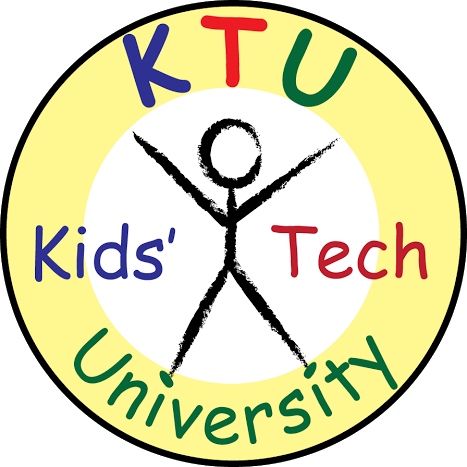
Kids’ Tech University Presents:

Science Tools



Module Instructions &

Supplemental Material



**2012-2013 Virginia Standards of Learning:**

Scientific Investigation, Reasoning, and Logic

This module incorporates the following Standards of Learning for 4th-7th Grade under the Virginia Standards of Learning. Standards found at: <http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml>

|  |  |
| --- | --- |
| **4th Grade** | **5th Grade** |
| * **4.1 a.** Distinctions are made among observations, conclusions, inferences, and predictions * **4.1 b.** Objects or events are classified and arranged according to characteristics or properties * **4.1 c.** Appropriate instruments are selected and used to measure length, mass, volume, and temperature in metric units * **4.1 e.** Predictions and inferences are made, and conclusions are drawn based on data from a variety of sources * **4.1 f.** Independent and dependent variables are identified * **4.1 h.** Hypotheses are developed as cause and effect relationships * **4.1 i.** Data are collected, recorded, analyzed, and displayed using bar and basic line graphs * **4.1 j.** Numerical data that are contradictory or unusual in experimental results are recognized * **4.1 k.** Data are communicated with simple graphs, pictures, written statements, and numbers * **4.1 l.** Models are constructed to clarify explanations, demonstrate relationships, and solve needs * **4.1 m.** Current applications are used to reinforce science concepts | * **5.1 b.** Estimates are made and accurate measurements of length, mass, volume, and temperature are made in metric units using proper tools * **5.1 c.** Estimates are made and accurate measurements of elapsed time are made using proper tools * **5.1 d.** Hypotheses are formed from testable questions * **5.1 e.** Independent and dependent variables are identified * **5.1 g.** Data are collected recorded, analyzed and communicated using proper graphical representations and metric measurements * **5.1 h.** Predictions are made using patterns from data collected, and simple graphical data are generated * **5.1 i.** Inferences are made and conclusions are drawn * **5.1 j.** Models are constructed to clarify explanations, demonstrate relationships, and solve needs * **5.1 k.** Current applications are used to reinforce science concepts |

|  |  |
| --- | --- |
| **6th Grade** | **7th Grade** |
| * **6.1 a.** Observations are made involving fine discrimination between similar objects and organisms * **6.1 b.** Precise and approximate measurements are recorded * **6.1 c.** Scale models are used to estimate distance, volume, and quantity * **6.1 d.** Hypotheses are stated in ways that identify the independent and dependent variables * **6.1 e.** A method is devised to test the validity of predictions and inferences * **6.1 f.** One variable is manipulated over time, using many repeated trials * **6.1 g.** Data are collected, recorded, analyzed, and reported using metric measurements and tools * **6.1 h.** Data are analyzed and communicated through graphical representation * **6.**1 i. Models and simulations are designed and used to illustrate and explain phenomena and systems * **6.**1 j. Current applications are used to reinforce science concepts | * **LS.1 a.** Data are organized into tables showing repeated trials and means * **LS.**1 c. Triple beam and electronic balances, thermometers, metric rulers, graduated cylinders, and probeware are used to gather data * **LS.**1 d. Models and simulations are constructed and used to illustrate and explain phenomena * **LS.1 g.** Variables are controlled to test hypotheses and trials are repeated * **LS.1 h.** Data are organized, communicated through graphical representation, interpreted, and used to make predictions * **LS.1 i.** Patterns are identified in data and are interpreted and evaluated * **LS.**1 j Current applications are used to reinforce life science concepts |

**2009 Virginia Math Standards:**

Measurement, Geometry (Properties and Relationships), Probability and Statistics (Practical Applications)

This module incorporates the following Standards of Learning for 4th-7th Grade under the Virginia Standards of Learning. Standards found at:

<http://www.doe.virginia.gov/testing/sol/standards_docs/mathematics/index.shtml>

|  |
| --- |
| **4th Grade** |
| * **4.4 b.** Add, subtract, and multiply whole numbers * **4.4 c.** Divide whole numbers, finding quotients with and without remainders * **4.4 d.** Solve single-step and multistep addition, subtraction, and multiplication problems with whole numbers |
| **6th Grade** |
| * **6.14 c.** Compare and contrast graphs that represent information from the same data set * **6.16 a.** Compare and contrast dependent and independent events |

**Introduction:**

Welcome, Instructors and Parents, to The Virtual Kids’ Tech University’s ***Science Tools*** Module! The goal of The Virtual Kids’ Tech University is to improve science literacy in primary education to ensure a strong STEM workforce of tomorrow. KTU targets elementary and middle school students at a critical point in their education where they may be intimidated by science and introduces them to a variety of fields through interactive modules and lessons online. This module, *Tools of Science*, includes three lessons; ***The Scientific Method***(covers the steps and processes used in the scientific method, data analysis, and graphing activities)*,* ***The Scientific Method Applied***(focuses on an interactive scientific experiment and looks into Queueing Theory), and ***The Tools of Science*** (measurement activities, units, and conversions for Volume, Length, Temperature, and Mass). The *Science Tools* Module is designed to provide an interactive introduction to some of the building blocks for scientific discovery and inquiry. The *Science Tools* Module as a whole aids in explaining the metric measurement system, the proper tools to utilize for the major domains of measurement, graphing/data analysis, the scientific method and much more. This module can be broken down by individual lesson and can be applied in a formal setting or in an informal setting, allowing flexibility for both instructors and students.

**Included Lesson Materials:**

Included in this document are all of the tools you will need to complete this module with your class. The following materials are incorporated within this lesson:

* **Online Module Link** – The link for the online module provides access to the online version of the Science Tools module, which includes the individual lessons, interactive activities, review games, and more!
* **Supplemental Instructor’s Notes** – In the Supplemental Materials section of this document there are Instructor’s Notes that provide additional information and key points for pages of each lesson within the module. (These notes are also included in the PowerPoint document).
* **PowerPoint Lesson** – Provides identical information as the online module in the form of slides, to allow for a lecture-based lesson. The document also includes instructor’s notes in the notes section on PowerPoint.
* **Worksheets** –The Follow-Along worksheet guides students through the online module by giving step-by-step instructions and fill-in-the-blank sentences that coordinate directly with the information in the lesson. The Applied Learning Worksheets provide questions that help students review the information from the module and applied what they have learned.
* **Interactive Lesson Activities**: Within each lesson are interactive online activities that help students with graphing, measurement, data tables, review questions, etc.

**Instructions:**

This module can be employed in two different settings: via computer or as a lecture. This module is primarily designed for online use because of the interactive activities; however, this lesson plan also provides identical information to the online module in a PowerPoint document to be given as a lecture. When using the lesson in a lecture format, you will need to have the capability to project the PowerPoint document provided for this module on to a projector screen for the student(s), accompanying your verbal lecture. If the Lesson will be used via computer, make sure to run the program on a compatible web browser (Chrome, Safari, Firefox, and Internet Explorer 10+ are all compatible). If there is a default setting for the browser on the computer(s) you will be using, be sure to have the scripts unblocked before running the module.

**Supplemental Materials Table of Contents:**

***Scientific Method:***

* **Pages 6-9:** Scientific Method Supplemental Instructor Notes
* **Page 10-13:** Scientific Method Follow-Along Worksheet
* **Pages 14-15:** Scientific Method Worksheet
* **Pages 16-19**: Scientific Method Follow-Along Worksheet Answer Key
* **Pages 20:** Scientific Method Worksheet Answer Key

***Scientific Method Applied:***

* **Pages 21-23:** Scientific Method Applied Supplemental Instructor Notes
* **Pages 24-25:** Scientific Method Applied Worksheet
* **Page 26**: Scientific Method Applied Worksheet Answer Key

***Tools of Science:***

* **Page 27:** Tools of Science Supplemental Instructor Notes

**Scientific Method Supplemental Instructor Notes:**

Below is a list of notes that have been formatted to be coordinated on a slide-by-slide basis with the online version of each lesson. These notes are also located in the notes section under each slide on the PowerPoint document for this lesson if looking at them in context is preferable. There are **not** notes for every single slide; *the notes below are titled with the identical title from the coordinating slide in the PowerPoint document or virtual model*. It is necessary that you, as the instructor, familiarize yourself with the online module and review these notes before hosting a computer lesson or lecture for students.

**“Steps of the Scientific Method”:**

We use the scientific method everyday to solve problems we are faced with. If anything, the Scientific Method is just a glorified version of our own natural thought process. However, to go through this process correctly, we cannot neglect the natural chain of events. A question leads to a guess (hypothesis), which leads to us searching for the answer (research). To prove our guess correct we have to test it (experiment) by changing something (variables). The proof (data) we gain from changing (testing) will lead us to our answer (conclusion).

**“Question”:**

Make sure that students realize that the beginning of the Scientific Method process can begin with a Question OR a Problem…they can be interchangeable. The Scientific Method helps us solve everyday questions or bigger problems that lead to multiple questions.

**“Research”:**

Students need to understand that to conduct a scientific experiment correctly, they must research the topic they wish to learn about beforehand. This is because you cannot make an educated guess without having educated yourself on the topic you’re exploring. Researching the topic will also provide enough information to lead to a more accurate and sound experiment.

**“Hypothesis”:**

The Hypothesis is a crucial step in the entire Scientific Method. This step is virtually what the entire science experiment is founded upon because it highlights the chosen independent and dependent variables. Students should be aware that this statement is not just a “guess”, **it has to include what will be changed in the experiment as well as the reason behind the predicted result**. Depending on the grade level or standards your teaching is based upon, you may want to emphasize the “if, then, because” method to writing a Hypothesis. This method will ensure that the independent variable, dependent variable, and research for the experiment are all incorporated into the hypothesis statement.

**“Design the Experiment”:**

Designing the Experiment is a type of extension upon the Hypothesis to provide evidence as to whether your hypothesis will be supported or not supported. The design of the experiment must be based upon the independent variable that is being changed. In other words, make sure that students know that when it comes to Independent Variables, **they can only change ONE thing that they are personally controlling in the experiment**. Make sure that the change you are looking to measure (dependent variable) is measurable either **qualitatively** or **quantitatively**. Heavily emphasize to students this point: **all dependent variables MUST be measurable in order to provide evidence for the Hypothesis.**

**“Controls”:**

Make sure that the students understand that if they are doing any type of comparison, all aspects of the experiment, except for the Independent Variable, MUST remain the same for the subjects being compared. They must also notate these controls somewhere to refer to in case the experiment yielded abnormal results or if they wish to perform the experiment again. It only takes one unintended variable changing while comparing subjects to make the entire experiment invalid.

**“Procedures”:**

Students need to have a basic comprehension of the way procedures must be written in a way that can allow for repetition of the experiment by others. In other words, make sure that students get in the habit of writing HIGHLY detailed Procedure pages (including all measurements, processes, and controls). Make sure to click on the procedures page to look at an accurate procedures document for the example experiment in the lesson.

**“Perform the Experiment”:**

After the controls and variables have all been accounted for and the materials are set up, it is finally time to perform the experiment! A major point in performing the experiment that the kids need to understand is that they must perform the procedures EXACTLY as they are written. If they are creating the experiment themselves, they need to be VERY conscious as to whether or not their procedures are detailed enough to be repeated.

**“Make a Table”:**

Although they seem like an afterthought, tables are crucial in expressing the data fully and accurately. This is the place where the full effects of the independent variable are first visible as data. It is important to emphasize that when students are creating their tables, they **must use units**. Make sure they understand that it is **never** acceptable to simply record numbers; this will cause their data to be invalid.

**“Tables: Columns”:**

This is an optional slide to break down the table if your class is new to the material or having difficulty remembering the basic set up. Make sure to express the difference between columns and rows as simply as it truly is. However, when it comes to variables, make sure that they understand the way variables interact with the columns and rows.

**“Tables: Rows”:**

This is an optional slide to break down the table if your class is new to the material or having difficulty remembering the basic set up. Make sure to express the basic difference between columns and rows as simply as it truly is. However, when it comes to variables, make sure that they understand the way variables interact with the columns and rows.

**“Record the Data”:**

Make it clear to students how the table is essentially the blank template for their data. Once they have set up the table, they can **then** perform the experiment and record the data. Emphasize again that **units** are **crucial**. Neglecting to record the units along with the numerical data will lead to invalid data. If you are using only the PowerPoint version of this Lesson, you may want to refer to the Worksheet included in the Lesson plan to give your class extra practice on becoming comfortable with graphs. If you are using the interactive online module, there will be an opportunity for your class to practice working with tables using one of the interactive activities.

**“Analyze the Data”:**

This is a major step in their entire experiment. Next to running the experiment, this is the most important step towards providing evidence for the hypothesis. The analysis of data is an opportunity for the student to express their data visually and comprehensively. As explained in proceeding slides, there are various ways to express and analyze data, all of which provide different perspectives. These different perspectives collectively allow the student to reach a very accurate conclusion, regardless of whether it supports their hypothesis or not.

**Bar Graphs:**

Bar graphs are the simplest way to display change between two subjects. This slide does not go into deep detail about the set up of the graph to avoid over-complicating the basic concept (in case this is being taught to lower grade levels). However, there are slides that can be reached regarding the very detailed breakdown of graph set up and the different types of graphs and their functions. The main purpose of this slide is simply for students to see that Plant B grew larger than Plant A from a visual representation.

**Conclusion:**

The conclusion is the point at which the entire experiment derives its purpose. This is where the analyzed data is met with reasons, causes, and results. This is also the point where the Hypothesis is either supported or not. Without enough data and proper representations and analysis of that data, an accurate conclusion cannot be drawn. Emphasize to students that the conclusion depends on all aspects of the scientific method being done properly, to reach an accurate answer. If all of those parts are done correctly, then a conclusion can be drawn that solves the problem at hand and leads to answers for previous and even future questions!

Additional Slides:

**“Graphs”:**

If students are brand new to the world of graphing, you may want to spend some additional time on this portion of the material, as it will be crucial to their understanding of many things in math and science in the future.

**“Scatter Plots”:**

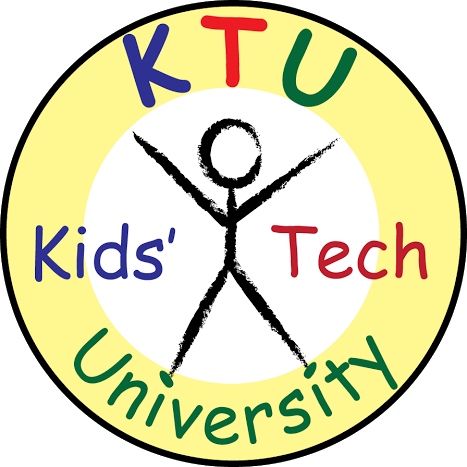
This is the students’ first real look at how points are plotted on a graph before it becomes a more visual representation. The major objective that they need to understand here is that scatter plots are used primarily for plotting all data points and viewing them. If they are having difficulty understanding the way points are plotted, it is highly suggested that you have them take time on the interactive graphing activities, found in the online module on the “Graphs” page, to gain a better understanding.

**Line Graphs:**

Since we technically have incorporated 2 independent variables (time in days and the types of fertilizers) we have to display the data in a way that shows time as our independent variable. Although rates are important to look at when using line graphs (Plant B grew at a faster rate than Plant A), avoid discussing them while you are still introducing the graphs themselves. From this graph students should really be focused on understanding that this graph is designed to show that Plant B grew faster. For example, if they look at a height such as 20 cm, Plant B achieved this before Day 4, however, it took Plant A until Day 4 to reach the same height. In other words, Plant B grew faster!

**“Pie Charts”:**

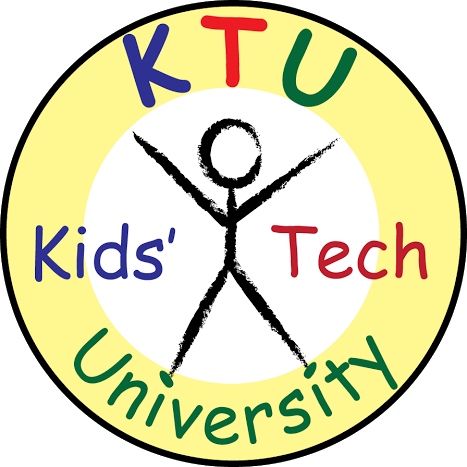
Looking at data from as many perspectives as possible helps draw the most accurate and well-rounded conclusions possible. In this example, the data is displayed in terms of trials and percentages. Since both fertilizers were able to achieve heights of at least 20cm, it is important to look at which fertilizer was more AFFECTIVE overall in creating plants that reach a certain height. This gives yet another aspect to the data that can not be easily shown by just looking at the chart.

**Scientific Method Follow-Along**

(Designed to coordinate directly with the Online Module)

Welcome to Kid’s Tech University’s lesson on Scientific Method! By going through this module you will learn about the steps in the scientific method, graphing, tables, and variables! Follow through this worksheet to complete this lesson!

1. After looking at the first slide, click Continue Learning to look at the *Scientific Method* page. Read the entire page to fill in the blanks in the following sentence:
   1. Every time you \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, you use the Scientific Method.
2. Click Continue Learning to get to the *Steps of the Scientific Method* page. Read the entire page to fill in the blanks in the following sentences:
   1. The order of the scientific method is:
   2. Problem/Question
   3. Research
   4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   5. Procedure/Experiment
   6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   7. Conclusion
3. Click Continue Learning to get to the *Question* page. Read the entire page to fill in the blanks in the following sentence:
   1. Everyday you are faced with problems or come up with questions. Having a Question is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ step to finding the solution.
4. Click Continue Learning to get to the *Research* page. Read the entire page to fill in the blanks in the following sentence:
   1. To begin answering your question, you have to do a little \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on the topic.
5. Click Continue Learning to get to the *Hypothesis* page. Read the entire page to fill in the blanks in the following sentences:
   1. After researching your topic you have enough information to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ how your experiment will go.
   2. If you use Fertilizer 1 on Plant A and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on Plant B, then you can expect \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to grow taller because its fertilizer has more growth nutrients.
6. Click Continue Learning to get to the *Design the Experiment* page. Read the entire page to fill in the blanks in the following sentences:
   1. A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is something that changes (varies or can change).
   2. Dependent Variable: This variable depends on other variables. It is the variable that you are trying to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
7. Click on the link that says, “Click here to learn more about controls,” to get to the *Controls* page. Read the entire page to fill in the blanks in the following sentence:
   1. Controls are the part of the experiment that you want to keep the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ no matter what.
8. Click Continue Learning to get to the *Procedures* page. Read the entire page to fill in the blanks in the following sentences:
   1. Procedures are the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for an experiment.
   2. Describe how to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the independent variable.
   3. Describe how to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the dependent variable.
9. Click Continue Learning to get to the *Perform the Experiment* page. Read the entire page to fill in the blanks in the following sentence:
   1. You record the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of Plant A and Plant B for \_\_\_\_\_\_\_\_\_\_ days in a row once they start sprouting.
10. Click Continue Learning to get to the *Make a Table* page. Read the entire page to fill in the blanks in the following sentences:
    1. To organize the data better we use \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
    2. Tables have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (vertical – like columns on buildings) and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (horizontal – like rows of corn across a field).
11. Click Continue Learning to get to the *Tables: Columns* page. Read the entire page to fill in the blanks in the following sentences:
    1. Each column of a table is for one \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
    2. In our experiment we have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ variables:
    3. The Day (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ variable)
    4. Height of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (dependent variable)
    5. Height of Plant B (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ variable)
12. Click Continue Learning to get to the *Tables: Rows* page. Read the entire page to fill in the blanks in the following sentence:
    1. The data within a row of a table is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. So rows help us organize sets of related \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
13. Click Continue Learning to get to the *Record the Data* page. Read the entire page to complete the activity and to fill in the blanks in the following sentences:
    1. Day 2: Plant A was \_\_\_\_\_\_\_\_\_\_\_\_\_cm tall and Plant B was \_\_\_\_\_\_\_\_\_\_\_cm tall.
    2. Day 3: Plant A was \_\_\_\_\_\_\_\_\_\_\_\_\_cm tall and Plant B was \_\_\_\_\_\_\_\_\_\_\_cm tall.
    3. Day 4: Plant A was \_\_\_\_\_\_\_\_\_\_\_\_\_cm tall and Plant B was \_\_\_\_\_\_\_\_\_\_\_cm tall.
14. Click Continue Learning to get to the *Analyze the Data* page. Read the entire page to complete the activity and to fill in the blanks in the following sentence:
    1. Charts and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ help make the data from your table more visual. This will help you spot trends and reach \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
15. Click Continue Learning to get to the *Bar Graphs* page. Read the entire page to complete the activity and to fill in the blanks in the following sentence:
    1. Bar graphs are used to show the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ change in something.
16. Click Continue Learning to get to the *Conclusion* page. Read the entire page to complete the activity and to fill in the blanks in the following sentence:
    1. From our data, we conclude that our \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ was correct and Fertilizer 2 helped Plant B grow taller than Plant A.

**Scientific Method Worksheet**

(Most Suitable for 4th -7th Grade)

Please read all of the directions in this section to complete this worksheet.

🡪 Steps of the Scientific Method

*What are the six main steps in the scientific method? Some of the answers have already been filled in:*

1. Question/Problem
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Procedure/Experiment
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Conclusion

🡪 Multiple Choice

*Choose the answer that best answers the question:*

1. This variable does not depend on the other variable. This is the variable that you control.
   1. Dependent Variable
   2. Independent Variable
2. All of the following are things that should be included when you are writing your Procedures for an experiment, **except**:
   1. Measurements for all of the materials you used
   2. The color shirt you are wearing while you are taking measurements
   3. The unit (gram, liter, centimeter, etc.) at the end of a number
3. Each column in a Table represents one:
   1. Number
   2. Variable
   3. Measurement
4. Putting data into Graphs helps us do all of the following **except**:
   1. Visualize the data
   2. See trends in the data
   3. Understand the question better
   4. Reach conclusions about the data

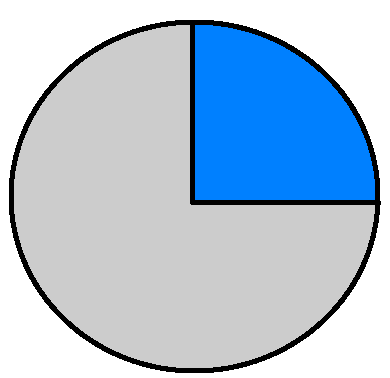
🡪 Graphing

*Look at the following graphs and determine what type of graph they are by choosing an option from the following answer choices and writing it on the line below the corresponding graph:*

**a. Pie Chart**

**b. Scatter Plot**

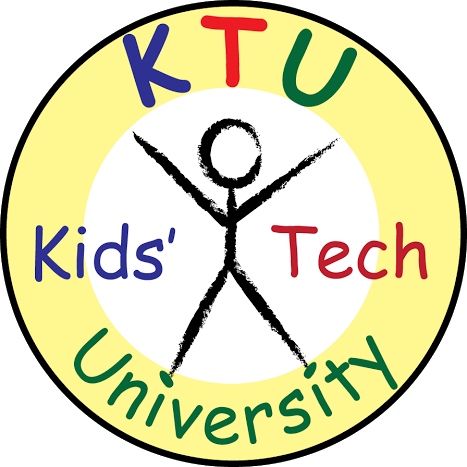
**c. Bar Graph**



1.

3.

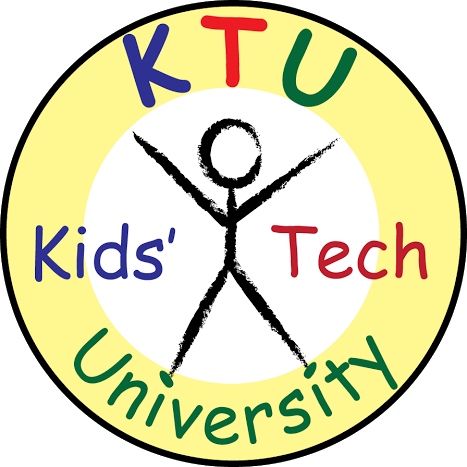
2.

**Scientific Method Follow-Along**

ANSWER KEY

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1. After looking at the first slide, click Continue Learning to look at the *Scientific Method* page. Read the entire page to fill in the blanks in the following sentences:
   1. Every time you Solve a Problem, you use the Scientific Method.
2. Click Continue Learning to get to the *Steps of the Scientific Method* page. Read the entire page to fill in the blanks in the following sentences:
   1. The order of the scientific method is:
      1. Problem/Question
      2. Research
      3. Hypothesis
      4. Procedure/Experiment
      5. Analyze Data
      6. Conclusion
3. Click Continue Learning to get to the *Question* page. Read the entire page to fill in the blanks in the following sentences:
   1. Everyday you are faced with problems or come up with questions. Having a Question is the First Step step to finding the solution.
4. Click Continue Learning to get to the *Research* page. Read the entire page to fill in the blanks in the following sentences:
   1. To begin answering your question, you have to Research the topic.
5. Click Continue Learning to get to the *Hypothesis* page. Read the entire page to fill in the blanks in the following sentences:
   1. After researching your topic you have enough information to Predict how your experiment will go.
   2. If you use Fertilizer 1 on Plant A and Fertilizer 2 on Plant B, then you can expect Plant B to grow taller because its fertilizer has more growth nutrients.
6. Click Continue Learning to get to the *Design the Experiment* page. Read the entire page to fill in the blanks in the following sentences:
7. A Variable is something that changes (varies or can change).
8. Dependent Variable: This variable depends on other variables. It is the variable that you are trying to Measure.
9. Click on the link that says, “Click here to learn more about controls,” to get to the *Controls* page. Read the entire page to fill in the blanks in the following sentence:
   1. Controls are the part of the experiment that you want to keep the Same no matter what.
10. Click Continue Learning to get to the *Procedures* page. Read the entire page to fill in the blanks in the following sentences:
    1. Procedures are the Directions for an experiment.
    2. Describe how to Change the independent variable.
    3. Describe how to Measure the dependent variable.
11. Click Continue Learning to get to the *Perform the Experiment* page. Read the entire page to fill in the blanks in the following sentences:
    1. You record the Heights of Plant A and Plant B for Four days in a row once they start sprouting.
12. Click Continue Learning to get to the *Make a Table* page. Read the entire page to fill in the blanks in the following sentences:
13. To organize the data better we use Tables.
14. Tables have Columns (vertical – like columns on buildings) and Rows (horizontal – like rows of corn across a field).
15. Click Continue Learning to get to the *Tables: Columns* page. Read the entire page to fill in the blanks in the following sentences:
    1. Each column of a table is for one Variable.
    2. In our experiment we have Three variables:
       1. The Day (Independent variable)
       2. Height of Plant A (dependent variable)
       3. Height of Plant B (Dependent variable)
16. Click Continue Learning to get to the *Tables: Rows* page. Read the entire page to fill in the blanks in the following sentences:
    1. The data within a row of a table is Related. So rows help us organize sets of related Data.
17. Click Continue Learning to get to the *Record the Data* page. Read the entire page to complete the activity and to fill in the blanks in the following sentences:
    1. Day 1: Plant A was 2 cm tall and Plant B was 2.5 cm tall.
    2. Day 2: Plant A was 7.5 cm tall and Plant B was 10 cm tall.
    3. Day 3: Plant A was 13 cm tall and Plant B was 17 cm tall.
    4. Day 4: Plant A was 20 cm tall and Plant B was 25 cm tall.
18. Click Continue Learning to get to the *Analyze the Data* page. Read the entire page to complete the activity and to fill in the blanks in the following sentence:
19. Charts and Graphs help make the data from your table more visual. This will help you spot trends and reach Conclusions.
20. Click Continue Learning to get to the *Bar Graphs* page. Read the entire page to complete the activity and to fill in the blanks in the following sentence:
    1. Bar graphs are used to show the Total change in something.
21. Click Continue Learning to get to the *Conclusion* page. Read the entire page to complete the activity and to fill in the blanks in the following sentence:
    1. From our data, we conclude that our Hypothesis was correct and Fertilizer 2 helped Plant B grow taller than Plant A.

**Scientific Method Worksheet**

ANSWER KEY

🡪 Steps of the Scientific Method

1. Question/Problem
2. Research
3. Hypothesis
4. Procedure/Experiment
5. Data Analysis
6. Conclusion

🡪 Multiple Choice

1. B
2. A
3. B
4. B
5. C

🡪 Graphing

1. B
2. C
3. A

**Scientific Method Applied Supplemental Instructor Notes:**

Below is a list of notes that have been formatted to be coordinated on a slide-by-slide basis with the online version of each module. These notes are also located in the notes section under each slide on the PowerPoint document for this module looking at them in context is preferable. There are **not** notes for every single slide; *the notes below are titled with the identical title from the coordinating slide in the PowerPoint document or virtual model*. It is necessary that you, as the instructor, familiarize yourself with the online module and review these notes before hosting a computer lesson or lecture for students.

**“The Scientific Method in Everyday Life; The Grocery Store”:**

Before beginning this module, it is HIGHLY recommended that students first review KTU’s *Scientific Method* module to preface the information they will be exposed to in this module. This module is applicable for all age groups; however, it would be highly beneficial for students to have a firm understanding of the scientific method prior to seeing it in a more advanced context.

**“Background Research” 1:**

This slide incorporates the first introduction of mathematics within the module. Students will not be able to move on past this slide until they have completed the two questions at the bottom. The first asks for the average from the number set above. If students are having any difficulty, make sure that they press the “solve” button to work through averaging step by step. After they find the average they can move on to the second question which asks for the average number of people that come in per hour into the store. This can be solved by dividing the initial average by the number of hours per day the store is operating. If they make it through all of the steps correctly, they should find the average number of people that come in per hour to the store and the “Continue Learning” button should appear to allow them to move on.

**“Background Research” 3:**

This slide uses the exact same mathematical processes as the first Background Research slide, just with different number sets. Instead of finding the average number of customers per day, students will find the average time each cashier takes to checkout a customer. If students are still having difficulty with averaging, there is another “solve” button to walk them through step by step towards finding the average. Following the first averaging question is a second question that asks how many cashiers will be needed to serve a certain number of customers per hour. This question requires students to first find the number of customers a cashier can check out per hour (60 mins divided by the first average they found about checkout time per customer). Following this they need to divide the number of people per hour by the number of customers a cashier can check out per hour. If they make it through all of the steps correctly, they should find how many cashiers they will need and the “Continue Learning” button should appear to allow them to move on.

**“Hypothesis”:**

Since the student should have already reviewed KTU’s *Scientific Method* module, they should be familiar with the appropriate format for a hypothesis. This being said, make sure to emphasize the underlined “If”, “then”, and “because” statements to ensure that they learn to cover all of the variables and research required in the formatting of a hypothesis.

**“What do We Expect to See”:**

If students are at all confused by the GIF animation provided on this page, make sure that they understand that this is a theoretical image of grocery store lines (the yellow dots are people and the cash registers are cashiers). The animation on this page is only present to help students visualize the hypothesis made on the previous page.

**“Experiment: Observe What Happens”:**

Similar to the “What do We Expect to See” page, this page incorporates a GIF animation that displays the reality of grocery store lines (the red dot reading “delay”, indicates that lines are not flowing smoothly as we had assumed in our hypothesis).

**“Data”:**

This page builds upon the student’s current understanding of data by incorporating some differentiations in the form of qualitative vs. quantitative data. It is crucial that students understand this concept because it enforces the need for units. Students must answer all 11 qualitative vs. quantitative questions before moving on by clicking on the gray “Qualitative vs. Quantitative” button on the page. Once they have completed the questions the “Continue Learning” button should reappear and allow them to continue.

**“Conclusion”:**

Make sure students are aware that having experimental data prove their hypothesis as incorrect is OK. In fact, it typically leads to better questions and experiments that will help them learn more about what they are researching.

**“Experiment”:**

The scientific method is NOT linear; it is continuous. Since the first conclusion proved the initial hypothesis to be incorrect, it is necessary to refine the research further by trying a different experiment. The student will be asked to make a “guess” as to how many cashiers will be enough, knowing now that 3 cashiers was insufficient. When the student makes a guess, the “Continue Learning” button should appear to allow the student to move on.

**“Perform the Experiment”:**

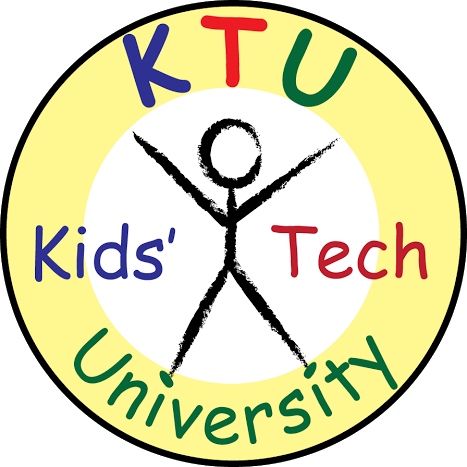
After the student has clicked the “Run Experiment” button and received the results from their theoretical experiment, they should be taking a look at all of the data that appears. Although there will be quite a bit to look at, the emphasis should be looking to the bar graph to see which number of cashiers yielded the highest profit. If the bar graph appears to display a tie between two different numbers of cashiers, make sure students look at the table to check the Profits that coordinate with the numbers. Even though the bar graph may appear to have two very close values, the number values can be distinguished more clearly in the table. Once the student has identified the optimal number of cashiers and submitted their answer, the “Continue Learning” button should appear to allow them to continue.

**“Analyze the Data”:**

Take time to discuss the questions on this page with your student(s). It will give them an introduction into the final portion of the module. It is important that they also understand the concept of unhappy customers leaving as part of the data analysis.

**“Conclusion 2”:**

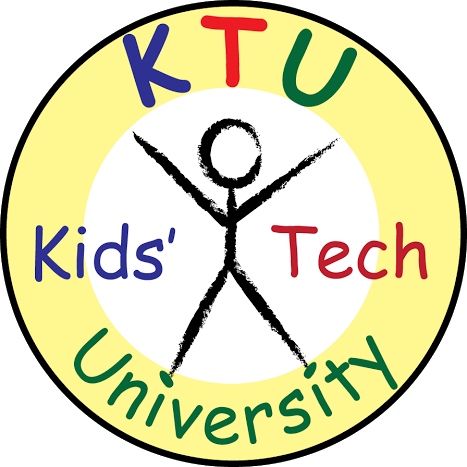
Discuss the topics on this page as well as those on the “Conclusion 1” page to help students see that data can be multifaceted and lead to multiple discoveries. However, encourage them to use the facts they learn from experimentation to develop a final conclusion that focuses solely on their initial hypothesis.

**Scientific Method Applied:**

The Grocery Store

Welcome to Kid’s Tech University’s lesson on the *Scientific Method Applied*! Finish the Scientific Method Applied Module fully before completing this worksheet.

1. Before we completed our experiment, how many cashiers did we originally believe would be the correct number to handle the average flow of customers in the store? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. When there are more customers than the store can handle:
   1. Underloading
   2. Overloading
   3. Critical Point
3. When there are too many cashiers hired for the number of customers in the store:
   1. Underloading
   2. Overloading
   3. Critical Point
4. What happened to the number of customers leaving when we hired more cashiers?
   1. There were more angry customers that left the store.
   2. There were less angry customers that left the store.
5. Hiring more cashiers allowed the store to do what?
   1. Store more food in the store.
   2. Handle more customers without the lines backing up too much.
   3. Stay open more hours each day.
6. If Overloaded means to have more customers to serve than the store can handle, what do you think Critically Loaded means?
   1. The store is serving the maximum amount of customers that it can handle.
   2. The store does not have enough customers to stay in business.
7. In our hypothesis we stated that our store would need 3 cashiers to handle to customer flow for the day. Why was our hypothesis not supported?
   1. The store needed more than 3 cashiers for when it is Critically Loaded with customers.
   2. The store needed more than 3 cashiers for when it is Underloaded with customers.
   3. The store needed more than 3 cashiers for when it is Overloaded with customers.
8. Based on what you learned from this experiment, the store needed:
   1. Less cashiers than what is required to handle the average number of customers.
   2. More cashiers than what is required to handle the average number of customers.
9. Do you think it is acceptable that our first hypothesis was not supported?
   1. No, since the first Hypothesis was not supported, the experiment became invalid.
   2. It is acceptable that our first hypothesis was not supported because it led us to conducting another experiment that helped us to find the actual answer.
10. What could we change about this experiment to make it more accurate?
    1. Repeat this experiment multiple times and in different types of stores to get a wider range of data.
    2. Give customers coupons before running the experiment.
    3. Change the layout of the store.

**Scientific Method Applied:**

ANSWER KEY

Welcome to Kid’s Tech University’s lesson on the *Scientific Method Applied*! Finish the Scientific Method Applied Module fully before completing this worksheet.

1. Three
2. B
3. A
4. B
5. B
6. A
7. C
8. B
9. B
10. A

**Tools of Science Supplemental**

**Instructor Notes:**

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**“Length”:**

For the length portion, there are several different topics going on. To avoid overwhelming students, you may want to start by simply talking about length as a measurement of distance. However, distance can describe many different qualities. There are also conversions to help connect the students with measurements they are familiar with as well as guide them towards the metric units utilized in the world of science. Beyond this page is a Measuring Length Activity that is excellent for making fine discriminations of length by virtually measuring several different objects with both a metric ruler and a U.S. 12-inch ruler.

**“Volume”:**

The volume slide is the most complex of the slides because it breaks off into 3 subcategories that explain how to find volume for each form of matter. To understand this material, students should be somewhat familiar with the concept of matter and how matter takes up 3-dimensional space. The liquid volume activity focuses on reading a meniscus in a graduated cylinder to obtain an accurate measurement for the volume of liquids. The Solids portion of the volume slide focuses on finding volume for solid objects using the Displacement method. There is also an activity that allows students to practice finding volume using displacement. It is highly recommended that students preface this activity with the liquids activity described above. The final volume activity is for gases and allows students to practice finding the volume of cubes, rectangular prisms, and cylinders. It is **highly recommended** that students be given access to calculators for this portion if they are not currently comfortable with multiplication, division, and decimals.

**“Temperature”:**

The “Temperature” slide focuses on introducing students to the Celsius temperature scale in its relation to Fahrenheit, as well as freezing and boiling points. Included is an activity on reading temperature using a thermometer as well as converting temperatures from Celsius to Fahrenheit.

**“Weight and Mass”/ “Weight vs. Mass”:**

Since weight is used to calculate mass in scientific measurements on scales, it is difficult to express to define one without the other in this context. To accommodate, the “weight and mass” slide combines weight and mass to help distinguish the difference for scientific purposes. The “Weight and Mass” page expresses how weight and mass are used to find mass measurements using scientific units and their conversions. The connected “Weight vs. Mass” page distinguishes the differences between weight and mass more clearly.