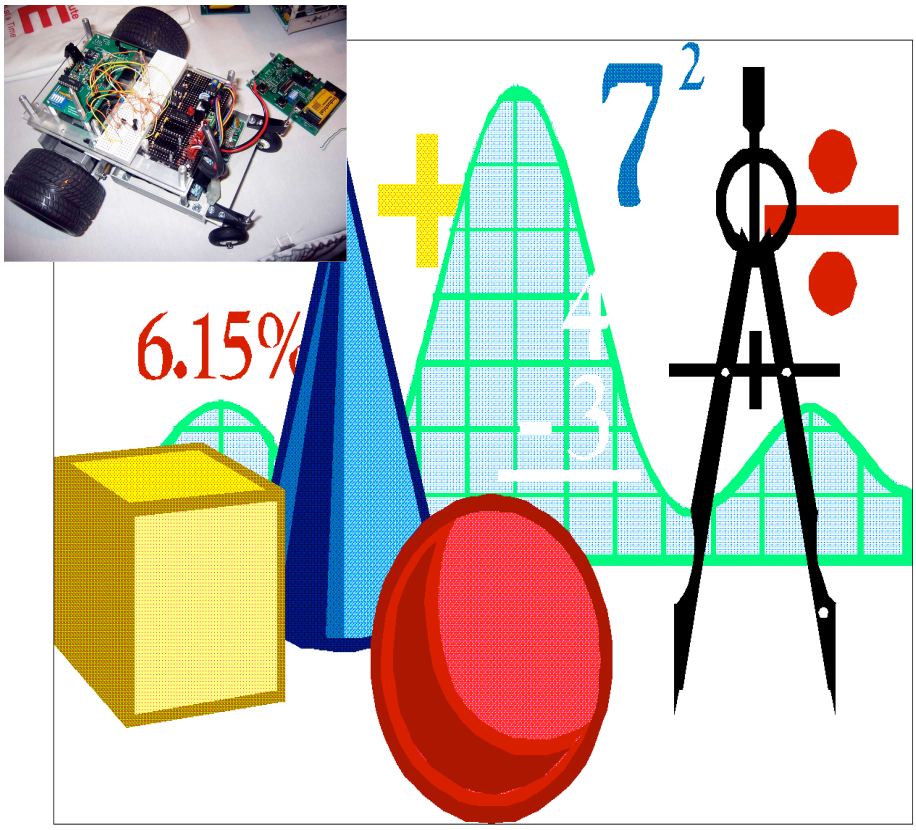
SPIRIT Lesson Writing Guide
May 18, 2011

======= Guide =======



Written By:
Brian Sandall

-- For SPIRIT Lesson Authors--

SPIRIT Lesson Writing Guide

Document listing

1) Lesson writing paragraph
2) Lesson writing guidelines
3) Sample lesson Trig SOH Easy
4) Sample lesson Trig SOH Easy Assessment
5) Listing of available I components

Lesson Writing Guide Paragraph

After editing over one hundred AEIOU formatted lessons related to the SPIRIT, SHINE and SOLAR projects, it has become apparent that a better lesson-writing guide be made available to prospective teachers writing lessons in this format. The guide outlines a lesson writing flow that makes sense from a curriculum development standpoint, which has not been explained to teachers thus far. The new lesson writing flow starts by selecting an I component then writing the U component to assess the I. Next, the A, E and O components are written with different activities which help teach the content as outlined in the I and U. Finally, the overall lesson summary should be written. This lesson flow has been found to be the most efficient when editing lessons and working with teachers writing lessons in the AEIOU format. The guide also highlight common errors that have been noted during the editing process and provides a lesson completion checklist for teachers to complete before submitting lessons to be edited. Each of the parts of the AEIOU lesson are explained in a more teacher friendly manner. Finally, an exemplary lesson was located, annotated with important concepts and provided along with the guide to help teachers become more successful in the AEIOU lesson writing process.

SPIRIT Lesson Writing Guide

Read this document BEFORE you start to write your lesson. It should be helpful from a writing and editing standpoint for your developing lesson.

Typically, in the AEIOU format, the I component can be a stand-alone block of instruction containing the desired content that is "taught" to students. It can also be incorporated throughout the A, E and O components. It will depend on the lesson and activities that students are completing as to which situation type of "I" it will be.

1) The first thing that you must do is select an "I" from the list of available "I's". This is because to have a quality lesson, founded upon instructional theory (and common sense), you MUST know what it is you are trying to teach within the context of a specific lesson.

IMPORTANT: SELECT THE "I" COMPONENT FIRST, THEN BASE YOUR EVALUATION (U) AND ACTIVITIES (A,E, and O) ON THE SELECTED "I"

NOTE: If you cannot find an I that you want to use on the list you should ask the editing team for permission to proceed with the development of a new I component not previously developed. This may mean that you have to write your own I!

2) You should be able to write the "U" after you have picked your "I". Again, instructional theory says you should write your assessment BEFORE planning your lessons so that you know what is important and what must be taught. You should have some idea how to assess what content topics that you are going to teach whether that assessment be written, performance, or "test" based questions. Your activity in the "U" is that students will be completing some type of assessment.

If your I and U don't match, you most likely have created a lesson with a bunch of activities (they may be cool) but the lesson will NOT be designed properly and will require a great deal of editing by the editing team to make them match. **I reiterate first pick an I component and then figure out how you will assess it (U component).**

3) The rest of the pages can be written in varying order as long as the FIRST page is written LAST. The first page is an overall summary and you cannot summarize until your lesson is complete.

IMPORTANT: ACTIVITIES IN THE A, E AND O MUST BE **DIFFERENT**. THEY ARE SEPARATE PARTS OF A SINGLE LESSON!!!!! THEY ARE **NOT** TO BE PARTS OF THE SAME ACTIVITY!!!!!

The "A" or "Asking" page is like the anticipatory set of your lesson. It gets the students engaged in the lesson. You pose questions. Students might be able to answer them or not. The goal of the "A" page is to have the students start thinking about the content that you are trying to teach (your I) and generate interest in the content.

The "E" page or "Exploration" page is where learning begins. Students explore the topic. It can be hands on, through research, guided discovery, or any other means of exploration. You are the content expert. Use your creativity and your talents to create and guide students in the activity in the "E". Students will

generally make information observations during the exploration.

The "O" page or "Organization" page is where the learning is compiled (or generally organized). This would be like Hunter's guided practice. Student put new knowledge into practice with the teacher's assistance. You can observe what students are doing and perform formative assessment so that learning can be redirected if necessary.

Finally, the overall summary (first page) should be written LAST. You should now be able to complete an outline of the content and context as well as give a general description of the activities in the lesson. The standards utilized and material required should be completed.

Other Lesson Guidelines

- Use the Lesson Plan Document included in the folder with this document. The lesson should be exactly 6 pages: (1) Lesson Header, (2) Asking, (3) Exploring, (4) Instructing, (5) Organizing, and (6) Understanding
- Submit single spaced Word document (doc) files using Times font 18 Point Bold for main titles, 12 point bold for secondary titles, and 12 point normal for text
- Reduce the resolution on all images and pictures to less than a few 100 KB
- Submit lessons with Track Changes off, all changes accepted, and Zoom 100%
- Refer to the robot as classroom robot, or as CEENBoT (use this upper/lower case)

Summary, Outline, and Activity

- Include summary, outline, and activity sections in each AEOU component
- Each of these provides a more and more detailed look at the component
- This should allow teachers to quickly read and evaluate the component
- Summary is a one sentence overview of the component
- Outline is a bulleted list of the component features
- Activity is a paragraph narrative that describes the component

The redundancy of the Summary, Outline, and Activity are built into the document on purpose. Each is focused on a different type or lesson "reader". Each area gives a different level of detail.

Resources, Attachments, and Attachment File Name

- Resources are references to external information such as books or websites
- Multiple worksheets and other attachments can be included with each component
- Use the lesson title, AEOU, attachment name, and underscores in file names:
  Lesson_Title_E_Worksheet1.doc, Lesson_Title_E_Worksheet2.doc
  Lesson_Title_O_Data_Table.doc, Lesson_Title_U_Rubric.doc

Finally, for an overall lesson title start with your last name, the project, and then the lesson name. Last_Name-Project-Lesson_title.doc ie. Jones-Project_SHINE-Lessons_R_Fun.doc

Characteristics to Check in Your Lesson
(Commonly found lesson writing errors)

1) The summary, outline and activity on each page should **only apply to that page**.
2) The summary, outlines, and activity on the first page should be very general and cover the **entire** lesson.
3) If you want a chart on one of your pages, please carefully describe what will go in the chart as headings, etc. You can create a chart very easily in word by going to the "Table" menu, "Insert" and then "Table". Select how may row and columns you wish.
4) If you want an image included in your lesson, which is encouraged, try to find one at Wikimedia commons http://commons.wikimedia.org/wiki/Main_Page These images are copy write free and usable. If you cannot find the image you want there, search the Internet and include the image. NOTE: Either way include the URL where you located the image so we can find it again or ask permission to use it.
5) Don't change the "U" page format. It is consistent throughout all the lessons. The outline for the U component will always be:

Outline:

- Formative assessment of **YOUR INSTRUCTIONAL COMPONENT**.
- Summative assessment of **YOUR INSTRUCTIONAL COMPONENT**.

6) The "U" component should try to include at least 2 different types of assessments, if possible. These could include: written, performance, exam, etc.
7) The formative assessment questions in the "U" are questions that the teachers most likely ask THEMSELVES as the lesson is progressing to check students understanding. They are things to consider and address from the teacher's standpoint.
8) Run spell check to check for spelling and grammar errors in your lesson before turning it into the editors.
9) If you do not use an attachment or resource on every page, DELETE the unnecessary lines.
10) Put the lesson title on top of EVERY page.

Lesson writing checklist (Complete before submission)

- ☐ Do the "I" and "U" match? Are you testing what you are instructing and are you instructing what you are testing?
- ☐ Does your "U" component have two different assessment activities (if possible)?
- ☐ Did you change the outline of the "U" (the answer should be no)
- ☐ Are the activities for the A, E, and O all different?
- ☐ Have you included a summary, outline and activity on the A, E, O, and U page?
- ☐ Do the individual page summary, outline and activity apply to only that page?
- ☐ Are charts specifically described or a draft chart included?
- ☐ Are images described, or included with a URL as to the location where you found it?
- ☐ Does the first page give an overall summary of the entire lesson?
- ☐ Did you put the lesson title at the top of every page?
- ☐ Did you delete unnecessary lines? For example, resources , attachments, etc.
- ☐ Did you run spell/grammar check?
- ☐ Are your files named correctly using the naming convention in this document?
- ☐ Is your font Times font 18 Point Bold for main titles, 12 point bold for secondary titles, and 12 point normal text?
- ☐ Do you only have six (6) pages to your main lesson?
- ☐ Are attachments named correctly and ready to send?

SPIRIT 2.0 Lesson:

Trig is SOH Easy!

Comment: Document length is 6 pages only. All other requirements are attachments.

==========Lesson Header ==========

Lesson Title: Trig is SOH Easy!
Draft Date: June 27, 2008
1st Author (Writer): Lynn Spady
Instructional Component: Trig Functions
Grade Level: Algebra I – 8th/9th Grade

Comment: Instructional component used in the lesson.

Comment: Level lesson is geared toward.

Content (what is taught):

- Identification of opposite and adjacent (from reference angle), and hypotenuse in a right triangle
- Understanding trig ratios (sine, cosine, and tangent)
- Application of trig ratios to find a missing side length

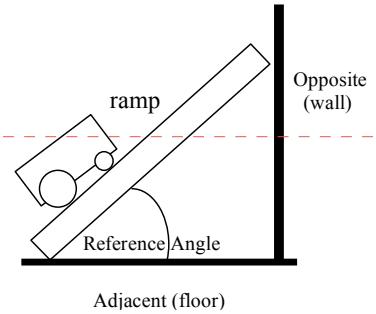
Context (how it is taught):

- The robot will travel up a ramp set at different angles.
- The angle measurement and ramp length will be recorded.
- The opposite side of the reference angle (wall) and adjacent side (floor) will be calculated.

Activity Description:

Comment: See how the Content, Context, and Activity pertain to the entire lesson.

In this lesson, students will investigate the steepest ramp possible for a robot to travel. The angle of the ramp and ramp length will be used to find the opposite and adjacent side lengths using sine and cosine. Students will first investigate a given ramp angle and perform the calculations. Then, students can try different angles to find the maximum angle possible for the robot to travel.



Standards:

Comment: Standard from list in lesson writing packet.

- Math—C4, D2, E1, E3
- Science—A1, A2
- Technology—C4, A3,

Materials List:

- Classroom Robot
- Protractors
- Meter Sticks
- Ramps

ASKING Questions: Trig is SOH Easy!

Comment: Look at the A, E and O. All are different activities.

Summary:
Students are asked to make observations as the robot travels up and down a ramp.

Comment: See how the summary, outline and activity show increasing detail about the page and only reference this particular page.

Outline

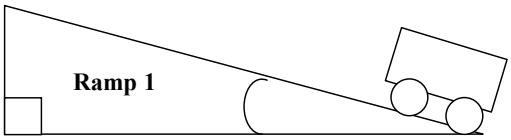
- Demonstrate the robot traveling up a ramp.
- Demonstrate the robot traveling down a steeper ramp.
- Ask students what they think is the steepest ramp the robot can travel.
- Determine vocabulary.

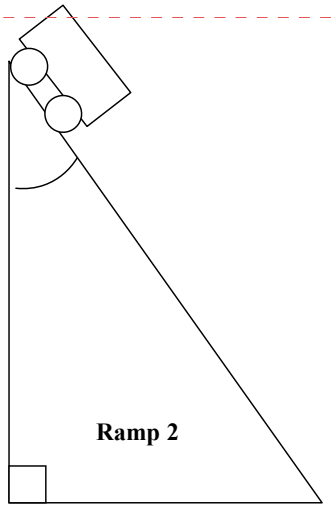
Activity:
Demonstrate the robot traveling up a ramp and then demonstrate the robot traveling down a steeper ramp. Point out the angle of the ramp and the right angle formed.

Questions	Answers
What is similar about the two ramps?	Both ramps form right triangles.
What is different about the ramps?	The robot is traveling up one ramp and down the other. The second ramp is steeper than the first.
How could we find out how steep the ramp is?	We could estimate or use a protractor.
How could we find out the other measurements (how far the top of the ramp is from the floor and how far the bottom of the ramp is to the floor)?	We could estimate it or use a meter stick.
What is the steepest angle of the ramp you think the robot can travel?	???

Image Idea: Picture of the set-up of both ramps.

Comment: Possible images are included. These can come from the web if URL is included.





EXPLORING Concepts: Trig is SOH Easy!

Comment: See how the summary, outline and activity show increasing detail about the page and only reference this particular page.

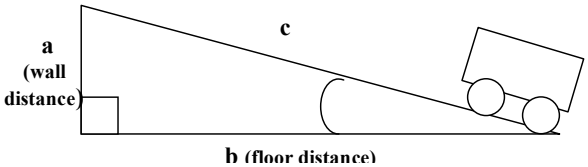
Comment: See lesson title on every page.

Summary:
Students will be using the robot to travel up different ramp angles while recording the information in a chart.

Outline:

- The robot travels up a ramp at a set angle.
- Students record the ramp angle measurement, ramp length, floor distance, and wall distance.
- Students explore and record different ramp angles.

Activity:
Students will work in groups of 3-4 to observe the robot traveling up a ramp that is set at different angles. Students will use a chart to record the information and will set up trig ratios although the trig ratios have not formally been taught. Students will try to find the maximum ramp angle the robot can travel. Students may want to make notes next to each ramp angle describing how the robot climbed the ramp. Groups may then share the process by which they found their maximum angle. The groups may also explain how they would do things differently if they were to carry out the same activity again.



Comment: A sample chart is included with headings that are needed.

Angle of Ramp	a	b	c	a/b	a/c	b/c

INSTRUCTING Concepts: Trig is SOH Easy!

Comment: I component selected from the list of available I's

Putting "Trig Functions" in *Recognizable* terms: Trig functions are **ratios** of the legs and hypotenuse of the right triangles used in the Pythagorean Theorem. The basic trig functions are related to the **reference angle** (the given angle or its equivalent).

Putting "Trig Functions" in *Conceptual* terms: If we look at a rectangular coordinate system and place an angle (θ) so that its **vertex** is located at the origin and the adjacent leg of the angle lies on the abscissa, the basic trigonometric functions of that angle are defined to be:

1) Sine – the ratio of the length of the leg opposite the reference angle divided by the length of the hypotenuse.

2) Cosine – the ratio of the length of the leg adjacent to the reference angle divided by the length of the hypotenuse.

3) Tangent – the ratio of the length of the leg opposite the reference angle divided by the length of the leg adjacent to the reference angle.

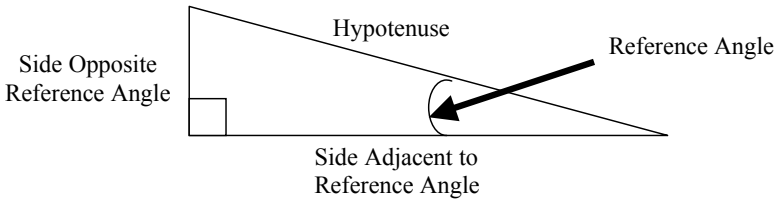
Putting "Trig Functions" in *Mathematical* terms: The basic trig functions for an angle θ positioned as above are defined, then, to be:

1) $\sin \theta = y/r$

2) $\cos \theta = x/r$

3) $\tan \theta = y/x$

where x is the x coordinate of any point on the terminal side of the angle other than the origin, y is the y coordinate of that point, and r is the length of the line segment from the origin to that point. (Remember from the Pythagorean Theorem that $x^2 + y^2 = r^2$).



Putting "Trig Functions" in *Process* terms: Since the trig functions of an angle are defined to be the ratios above, and those ratios do not change based upon the position of the point (x,y) on the hypotenuse, the sine, cosine, and tangent are related to the angle θ and not the (x,y) point chosen to calculate the ratios.

Putting "Trig Functions" in *Applicable* terms: Drive the bot along a [straight] line from the origin and stop it at irregular (random) time intervals. Determine the coordinates of the bot's location and calculate the definition ratios for sine, cosine, and tangent at several different points along the line (the hypotenuse of the right triangle formed by connecting the (x,y) point to the abscissa with a vertical line).

ORGANIZING Learning: Trig is SOH Easy!

Comment: See how the summary, outline and activity show increasing detail about the page and only reference this particular page.

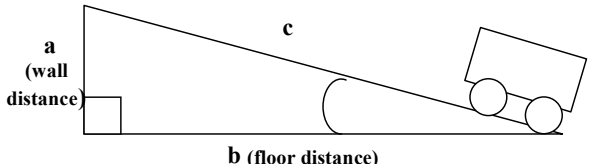
Summary:
Students will use a data table to record the ramp angle and the ramp length. The students will then calculate the floor distance and the wall distance trig ratios (sine and cosine).

Outline:

- Set up ramp for a 30 angle using a protractor.
- Record angle and ramp length.
- Calculate the floor distance, using cosine (adjacent over hypotenuse).
- Calculate the wall distance, using sine (opposite over hypotenuse).
- Measure floor and wall distance with meter stick to compare accuracy.

Activity:
Students will set the ramp angle at 30 using a protractor. Students will then drive the robot up the ramp making sure it makes it to the top without problems. Students will calculate the floor distance using cosine and wall distance using sine. Students will then measure the floor and wall distance using a meter stick to check accuracy. As an extension, students could calculate the percent error (difference of the calculated measurement and the actual measurement divided by the calculated measurement).
NOTE: Students may wonder why it is necessary to use the trig functions to find the measurements when it would be easier to measure the distances using a meter stick. If students do not come up with the idea on their own, point out that if you were to extend significantly the ramp, it would not be possible to measure using a meter stick.

Worksheet Idea: A chart that has the ramp angle, ramp length, calculation of floor and wall distance, and actual floor and wall measurement. Also, a second worksheet with expected results.



Comment: Note: Attachment and Resources are not needed so they are deleted.

Angle of Ramp	Ramp Length	Floor Distance	Actual Floor Distance	Wall Distance	Actual Wall Distance
30					

UNDERSTANDING Learning: Trig is SOH Easy!

Summary:
Students will write a summary of the basic trig ratios including vocabulary and pictures (sample rubric attached). Students will also calculate a missing side using trig ratios.

Outline:

- Formative assessment of trig ratios.
- Summative assessment of trig ratios.

Comment: Outline is not changed. Just insert I component.

Formative Assessment:
As students are working, ask yourself or your students these types of questions:

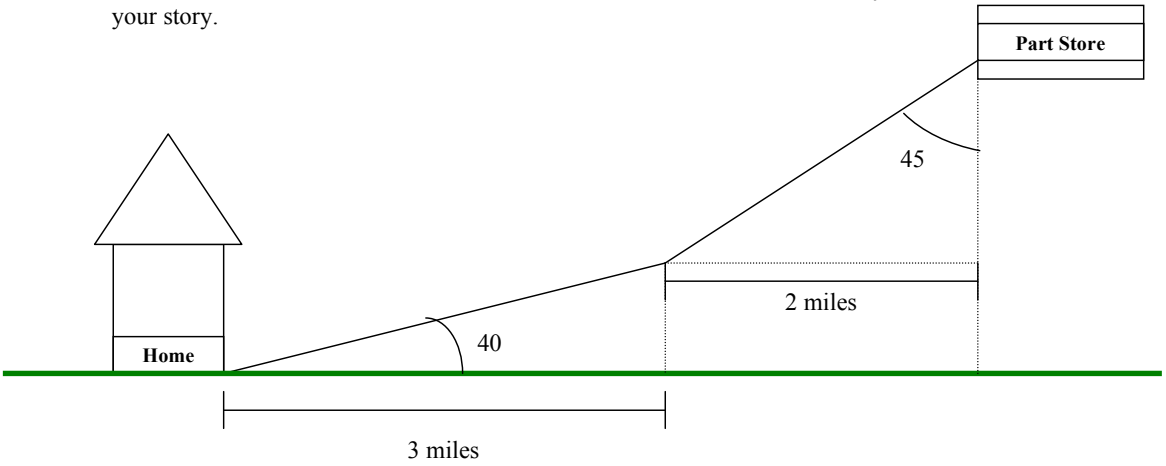
1. Were the students able to set up the trig ratios and solve for a missing side?
2. Can students explain the reason for needing to know the trig ratios?

Comment: Note: questions that teachers would ask themselves as the lesson is in progress.

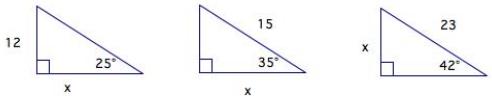
Summative Assessment:
Students will complete the following essay question about the basic trig ratios:

Using the diagram of Bot City below, write a story about the classroom robot traveling from its home to the part store. What is the distance the robot has to travel if it needs to travel both hills? Is there another route that is shorter? Be sure to include mathematical vocabulary and calculations in your story.

Comment: NOTE: 2 different assessment choices.

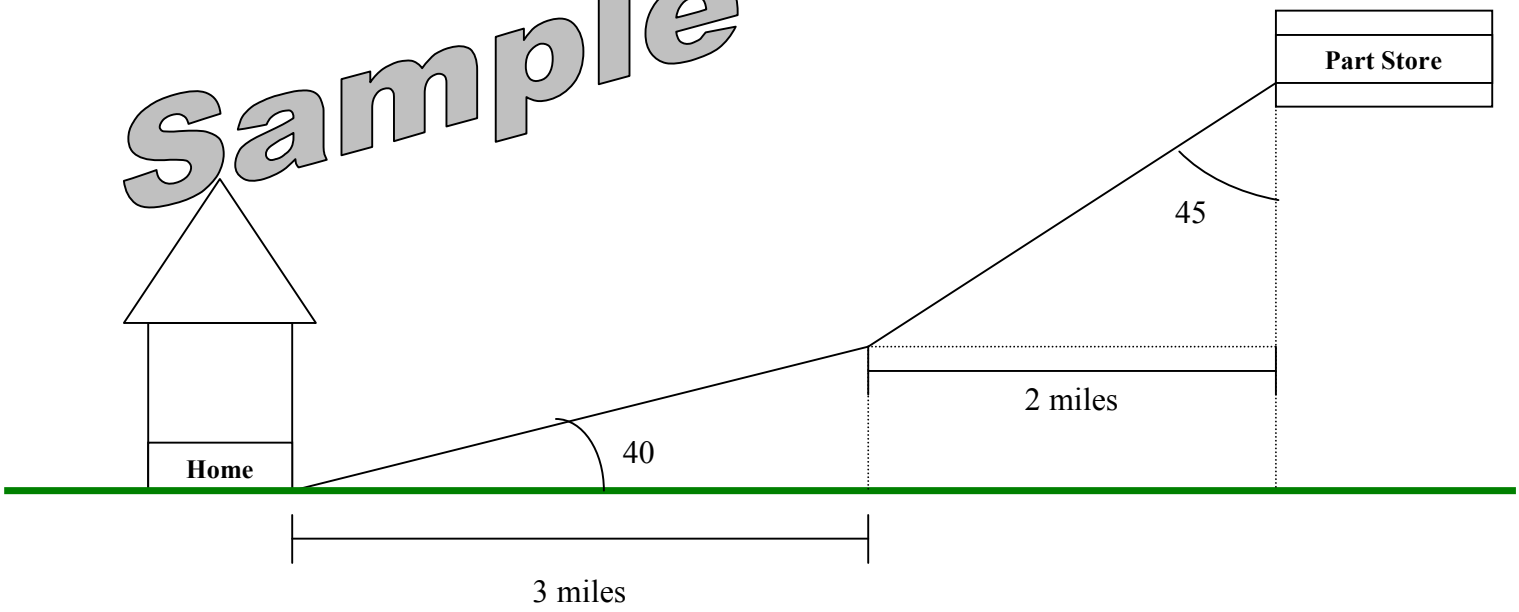


Students can complete the following quiz questions:
1) Solve for x.



Attachments:
M019-Trig_SOH_Easy-U-Assessment_Sample.doc

Comment: Note the file naming convention used on the attachment. File name-page-description



Mr. Robot needed a new battery. He left his home and traveled up Binary Street, which is 40 degrees steep (reference angle). To calculate how long Binary Street is we need to use the information that we know which is the adjacent side length of 3 miles. We can use the trig ratio that involves adjacent and hypotenuse, which is cosine. So, here is the calculation for the length of Binary Street:

Binary Street – Cosine $40 = \frac{3}{x}$

$$0.7660 = \frac{3}{x}$$

$$\frac{0.7660x}{0.7660} = \frac{3}{0.7660}$$

$$x \approx 3.9 \text{ miles}$$

So it looks like Mr. Robot needs to travel approximately 3.9 miles up Binary Street. Now, it's the very steep Capacitor Street, which requires a lot of energy to climb. Mr. Robot hopes his dying battery will get him to the store in time. To find the length of Capacitor Street, we can use the trig ratio sine, which is equal to the opposite side of the reference angle (45 degrees) over the hypotenuse. This is going to be SOH easy!

Capacitor Street – Sine $45 = \frac{2}{x}$

$$0.7071 = \frac{2}{x}$$

$$\frac{0.7071x}{0.7071} = \frac{2}{0.7071}$$

$$x \approx 2.8 \text{ miles}$$

So, 3.9 miles plus 2.8 miles means that Mr. Robot needs to travel 6.7 miles to the Part Store. Can he make it on his faulty battery? Hopefully he doesn't have to call a TOA truck!

CURRENT I COMPONENTS AVAILABLE FOR AEIOU LESSON WRITING

These components are available on the website: http://www.ceen.unl.edu/TekBots/SPIRIT2/ for use in the I component of the lesson. Click on the desired STEM topic and scroll down to the bottom to find the I components. Copy and paste the I on page 4 of the AEIOU template.

Science I Components

I-Sci-01-Force.doc
I-Sci-02-Friction.doc
I-Sci-03-Hookes_Law.doc
I-Sci-04-Magnetism.doc
I-Sci-05-Momentum.doc
I-Sci-06-Power.doc
I-Sci-07-Newtons1st.doc
I-Sci-08-Newtons2rd.doc
I-Sci-09-Newtons3rd law-unedit.doc
I-Sci-09-Newtons3rd.doc
I-Sci-10-Torque.doc
I-Sci-11-Measurement.doc
I-Sci-12-Infrared.doc
I-Sci-13-Work.doc
I-Sci-14-Astronomical_Measurement.doc
I-Sci-15-Refraction_of_Light.doc
I-Sci-16-Cell_Organelles.doc
I-Sci-17-Solar_System.doc
I-Sci-18-Electric_Current.doc
I-Sci-19-Plane_Mirrors.doc
I-Sci-20-Planetary_Motion.doc
I-Sci-21-Concave_Mirrors.doc
I-Sci-22-Ohm_Law.doc
I-Sci-23-Elements.doc
I-Sci-24-Plate_Tectonics.doc
I-Sci-25-Waves.doc
I-Sci-26-Life.doc
I-Sci-27-Heredity.doc
I-Sci-28-Friction_on_an_Incline.doc
I-Sci-29-Voltage.doc
I-Sci-30-Mechanical_Advantage.doc
I-Sci-31-Circular_Motion.doc
I-Sci_32-Energy.doc
I-Sci-33-Solubility.doc
I-Sci-34-Titration.doc
I-Sci-35-Osmosis-Tonicity.doc
I-Sci-36-Bioburden.doc
I-Sci-37-Dimensional_Analysis.doc
I-Sci-38-Solar_Collectors.doc

Science I Components (cont.)

I-Sci-39-Terrestrial_Seasons.doc
I-Sci-40-Solar_Home_Design.doc
I-Sci-41-Microbes.doc
I-Sci-42-Mixtures.doc
I-Sci-43-Power_Grid.doc
I-Sci-44-Power_consumption.doc
I-Sci-45-Density.doc
I-Sci-46-Viscosity.doc

Technology I Components

I-Tech-01-Problem_Solving.doc
I-Tech-02-Scientific_Inquiry.doc
I-Tech-03-Computer_Programming.doc
I-Tech-04-Data_Analysis.doc
I-Tech-05-Information_Literacy.doc
I-Tech-06-Collaboration.doc
I-Tech-07-Communication.doc
I-Tech-08-Creativity.doc
I-Tech-09-Critical_Thinking
I-Tech-10-Ethics_of_Technology.doc
I-Tech-11-Lifelong_Learning.doc
I-Tech-12-Information_Systems.doc
I-Tech-13-Positional_Number_Systems.doc
I-Tech-14-Team_Building.doc
I-Tech-15-Leadership.doc
I-Tech-16-Technical_Writing.doc

Engineering I Components

I-Eng-01-Intellectual_Property.doc
I-Eng-02-Engineering_Design.doc
I-Eng-03-Scale_Drawings.doc
I-Eng-04-Invention_vs_Innovation.doc
I-Eng-05-Simple_Machines.doc
I-Eng-06-Technological_Systems.doc
I-Eng-07-Applied_Physics.doc
I-Eng-08-Error_Analysis.doc

Mathematics I Components

I-Math-01-Compound_Inequalities.doc
I-Math-02-d_rt.doc
I-Math-03-Linear_Functions.doc
I-Math-03-Proportions.doc
I-Math-04-PT.doc
I-Math-05-Quadratic.doc
I-Math-06-Rectangular.doc
I-Math-07-Real.doc
I-Math-08-Linear_Systems.doc
I-Math-09-Slope.doc
I-Math-10-Direct.doc
I-Math-11-Trig.doc
I-Math-12-Probability.doc
I-Math-13-Negative_exponents.doc
I-Math-13-Two_Step_Equations.doc
I-Math-14-Signed_Numbers.doc
I-Math-15-Compound_Inequalities.doc
I-Math-17-Functions.doc
I-Math-18-Central_Tendency.doc
I-Math-19-Scientific_Notation.doc
I-Math-20-Best-Fit_Curves.doc
I-Math-21-Cartography.doc
I-Math-22-Geo_Vocab.doc
I-Math-23-Riemann_Sum.doc
I-Math-24-First_Fundamental_Thrm_Calculus.doc
I-Math-25-Related_rates.doc
I-Math-26-Area_polygons.doc
I-Math-27-Inverse_variation.doc
I-Math-28-Distance_Optimization.doc
I-Math-29-Ratios.doc
I-Math-30-Circles.doc
I-Math-31-SurfaceArea-Volume.doc
I-Math-32-Displays_of_Data.doc
I-Math-33-Exponential_functions.doc
I-Math-34-Perimeter.doc