineering Kit

The idea for this hands-on activity is to have an activity students can work independently on while project proposals are wrapping up. With an engineering-themed kit and/or activity, students can design, create, test, and redesign. They can also compare their design/function. Since this lesson was not available earlier, this activity can be anything. Some field sites might have a kit already ordered or have something extra.

Suggested Kits to Order:

- https://www.amazon.com/dp/B0CB7SM737/ref=sspa_dk_detail_2?psc=1&pd_rd_i=B0CB7SM737&pd_rd_w=uvmZM&content-id=amzn1.sym.7446a9d1-25fe-4460-b135-a60336bad2c9&pf_rd_p=7446a9d1-25fe-4460-b135-a60336bad2c9&pf_rd_r=ZTG24CHC7ERRDV40G640&pd_rd_wg=eZE2F&pd_rd_r=a5ebd524-d11a-43ee-bbf7-30dfca4e5344&s=toys-and-games&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWw
- https://www.amazon.com/Science-Experiment-Projects-Building-Educational/dp/B0986RXG42?psc=1&pd_rd_w=A1ljE&content-id=amzn1.sym.55c0153f-1fb7-42ff-8241-d1c0f3732289&pf_rd_p=55c0153f-1fb7-42ff-8241-d1c0f3732289&pf_rd_r=VCY4QQ2A80J2K0XD4F1E&pd_rd_wg=aIesI&pd_rd_r=badc0f3f-709b-4dfb-8652-f043e29a7be6&ref_=sspa_dk_detail_img_1&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWxfdGhlbWF0aWM=
- https://www.amazon.com/Projects-Puzzles-Building-Educational-Birthday/dp/B0C1GFB5N1?psc=1&pd_rd_w=A1ljE&content-id=amzn1.sym.55c0153f-1fb7-42ff-8241-d1c0f3732289&pf_rd_p=55c0153f-1fb7-42ff-8241-d1c0f3732289&pf_rd_r=VCY4QQ2A80J2K0XD4F1E&pd_rd_wg=aIesI&pd_rd_r=badc0f3f-709b-4dfb-8652-f043e29a7be6&ref_=sspa_dk_detail_img_2&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWxfdGhlbWF0aWM=
- https://www.amazon.com/TEACHER-CREATED-RESOURCES-TCR20881-STARTERS/DP/B07NHQ8PN3?TH=1&th=1
- https://www.amazon.com/Stem-Starters-Getting-Started-Kit/dp/B07TM1GLDB?ref_=ast_sto_dp

---

Next club meeting, if you/your group have an approved project, we will start looking at the state data and/or will start collecting data.

Lesson #15: SORTING and trimming DATA

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

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.

Materials:
1. Internet access
2. Computer (with Microsoft Excel or Google Sheets)
3. Microsoft Excel file containing the HSTA Statewide Survey data
4. Laptop/desktop computers for each research group

HOA:
1. Continue with engineering hands-on activity

Note: Upperclassmen who are conducting projects that are not utilizing the HSTA Statewide Survey data may be assigned to assist younger students who will sort and trim data.

Today we learn how to sort and trim data. Before we do, upperclassmen (11^{th} and 12^{th} graders) complete the worksheet and give an update on your project. Students can work with the engineering kit if they are not working with state data or their own project.

Upperclassmen (11th and 12th graders) Project Updates

Use the space below to write out what you need to do for your project and when.

JANUARY						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

FEBRUARY						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

MARCH						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

APRIL						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

MAY						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

JUNE						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

JULY						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

AUGUST						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Introduce Students to the HSTA Statewide Survey Data File

Before we start, everyone did a great job at collecting data for the HSTA Statewide Survey. Check out how many surveys were completed in your county: https://redcap.wvctsi.org/redcap/surveys/?__dashboard=HTCEXJPRMFR 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?

If you are an upperclassmen who needs to work on their project do so at this time. If you are an upperclassmen who is waiting on materials, data collection, etc. pair up with a younger group and help them as we go over sorting and trimming HSTA Statewide Data. Pair upperclassmen with young groups to help them learn how to sort and trim data.

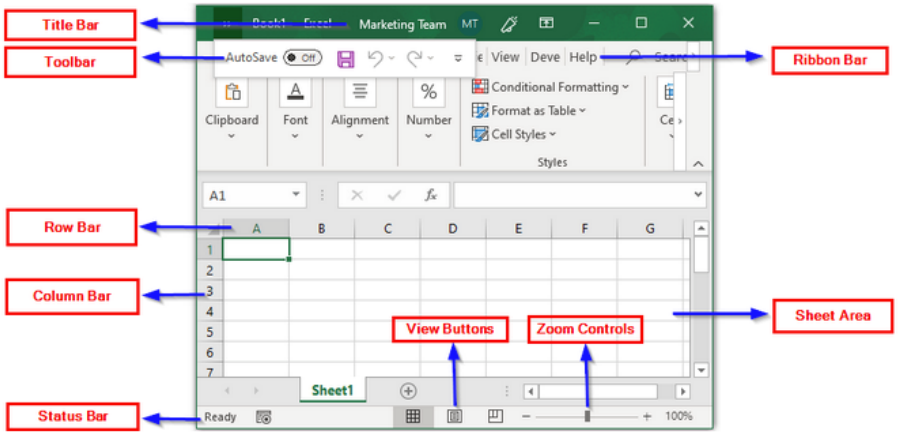
Everyone needs to find a computer and open Excel. Strongly encourage everyone to have their own computer and an Excel file open. If they are working as a group, they can compare files and answers with each other.
Follow along and read each step to save and review your data file.

- Your HSTA Teacher will email you a copy of the data file and provide the password. Begin by distributing a copy of the following Microsoft Excel HSTA Statewide Survey Data to your students. The data password for the data file is **hsta30**

  You can email this file to your students or post it in your Learning Management System or on a file-sharing site used by your HSTA club.

- Everyone should save the HSTA Statewide Survey data file on their own device/folder. If you want to open a shared file that is fine, but everyone should start with their own file to review/learn how to sort and trim. If students need a basic introduction to Excel and/or a review here is video for Excel Beginners https://www.youtube.com/watch?v=wbJcJCkBcMg

- After you have saved your file, make sure you 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 Statewide 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 surveys will be categorized as either North or South if a county was chosen.

Demonstrate How to Filter, Sort, and Trim Data in the Statewide Survey Data File

Now we will begin to sort and trim the Statewide Survey Data File so that only data needed for their research project remains. Make sure you have saved the Statewide Survey Data File to your 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 your **independent variable**.

Students will begin by locating the column that contains the survey question that contains the data for their independent variable. 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 your **dependent variable**.

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 your project's **inclusion criteria (constant variable)**.

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

If your project contains inclusion criteria (constant variables), locate the column(s) that contains the survey question(s) that contains the data associated with your inclusion criteria. Note: Student projects may include more than one inclusion criteria. 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 your data file by deleting the **columns** that you have not highlighted in the file (these are the columns that do not contain data related to your independent variable, dependent variable, or inclusion criteria).

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

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

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. Click on the filter icon that appears in 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 that 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 your data file to remove participants (**rows** of data) that did not answer the survey question that is related to your **dependent variable**.

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 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 that 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** (constant variables). Note: If the project contains multiple inclusion criteria, the below trimming procedure must be completed separately for each inclusion criteria.

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 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 that 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 you should only have columns of data that are highlighted light green, light blue, and yellow.

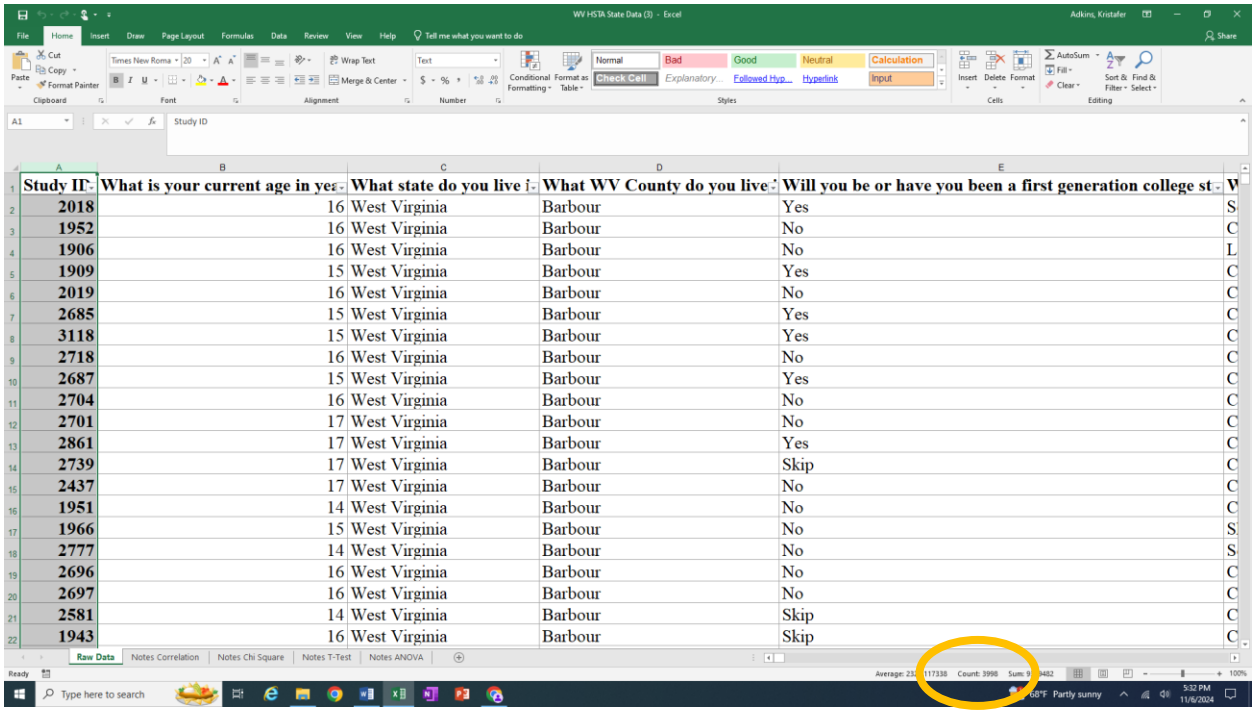
Step 9: Make sure to save your trimmed Excel data file to your computer/folder. Note: Students should name this file something different from the original file name, such as HSTA Survey Data 2024-2025 – Trimmed.

Calculate the Survey Response Total, Completion Total, and Completion Rate for the HSTA Statewide Survey

Underclassmen (9th and 10th graders; 11th and 12th graders partners) open your data file. Survey participation is reported by researchers using response totals and response rates. You will now use you *Statewide Survey Data File* and your *HSTA Survey Data 2024-2025 – Trimmed* data file to determine the response total and response rate for your projects.

Calculation of the Survey Response Total

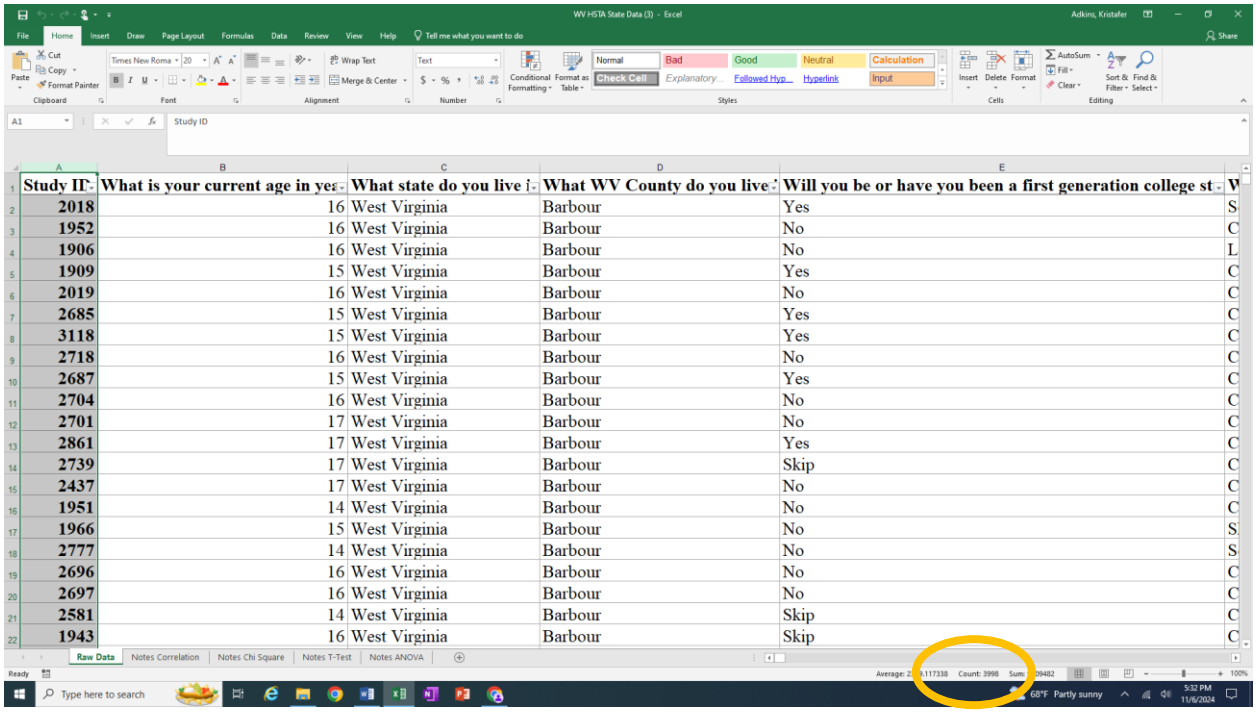
To begin, open the *Statewide Survey Data File*. Click on the header for Column A that contains the Study ID to highlight the entire column. Once Column A has been highlighted, look in the bottom right-hand side of the Excel window. You should see the word "Count:" with a number beside it (circled in the picture below). The number beside the word "Count:" is the number of rows of data that contain data within in 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

Calculation of the Survey Completion Total

To begin, open the *HSTA Survey Data 2024-2025 – 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. You 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 in 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

Calculation of the Survey Response Rate

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

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

You should calculate the response rate for your project. Write down the survey response rate, which will be reported on your presentation slides later. Note: The survey completion total will be different for each HSTA project.

Next club meeting, we 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.

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.

Materials:
1. Internet access
2. Computer (with Microsoft Excel or Google Sheets)
3. Projector/screen/TV monitor (for viewing online videos)
4. Dataset for your HSTA research project (if available)

HOA:
1. Continue with engineering hands-on activity

Today we learn about descriptive statistics. Before we do, upperclassmen (11^{th} and 12^{th} graders) complete the worksheet and give an update on your project. Students can work with the engineering kit if they are not working with state data or their own project.

Underclassmen (9^{th} and 10^{th} graders; 11^{th} and 12^{th} graders partners) open your *Statewide Survey Data File* and *HSTA Survey Data 2024-2025 – Trimmed* data files from last club meeting.

Upperclassmen (11th and 12th graders) Project Updates

Use the space below to write out what you need to do for your project and when.

JANUARY						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

FEBRUARY						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

MARCH						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

APRIL						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

MAY						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

JUNE						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

JULY						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

AUGUST						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Introduce Students to Descriptive and Inferential Statistics

Before we start, everyone will 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/measurements and each column represents individual research variables. 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?

How to Frequencies and Percentages

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 (Mean, Median, and Mode)

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 your 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.

You should spend the remaining time for this club meeting calculating the descriptive statistics for your 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. Note: Additional descriptive statistics (range, standard deviation, and variance) will be covered in Lesson 17.

Two numeric variables

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

Table 1: Descriptive Statistics		
	Variable #1 Name (units of measure)	**Variable #2 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)*

Categorical Independent Variable and Numeric Dependent Variable

An example of two descriptive statistics table are provided below for a project with a categorical independent variable and a numeric 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)*

Categorical Independent Variable and Categorical Dependent Variable

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

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

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

Count Table

	Independent Variable Response #1 =	Independent Variable Response #2 =	Total
Dependent Variable Response #1 =			
Dependent Variable Response #2 =			
Total			

Percentage Table

	Independent Variable Response #1 =	Independent Variable Response #2 =	Total
Dependent Variable Response #1 =	%	%	
Dependent Variable Response #2 =	%	%	
Total			

Example Dataset with two categorical variables.

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

Box 1: Independent Variable Response #1 and Dependent Variable Response #1
Box 2: Independent Variable Response #1 and Dependent Variable Response #2
Box 3: Independent Variable Response #1 and Dependent Variable Response #1
Box 4: Independent Variable Response #2 and Dependent Variable Response #2

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

Save this file with all your work. Now, create a slide in your PowerPoint so you can copy and paste the table(s) you created. Make sure you save space for your resultant graph for each table.

Next club meeting, we 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.

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

Materials:
1. Internet access
2. Computer (with Microsoft Excel or Google Sheets)
3. Projector/screen/TV monitor (for viewing online videos)
4. Dataset for your HSTA research project (if available)

Today we will continue to learn about descriptive statistics. Before we do, upperclassmen (11^{th} and 12^{th} graders) complete the worksheet and give an update on your project.

Underclassmen (9^{th} and 10^{th} graders; 11^{th} and 12^{th} graders partners) make sure your count/frequencies and Measures of Central Tendencies (Mean, Median, and Mode) are complete. Then we will move onto determining how to calculate the range, variance, and standard deviation for our dataset.

Upperclassmen (11th and 12th graders) Project Updates

Use the space below to write out what you need to do for your project and when.

JANUARY						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

FEBRUARY						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

MARCH						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

APRIL						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

MAY						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

JUNE						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

JULY						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

AUGUST						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Demonstrate How to Calculate Range, Variance, and Standard Deviation

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: you can only find the range for a numeric variable.

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 us 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, we 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 we calculate it for a dataset.

Note: you can only find the variance for a numeric variable.

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 Statewide Survey Data. When working with large datasets, you can use Excel to easily calculate the variance of your 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, you 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: you can only find the standard deviation for a numeric variable.

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

We 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 your 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.

You should spend the remaining time for this club meeting calculating the descriptive statistics for your research project. 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. The descriptive statistics table and resultant graph should be displayed on the same slide. A sample descriptive statistics table is provided below.

Note: Additional descriptive statistics (number of observations, mean, median, and mode) were already covered in Lesson 16.

Two numeric variables

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

Table 1: Descriptive Statistics		
	Variable #1 Name (units of measure)	**Variable #2 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		

Categorical Independent Variable and Numeric Dependent Variable

An example of two descriptive statistics table are provided below for a project with a categorical independent variable and a numeric 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.

Categorical Independent Variable and Categorical Dependent Variable

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

Note: No minimum, maximum, range, standard deviation, and variance can be determined for categorical variables.

Save this file with all your work. Now, create a slide in your PowerPoint so you can copy and paste the table(s) you created. Make sure you save space for your resultant graph for each table.

Next club meeting, we will go over graphing.

Lesson #18: Graphing DATA

Summary:
Students will learn how to graph data.

Objectives:
1. Demonstrate how to graph data.
2. Create a graph of your data for your HSTA research project.

Materials:
1. Internet access
2. Computer (with Microsoft Excel or Google Sheets)
3. Projector/screen/TV monitor (for viewing online videos)
4. Clean Water Kit and other materials
5. Dataset for your HSTA research project (if available)

HOA:
1. Complete lab #1 with the Clean Water Kit

Today we will complete a hands-on activity with a Clean Water Science Kit and learn about graphing.

Hands-on Activity #3 Clean Water Science Kit – First Lab

For this hands-on activity work with your FSC to order the following kit: https://www.amazon.com/4M-4572-Clean-Water-Science/dp/B002JCOU9Y/ref=asc_df_B002JCOU9Y?mcid=c3b91d316cd031be9f2c3553532be84d&tag=hyprod-20&linkCode=df0&hvadid=693127141859&hvpos=&hvnetw=g&hvrand=2612154440364529034&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9009439&hvtargid=pla-523025736934&psc=1 or https://www.homesciencetools.com/product/4m-clean-water-science-kit/.

The kit has three different labs in it. "This Clean Water Science kit allows kids to explore ways of reusing water. They will filter dirty water to make it clean, experiment with distillation to make clean water, and use solar energy to purify water. The 12-page color manual provides instructions for performing the three experiments, ideas for additional experiments with the kit, asks thought provoking questions, and provides background information on water, filtration, distillation and pasteurization. You provide a few common household items, like soil, cooking oil, drinking glass, ice cubes, etc. Each experiment can be performed three times. Ages 8 and up. Adult supervision is required."

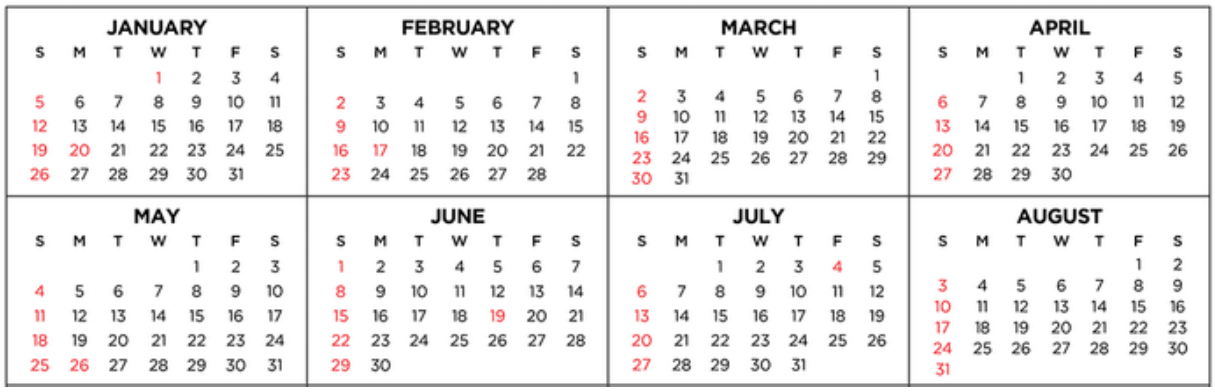
We suggest you order this kit before the lesson to go over the directions and see if there is anything else you need. You could have a senior student help with leading the lab. If they are waiting on data, etc. have the senior student(s) read/complete the lab and during the next meeting, they can lead the lab with the rest of the club. This can be repeated two more times to complete all three labs. The first lab will be completed during Lesson 18. The second lab will be completed during Lesson 20, and the final lab will be completed during Lesson 22.

Before we start, upperclassmen (11th and 12th graders) complete the worksheet and give an update on your project.

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

Upperclassmen (11th and 12th graders) Project Updates

Use the space below to write out what you need to do for your project and when.



JANUARY						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

FEBRUARY						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

MARCH						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

APRIL						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

MAY						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

JUNE						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

JULY						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

AUGUST						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Demonstrate How to Graph Data

The best advice that a statistician will give a young researcher is to always graph your data. The visual presentation of your data will give you a better understanding of the relationships between variables and/or groups than what you can see by looking at a data table. The type of graph that you use to display your data is controlled by the type of variables that are used in your research study. Read over the chart below to discover what type of graph you should complete based on your variables.

Independent Variable is _____ and it is **Categorical** or **Numeric**. (Circle One)

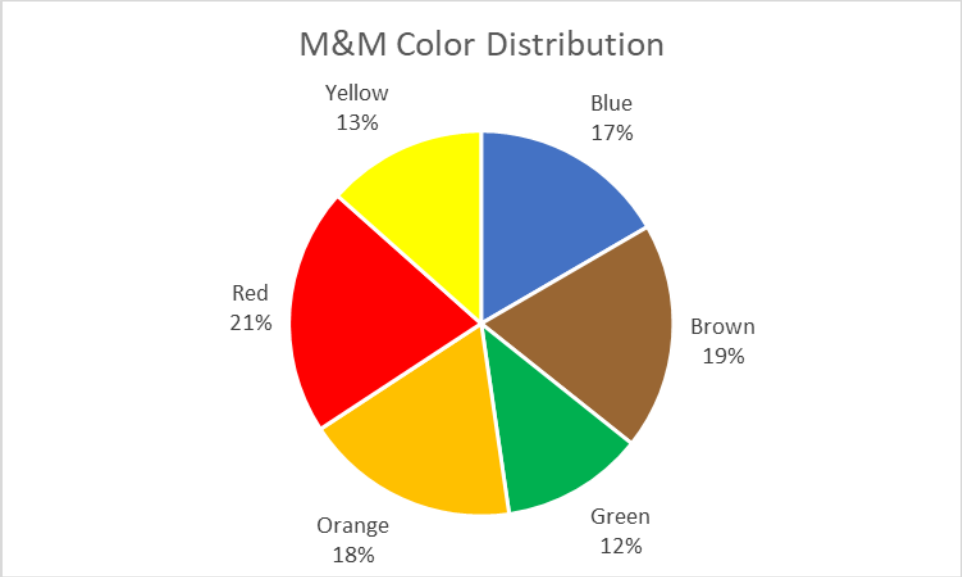
Dependent Variable is _____ and it is **Categorical** or **Numeric**. (Circle One)

Name the graph you should complete _____.

	Dependent Variable is Categorical	**Dependent Variable is Numeric**
Independent Variable is Categorical	Chi Square results, displayed in a **pie chart**.	ANOVA and t-test results, displayed in a **bar graph**.
Independent Variable is Numeric		Correlation and regression results, displayed in a **scatterplot** or **line graph**.

Continue reading the next few pages and find the directions for the graph you will complete. NOTE: This is in no way a comprehensive list of charts and graphs. There are others that may be used to describe statistics. **It is important to select the one that is appropriate for your data set(s). Use those directions to graph your data.**

Pie Chart

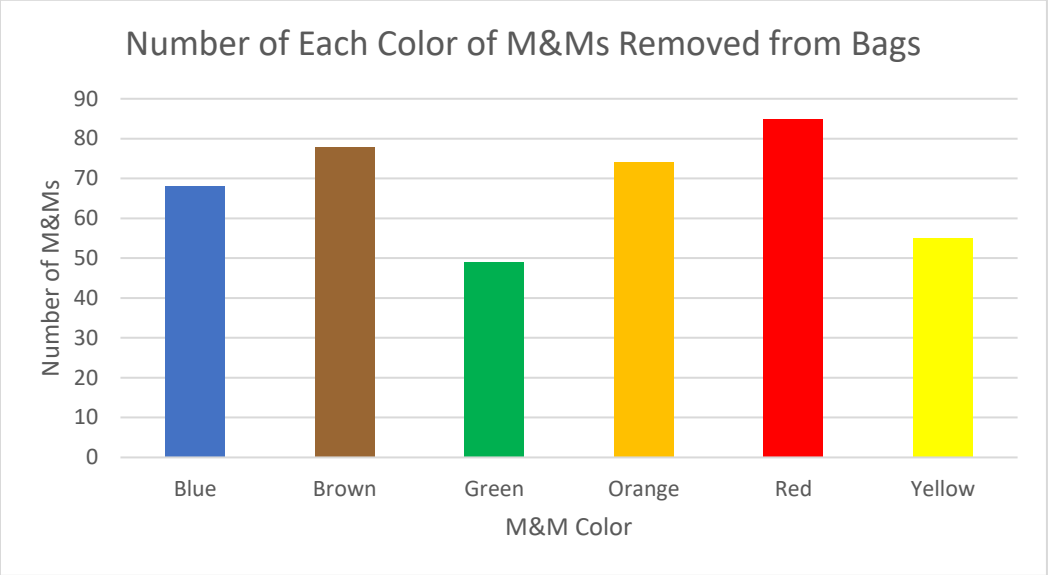


Pie charts are best suited when the researcher wishes to graphically represent ***percentage data*** for ***nominal or categorical variables*** (variables whose measurements contain text as opposed to numbers). Commonly used nominal or categorical variables in HSTA projects include gender (male/female), 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

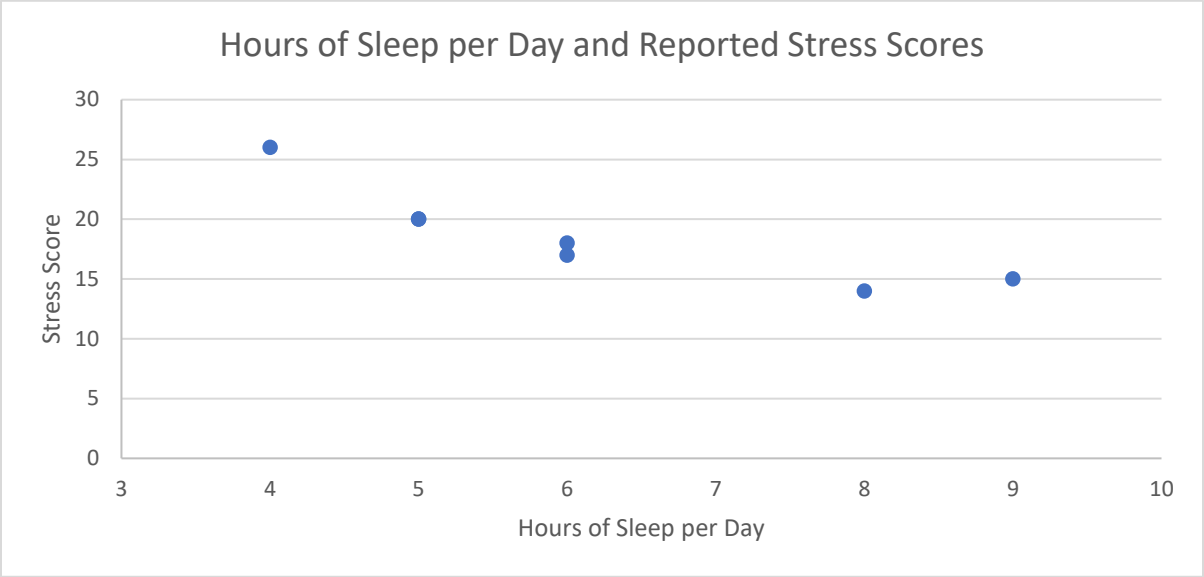


Bar graphs are best suited when the researcher wishes to graphically represent ***count data or data representing the mean of a dataset*** for ***nominal or categorical variables*** (variables whose measurements contain text as opposed to numbers). Commonly used nominal or categorical variables in HSTA 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

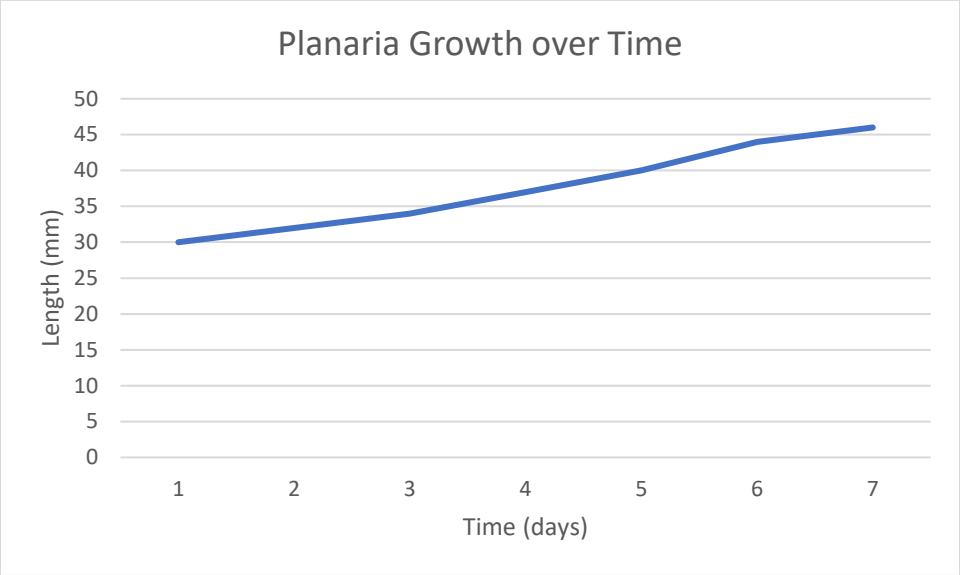


Scatter plot graphs are best suited when the researcher wishes to graphically represent ***quantity data*** for ***interval/ratio variables*** (variables whose measurements are numerical). Scatter plot graphs are most appropriate when displaying data for correlational studies. Commonly used interval/ratio 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 independent variable values), and 3) a label for the y-axis (indicating the values possible for the dependent variable). 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 interval/ratio 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).

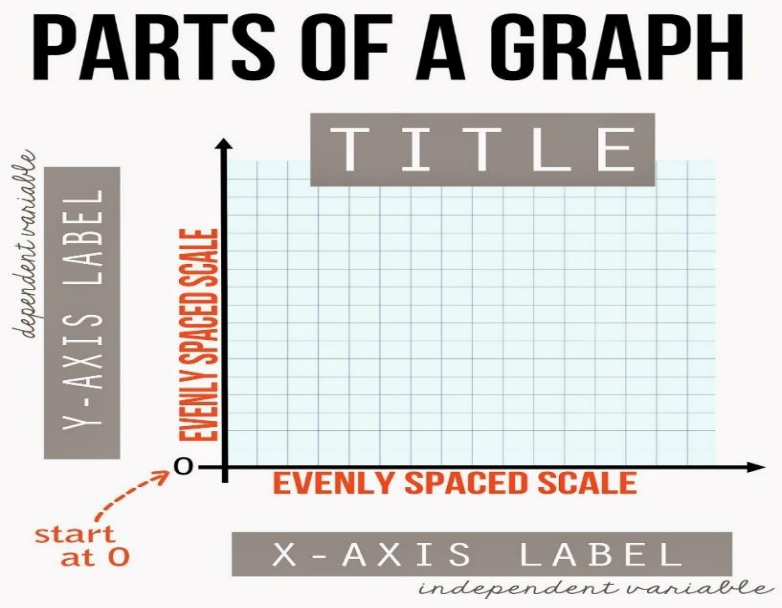
Have students watch this video to learn How to Make a Line Graph in Excel (Quick and Easy).

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 your HSTA Research Project

You should spend the remaining time for this club meeting creating a graphical summary of your data to include on your presentation slides. Make sure to verify that 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.



Save this file with all your work. Now, create a slide in your PowerPoint so you can copy and paste the table(s) you created. Make sure you save space for your resultant graph for each table.

Next club meeting, we will go over p-values and hypothesis testing (t-test and ANOVA).

Lesson #19: Probability (p-values) and hypothesis testing (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.

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.
6. Conduct the t-test or ANOVA on your HSTA project data (if applicable).

Materials:
1. Internet access
2. Computer (with access to Microsoft Excel and online statistical calculator websites)
3. Projector/screen/TV monitor (for viewing online videos)
4. Dataset for your HSTA research project (if available)

Activity:
1. Scientific notation review with Kahoot!

Activity Exponential Notation/ Scientific Notation

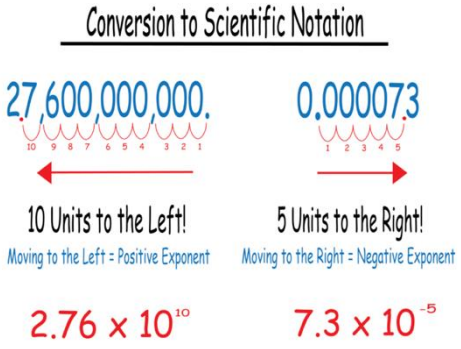
Today we will discuss probability, t-test, and ANOVA. We will start with a short review of exponents and a game of Kahoot!

Why do we care about exponents? To answer our 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 $C\times10^n$. Where C is between 1 and 10 and followed by an appropriate power of 10.
  - **Examples**
- 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.

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}



- 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.

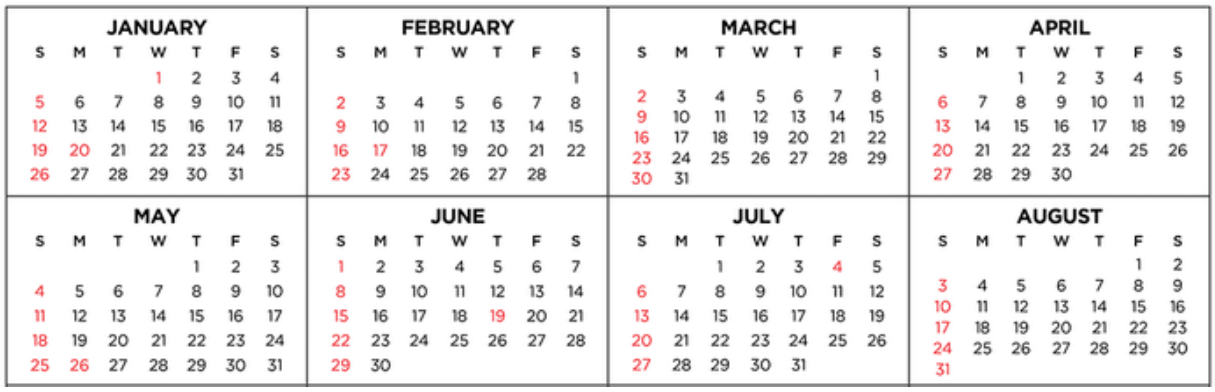
Kahoot! link https://create.kahoot.it/share/scientific-notation-quiz/e4a039c7-4857-4c18-9ddd-e02c3788ec1c

Before we move one, upperclassmen (11th and 12th graders) complete the worksheet and give an update on your project.

Underclassmen (9th and 10th graders; 11th and 12th graders partners) make sure your graphs are complete.

Upperclassmen (11th and 12th graders) Project Updates

Use the space below to write out what you need to do for your project and when.



JANUARY						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

FEBRUARY						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

MARCH						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

APRIL						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

MAY						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

JUNE						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

JULY						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

AUGUST						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Introduce Students to the Concept of Probability

To begin, we will watch the following video, Math Antics - Basic Probability, which introduces us to the basic concepts of probability.

Introduce Students to the Concept of Hypothesis Testing

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 with respect to 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 use in Testing Your Null Hypothesis

The type of inferential statistical test that you will use to determine the probability that your 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 (categorical/numeric) and dependent variable (categorical/numeric). Using the table below, find the intersection of the types of variables you have selected for your independent and dependent variables to determine which inferential statistical test you should use to test your null hypothesis.

Independent Variable is _____ and it is **Categorical** or **Numeric**. (Circle One)

Dependent Variable is _____ and it is **Categorical** or **Numeric**. (Circle One)

Name the inferential statistical test you will complete _____.
On the following pages, read over the directions to conduct a t-test or ANOVA.
If your test is a chi-square or correlation, we will discuss both tests next club meeting.
It is suggested you 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 (Y)	
		Categorical	*Numeric*
Independent Variable (X)	*Categorical*	**<u>Chi-Square Test</u>**	**<u>T-test</u>** (compares two groups) **<u>ANOVA</u>** (compares three or more groups)
	Numeric		**<u>Correlation</u>** (tells how much one variable tends to changes when the other variable changes)

How to Conduct a T-Test

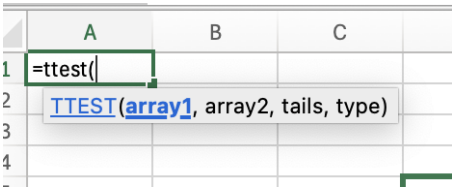
The t-test is the appropriate inferential statistical test for use in testing a null hypothesis when a researcher wishes to compare numerical dependent variable data across two groups from single independent variable that contains categorical data. The t-test can easily be performed in Microsoft Excel 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:

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.

IV-1	IV-2
DV	DV
DV	DV

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.

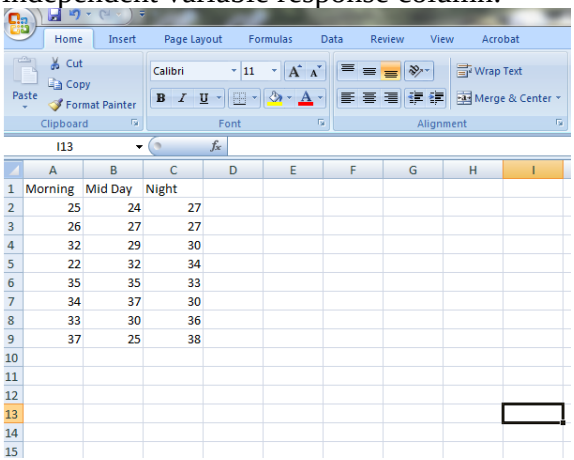
How to Conduct an ANOVA

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.

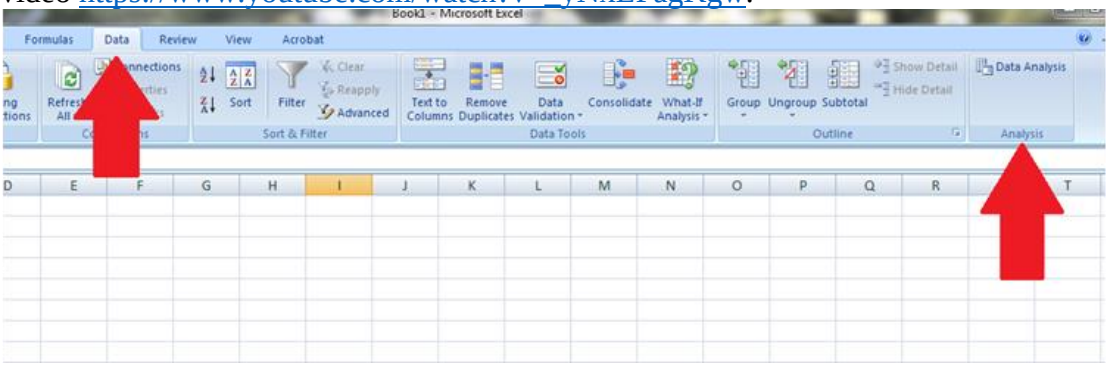
General directions follow as:
1. Open Excel.

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.

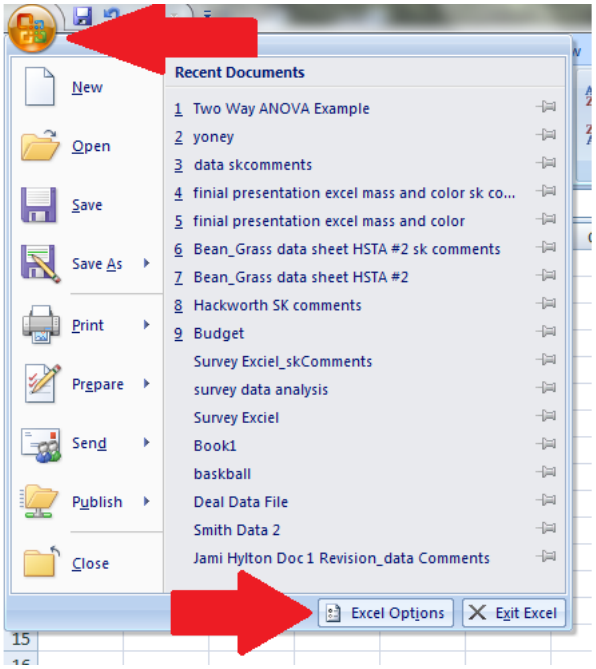


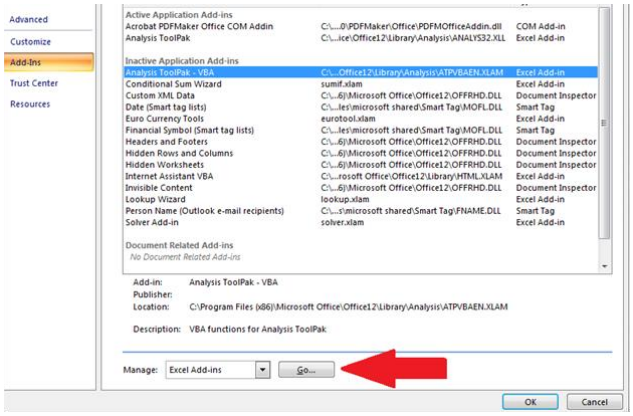
	A	B	C	D	E	F	G	H	I
1	Morning	Mid Day	Night						
2	25	24	27						
3	26	27	27						
4	32	29	30						
5	22	32	34						
6	35	35	33						
7	34	37	30						
8	33	30	36						
9	37	25	38						
10									
11									
12									
13									
14									
15									

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.



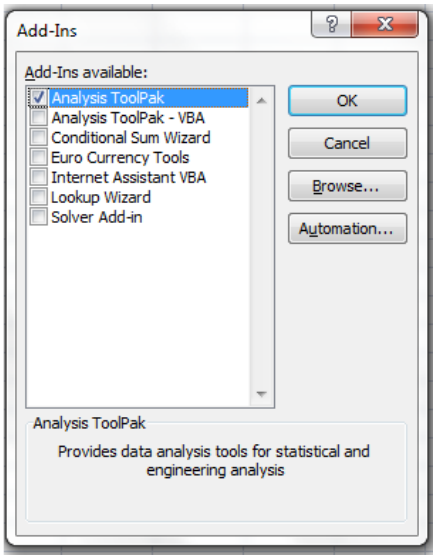
4. If not, click on the Start Button and then Excel Options.



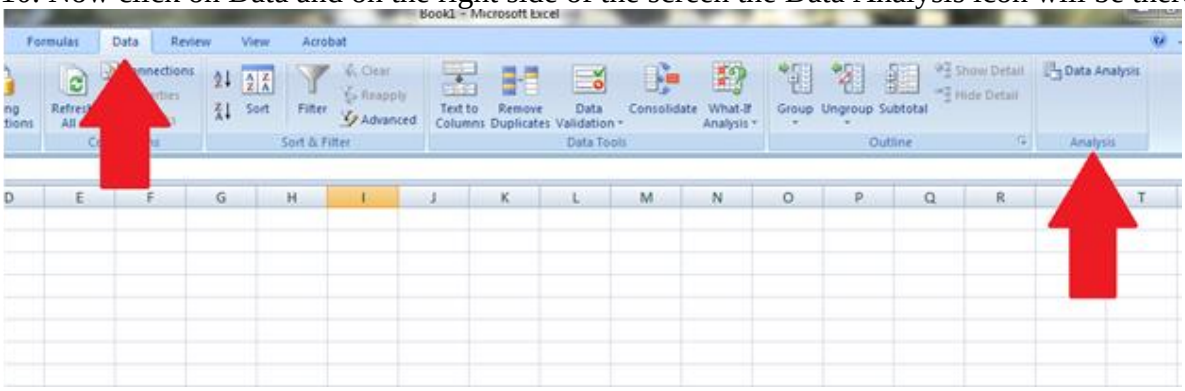


6. Click Add Ons
7. Click on Analysis ToolPak
8. Click on Go

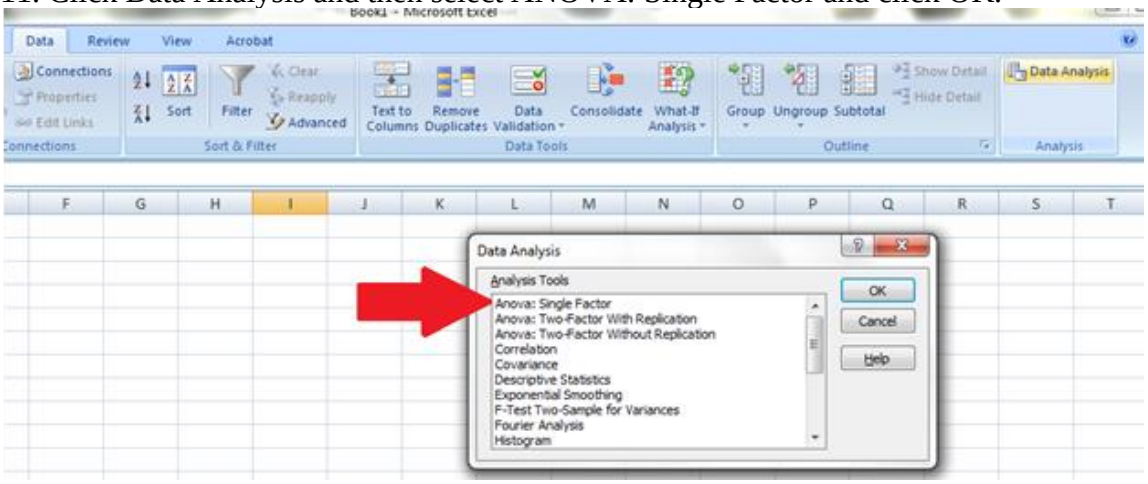
9. Make sure the Analysis TookPak is selected and click ok.



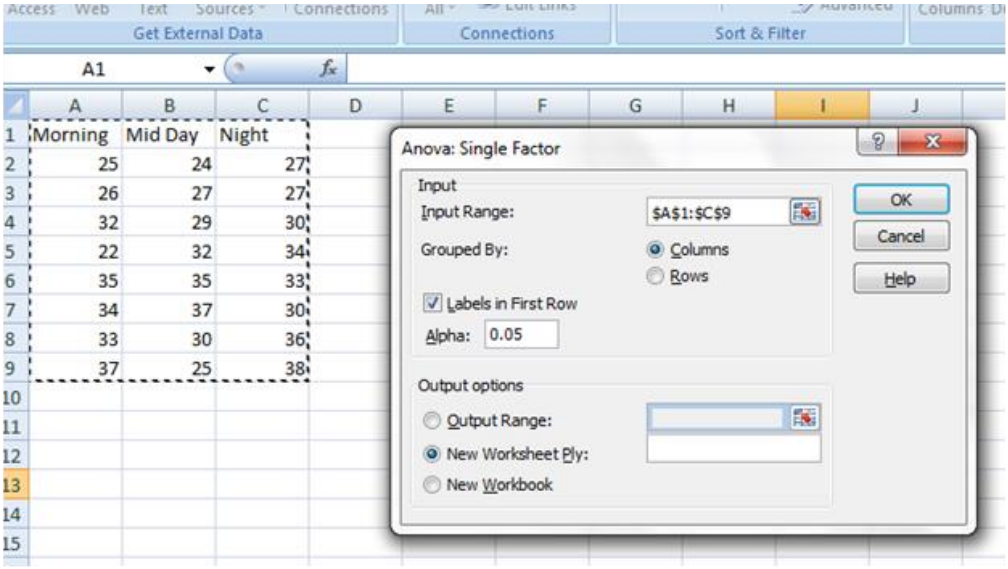
10. Now click on Data and on the right side of the screen the Data Analysis icon will be there.



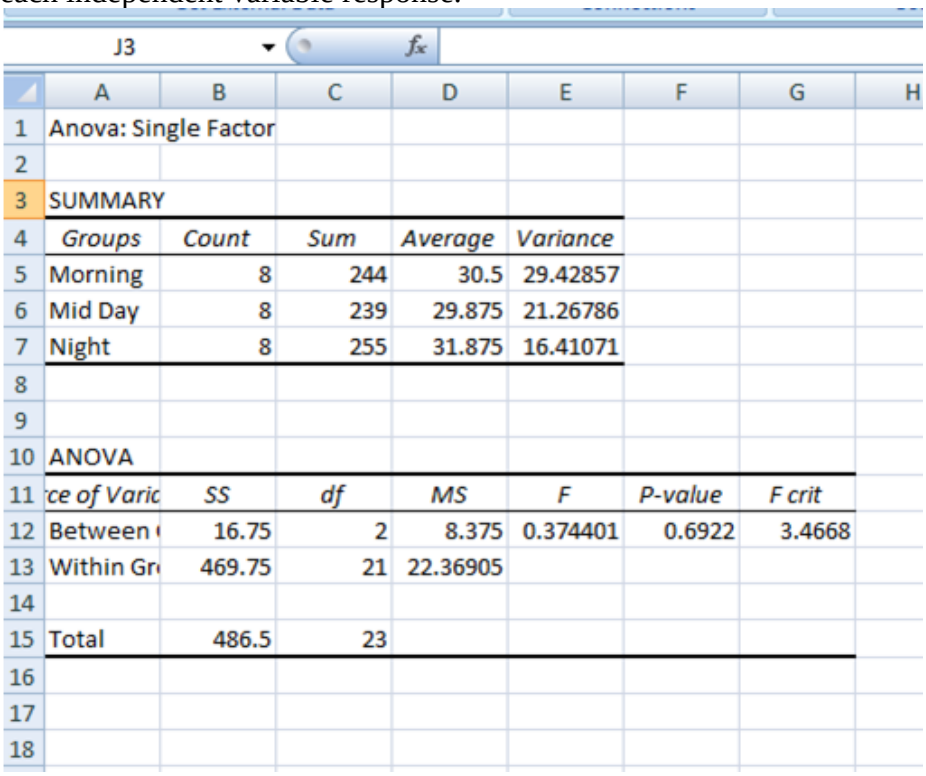
11. Click Data Analysis and then select ANOVA: Single Factor and click OK.



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 your HSTA Research Project (if applicable)

If a t-test or ANOVA is applicable to your data, complete the test now. You should be able to communicate with your HSTA teacher if the results of your t-test/ANOVA indicate the presence of a statistically significant difference and you 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

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.

Save your PowerPoint.

Next club meeting, we will go over hypothesis testing (chi-square and correlation).

Lesson #20: Hypothesis Testing (chi-square and correlation)

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

Objectives:
1. Demonstrate how to conduct a chi-square and correlation test.
2. Conduct a chi-square or correlation test on your HSTA project data (if applicable).
3. Complete the second lab from the Clean Water Kit.

Materials:
1. Internet access
2. Computer (with access to Microsoft Excel or Google Sheets and an online statistical calculator website)
3. Projector/screen/TV monitor (for viewing online videos)
4. Clean Water Kit and other materials
5. Dataset for your HSTA research project (if available)

Activities:
1. Complete the second lab from the Clean Water Kit.

Hands-on Activity #4 Clean Water Science Kit – Second Lab

The first lab will be completed during Lesson 18. The second lab will be completed during Lesson 20, and the final lab will be completed during Lesson 22.

Today we will complete the second lab hands-on activity with a Clean Water Science Kit and discuss chi-square and correlations.

Before we move on, upperclassmen (11^{th} and 12^{th} graders) complete the worksheet and give an update on your project.

Underclassmen (9^{th} and 10^{th} graders; 11^{th} and 12^{th} graders partners) make sure your count/frequencies and Measures of dispersion (Range, Standard Deviation, and Variance) are complete.

Upperclassmen (11th and 12th graders) Project Updates

Use the space below to write out what you need to do for your project and when.

JANUARY						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

FEBRUARY						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

MARCH						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

APRIL						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

MAY						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

JUNE						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

JULY						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

AUGUST						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Selection of the Inferential Statistical Test for use in Testing Your Null Hypothesis

The type of inferential statistical test that you will use to determine the probability that your 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 (categorical/numeric) and dependent variable (categorical/numeric). Using the table below, find the intersection of the types of variables you have selected for your independent and dependent variables to determine which inferential statistical test you should use to test your null hypothesis.

Independent Variable is _____ and it is **Categorical** or **Numeric**. (Circle One)

Dependent Variable is _____ and it is **Categorical** or **Numeric**. (Circle One)

Name the inferential statistical test you will complete _____.
On the following pages, read over the directions to conduct a chi-square or correlation.
It is suggested you take an example research question or a group research question and do a chi-square and correlation with the club. They can follow along on their computers and practice each test.

		Dependent Variable (Y)	
		Categorical	*Numeric*
Independent Variable (X)	*Categorical*	**<u>Chi-Square Test</u>**	**<u>T-test</u>** (compares two groups) **<u>ANOVA</u>** (compares three or more groups)
	Numeric		**<u>Correlation</u>** (tells how much one variable tends to changes when the other variable changes)

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:

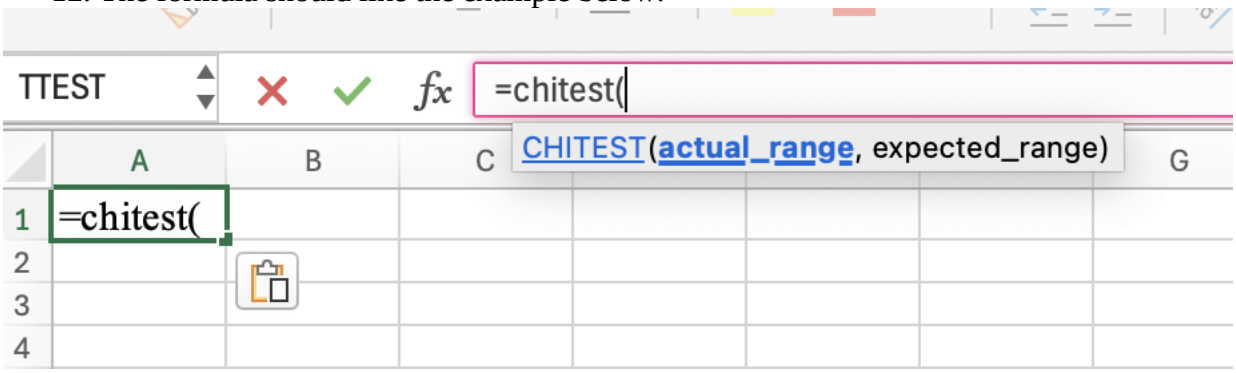
Observed Results			
	Variable 2		
Variable 1	Response 1	Response 2	Row Total
Response 1	a	b	a+b
Response 2	c	d	c+d
Column Total	a+c	b+d	a+b+c+d

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.

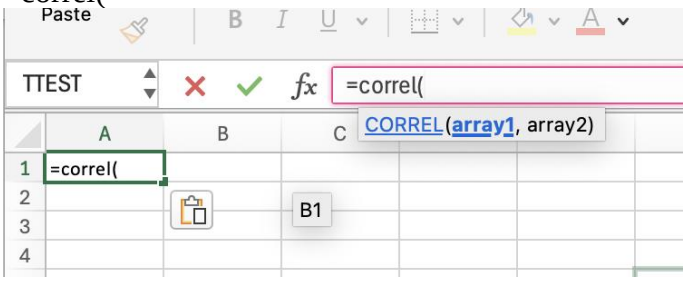
Positive correlations indicated that the directional change in the value of one variable moves in the same direction as the other variable (both variables increase in value or both variables decrease in value). Negative correlations indicate that the directional change in the value of one variable produces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



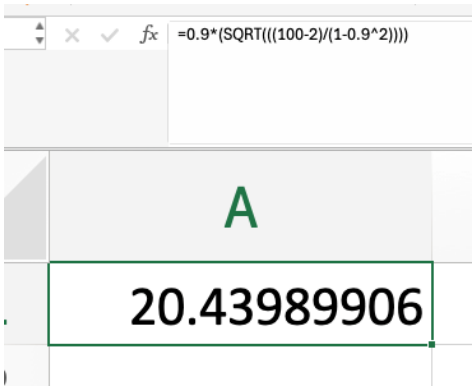
6. For 'Array 1' highlight the first column of numbers, only the numbers
7. For 'Array 2' highlight the second column of the numbers, only the numbers
8. Click OK and the correlation result will appear. This number is the *Correlation Coefficient (r).*
9. Now that you have a correlation coefficient you 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:

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

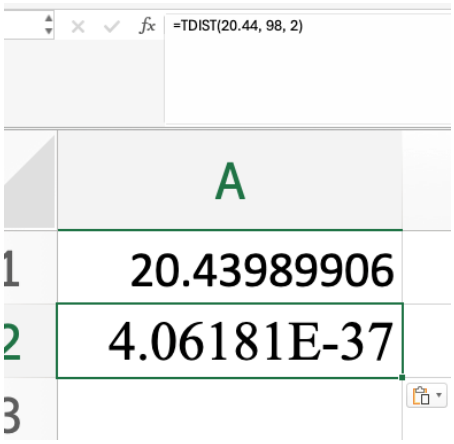
where r = coefficient of correlation n = total number of variants, (n-2) = degree of freedom.

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

12. Before you copy the formular into excel, replace r and n with your real numbers.
13. 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



14. 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.

Conduct a chi-square or correlation test to your HSTA Research Project (if applicable)

If a chi-square or correlation is applicable to your data, complete the test now. You should be able to communicate with your HSTA teacher if the results of your chi-square/correlation indicates the presence of a statistically significant difference and you 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.

Save your PowerPoint.
Next club meeting, we will continue working on projects and/or have a guest speaker.

Lesson #21: Guest Speaker

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

Objectives:

1. Engage with a guest speaker from the community.

Materials:

1. Check with the guest speaker about what supplies they need.

Activities:

1. Plan a hands-on activity with the guest speaker.

Hands-on Activity #5 – Guest Speaker

Work with the guest speaker to plan a hands-on activity. Ask them if they need materials and work with the FSC to order/pick up materials.

Lesson #22: CONCLUSION and presentation preparation

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

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

Materials:
1. Results of statistical tests completed for each project
2. Clean Water Kit and other materials

Activities:
1. Complete third lab in the Clean Water Kit.

Hands-on activity #6 - Clean Water Kit – Third Lab

The first lab will be completed during Lesson 18. The second lab will be completed during Lesson 20, and the final lab will be completed during Lesson 22.

Today we will complete the third hands-on activity with a Clean Water Science Kit and discuss the conclusion of our research projects.

Before we move on, upperclassmen (11th and 12th graders) complete the worksheet and give an update on your project.

Underclassmen (9th and 10th graders; 11th and 12th graders partners) make sure your count/frequencies and Measures of dispersion (Range, Standard Deviation, and Variance) are complete.

Upperclassmen (11th and 12th graders) Project Updates

Use the space below to write out what you need to do for your project and when.

JANUARY						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

FEBRUARY						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

MARCH						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

APRIL						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

MAY						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

JUNE						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

JULY						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

AUGUST						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Write a Conclusion Based on the Interpretation of your Statistical Test Results

Your conclusion to your 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 your null hypothesis, 3) confirmation that you have answered your research questions, 4) a discussion of limitations to the study and what their impact may be, and 5) a discussion on how you would implement change or bring awareness of your results to your community.

Brief Summary of the Project

This may be as simple as reminding your audience of your research question, the variables used in your project, and repeating your null hypothesis.

Interpretation of the Data to Conclude if it Supported or Rejected your Null Hypothesis

Provide a very brief summary of your data. If you compared two or more groups, report values of central tendency to describe your outcomes. Identify the statistical testing procedure you used and identify the resultant p-value. Note that you compared your p-value against a predetermined significance level of 0.05. If your p-value was less than 0.05, you reject your null hypothesis; if your p-value was 0.05 or greater, you accept your null hypothesis.

Confirm that you Have Answered your Research Question

Ensure that the variables used and the data analyzed were appropriate for answering your research question. Did your conclusion answer your research question?

Discuss Limitations

Every research study has limitation. As a researcher, you should be aware of and communicate what these limitations are and how they may impact the interpretation of your results. You should identify at least one limitation for your HSTA project.

Identify How You Would Implement Change and/or Bring Awareness of your Results to your Community

Lastly, results from research are not useful if they are not shared. Identify how you would share your results with your community, what changes should be implemented based on your results, and how you would go about implementing these changes in your 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.

Prepare a Completed Draft of your Project Presentation Slides

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

If you plan to utilize notecards for your presentation, you should prepare them before the next club meeting.

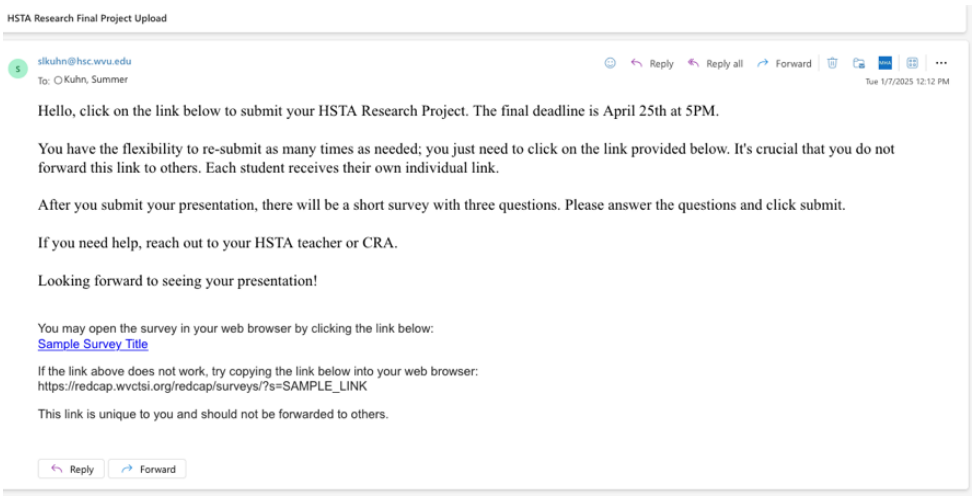
All students are required to upload a final presentation to REDCap. The final presentation needs to be submitted by April 25, 2025 5PM.

If you/your group are ready to submit your final research presentation, upload it to REDCap. If you 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 25, 2025 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 look like the sample below. 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


HSTA Research Final Project Upload

slkuhn@hsc.wvu.edu
To: Kuhn, Summer

Reply Reply all Forward

Tue 1/7/2025 12:12 PM

Hello, click on the link below to submit your HSTA Research Project. The final deadline is April 25th at 5PM.

You have the flexibility to re-submit as many times as needed; you just need to click on the link provided below. It's crucial that you do not forward this link to others. Each student receives their own individual link.

After you submit your presentation, there will be a short survey with three questions. Please answer the questions and click submit.

If you need help, reach out to your HSTA teacher or CRA.

Looking forward to seeing your presentation!

You may open the survey in your web browser by clicking the link below:
Sample Survey Title

If the link above does not work, try copying the link below into your web browser:
https://redcap.wvctsi.org/redcap/surveys/?s=SAMPLE_LINK

This link is unique to you and should not be forwarded to others.

Reply Forward

Lesson #23: Initial PRESENTATION PRACTICE and Peer feedback

Summary:
Students will provide feedback on colleague presentations.

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

Materials:
1. Internet access
2. Computer (with access to Microsoft Excel or Google Sheets and an online statistical calculator website)
3. Projector/screen/TV monitor (for viewing online videos)
4. Copies of the HSTA Symposium Scoring Rubric
5. Individual research group presentation files

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.

Provide Peer Feedback on Classmate Presentations using the Symposium Scoring Rubric

Students should be given copies of the Symposium Scoring Rubric 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.

Symposium Scoring Rubric

Student Name(s)_____

Score Sheet		0 or 1	Comments
Procedures *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 graphs, charts, and tables (title, key, x-y-axis)		
	Results including graphs, charts, and tables 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		

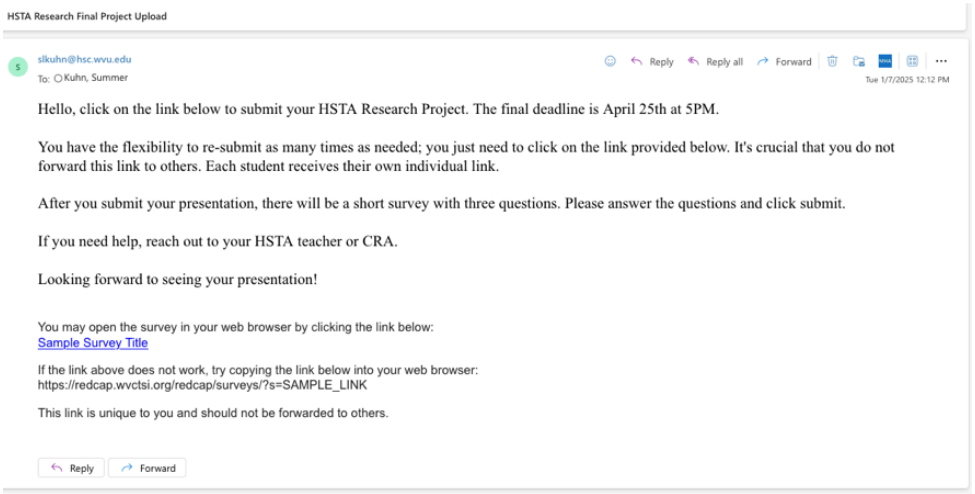
All students are required to upload a final presentation to REDCap. The final presentation needs to be submitted by April 25, 2025 5PM.

If you/your group are ready to submit your final research presentation, upload it to REDCap. If you 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 25, 2025 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 look like the sample below. 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



HSTA Research Final Project Upload

slkuhn@hsc.wvu.edu
To: Kuhn, Summer

Reply | Reply all | Forward

Tue 1/7/2025 12:12 PM

Hello, click on the link below to submit your HSTA Research Project. The final deadline is April 25th at 5PM.

You have the flexibility to re-submit as many times as needed; you just need to click on the link provided below. It's crucial that you do not forward this link to others. Each student receives their own individual link.

After you submit your presentation, there will be a short survey with three questions. Please answer the questions and click submit.

If you need help, reach out to your HSTA teacher or CRA.

Looking forward to seeing your presentation!

You may open the survey in your web browser by clicking the link below:
Sample Survey Title

If the link above does not work, try copying the link below into your web browser:
https://redcap.wvctsi.org/redcap/surveys/?s=SAMPLE_LINK

This link is unique to you and should not be forwarded to others.

Reply | Forward

Lesson #24: FINAL PRESENTATION PRACTICE and peer feedback

Summary:
Students will provide feedback on colleague presentations.

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

Materials:
1. Internet access
2. Computer (with access to Microsoft Excel or Google Sheets and an online statistical calculator website)
3. Projector/screen/TV monitor (for viewing online videos)
4. Individual research group presentation files

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.

Provide Verbal Peer Feedback on Classmate Presentations

Encourage students to provide constructive verbal feedback on one another's presentation. Feedback should be considered and applied before the Symposium.

We suggest bringing in peer teachers to score projects as a practice symposium.

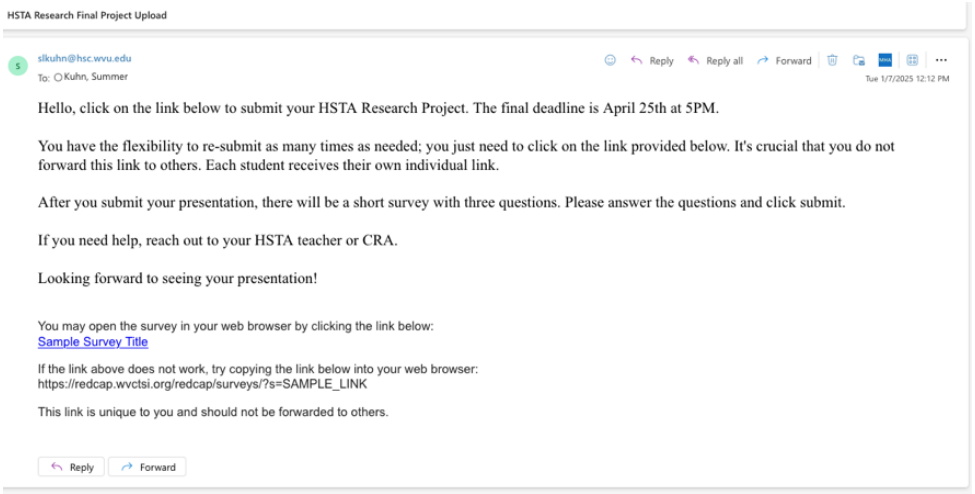
All students are required to upload a final presentation to REDCap. The final presentation needs to be submitted by April 25, 2025 5PM.

If you/your group are ready to submit your final research presentation, upload it to REDCap. If you 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 25, 2025 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 look like the sample below. 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



HSTA Research Final Project Upload

slkuhn@hsc.wvu.edu
To: Kuhn, Summer

Reply | Reply all | Forward

Tue 1/7/2025 12:12 PM

Hello, click on the link below to submit your HSTA Research Project. The final deadline is April 25th at 5PM.

You have the flexibility to re-submit as many times as needed; you just need to click on the link provided below. It's crucial that you do not forward this link to others. Each student receives their own individual link.

After you submit your presentation, there will be a short survey with three questions. Please answer the questions and click submit.

If you need help, reach out to your HSTA teacher or CRA.

Looking forward to seeing your presentation!

You may open the survey in your web browser by clicking the link below:
Sample Survey Title

If the link above does not work, try copying the link below into your web browser:
https://redcap.wvctsi.org/redcap/surveys/?s=SAMPLE_LINK

This link is unique to you and should not be forwarded to others.

Reply | Forward

Lesson #25: HSTA Wrap-Up

Summary:
Students will get symposium feedback on research presentations.

Objectives:
1. Read over symposium score sheets.
2. ***Take annual evaluation.***

Materials:
1. Internet access
2. Computer
3. Projector/screen/TV monitor

Activity: Complete a hands-on activity to wrap the HSTA year up.

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