Connecting Middle Grades Science and Mathematics with TI-Nspire™ and TI-Nspire™ Navigator™ – Day 2

There are three categories of T³ Professional Development, each with a unique set of learning objectives. This workshop is focused on technology integration, and its objectives are as follows:

Technology Integration

- Emphasis on learning to use TI technology, with broad "how-to" coverage highlighting a wide range of features
- Subject/content-focused training on appropriate usage of TI technology in the classroom
  - I am comfortable with essential technology skills for exploring math and science content.
  - I can design opportunities for students to use technology as a tool to deepen their understanding of mathematics and science.
  - I can locate and download TI activities that align to my standards.
  - I can describe the role technology should play in the successful implementation of my standards, and I can implement a vision of a classroom where students routinely use technology to engage in the practice and content standards.

Workshops focused on instructional practices and content knowledge have the following objectives:

Instructional Practices

- Emphasis on classroom practices with technology as a tool to enhance student learning
- Models CCSS, TEKS, and STEM tasks using in-depth discussions, reflective practices, and essential technology skills
  - I can demonstrate the importance of teacher actions for students' engagement in the Practices, and I can take actions that will enable students to become mathematical and scientific practitioners.
  - I can describe the role that technology should play in the successful implementation of my standards, and I can implement a vision of a classroom where students routinely use technology to engage in practice and content standards.
  - I can design tasks for students to employ the Practices, using technology as a tool to deepen their understanding of mathematics and science.
  - I can ask questions designed to make student thinking visible – to push them to think about connections, make comparisons, or probe their understanding.

Content Knowledge

- Emphasis on content with technology as support
- Addresses critical, tough-to-teach topics and new content standards for CCSS or TEKS
  - I have a deeper understanding of the mathematics and science in my content area, and I am aware of the shifts in content that affect what I teach.
  - I can design opportunities for students to use technology as a tool to deepen their understanding of mathematics and science.
  - I can locate and download TI activities that align to my standards.
  - I can describe the role technology should play in the successful implementation of my standards, and I can implement a vision of a classroom where students routinely use technology to engage in the practice and content standards.

The following technology will be needed for Days 1-6:

- TI-Nspire™ CX CAS Navigator™ 30-user system
- 30 additional TI-Nspire™ CX CAS handhelds
- 60 standard-A to mini-B USB cables
- 30 mini-A to mini-B USB cables
- A laptop for each participant with the TI-Nspire™ CX Navigator™ Teacher Software installed

In addition to the above technology, the following technology will be needed for each given day:

Day 1

- 30 stainless steel temperature sensors (Vernier or TI)
- 30 Vernier EasyLink™ adapters

Day 2

- 15 Conductivity Probes
- 15 Vernier EasyLink™ adapters

Day 3

- 15 CBR 2™ motion detectors
- 30 stainless steel temperature sensors (Vernier or TI)
- 30 Vernier EasyLink™ adapters

Day 4

- 15 Gas Pressure Sensors
- 15 Vernier EasyLink™ adapters

Day 5

- 15 CBR 2™ motion detectors

Day 6

- 15 Dual-Range Force Sensors
- 15 Vernier EasyLink™ adapters

Optional

- Vernier EasyTemps can be substituted for stainless steel temperature sensors and EasyLink™ adapters
- TI-Nspire™ Lab Cradles can be substituted for Vernier EasyLink adapters

Supplies List

Day	Activity	Equipment/Consumable	Quantity (per 5 people)
2	Kidney Stones, Gravity, and the International Space Station	1000 mL beaker	1 total
		1 mL increment medicine droppers	1-2
		100 mL graduated cylinder	1-2
		Electronic balance	1 total
		Salt	1 small container total
		Distilled water	1 gallon per 10 people
		Yellow food coloring	1 very small container total
		5 oz. plastic cups	~10

Day	Activity	Equipment/Consumable	Quantity (per 5 people)
3	Construct a Coolant System	100 mL beaker	1-2
		5 oz. plastic cups	~10
		50%, 70%, and 91% alcohol	1 small container of each (total)
		Hydrogen Peroxide	1 small container (total)
		Salt	1 small container total
		Sugar	Around 5 sugar packets
		Distilled water	1 gallon per 10 people
4	Create a Cold and Hot Pack	100 mL graduated cylinder or beaker	1-2
		Baking Soda	1 small container total
		Potassium Chloride	1 small container total
		Ammonium Chloride	1 small container total
		Calcium Carbonate	1 small container total
5	How Does It Bounce?	Ball that bounces	1-2
	Radioactive Decay	M&M's	1-2 fun-size packs
6	Why Bigger is Not Necessarily Better	Balloons	1 per person
		String	Around 2 feet per group
		Meter Stick	1-2
	Net Force Balloon Race	Helium-filled Mylar Balloons	1-2
		Manila Folders	1-2
		Scotch tape	1
		Scissors	1

I can…
Enter data into the built-in Lists & Spreadsheet application.
Add a page to an existing document.
Set up a plot in the built-in Data & Statistics application.
Plot a function.
Use a moveable line to approximate a pattern.
Locate a TI-Nspire™ activity on education.ti.com.
Download and open a TI-Nspire™ document.
Send a TI-Nspire™ document from a computer to a handheld.
Collect data using Events with Entry Mode in the built-in Vernier DataQuest™ application.
Recognize functional patterns in data.
Use the Documents Workspace in the TI-Nspire™ CX Navigator™ Teacher Software.
Recognize the application of different question types.

Entering and Graphing Data

PD Objectives

- Participants will enter data for height and armspan into a spreadsheet and then produce one- and two-variable graphs using Quick Graph.

Materials Needed/Set Up Requirements

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Participants will create a new two-page document using the Lists & Spreadsheet application.
- The main goal of this lesson is to equip teachers with the basic functionality of entering data in a spreadsheet and using Quick Graph to produce graphs. For one-variable data they will graph a dot plot, a box plot, and a histogram. For two-variable data, they will graph a scatter plot. They will also add a movable line and adjust it to fit the data.
- It is intended that participants use the handheld for this activity.
- This activity could also be done with the TI-Nspire™ Teacher Software.

Technology Tips

- With split pages, discuss using CTRL-Tab vs. clicking to select a work area.
- Also, if desired, discuss resizing the plot window by selecting **Menu > Zoom > Data**.

Summary Reflection Questions

- What are the advantages of seeing the data and the graph simultaneously?
- What could you do with the ability to move a point in the plot?
- How can you get students to articulate the lesson's mathematical ideas and vocabulary?
- What opportunity is there for students to compare and contrast ideas and strategies?

Will It Float or Sink?

PD Objectives

- Students calculate density in g/ml given the mass of a liquid and its volume.
- Students sort layers of liquids of different densities.
- Students predict where a solid object of a given density will float in a density column.

Content Standard(s)

- MS-PS1 Matter and Its Interactions

Materials Needed/Set Up Requirements

- *Will_It_Float_or_Sink .tns* file, TI-Nspire™ CX handhelds and Student Activity handout.
- *Bellringer - Density of Matter.tnsp*
- *Density_of_Matter_Questions.tns*
- Optional - Set up a density column in a large graduated cylinder to simulate the "flotation" of liquids. Ask the students to predict the order of the liquids.
- Optional – Colored pencils for density column drawing.

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Show the Bellringer Density of Matter.tnsp and use Density_of_Matter_Questions.tns as Quick Polls after the video or as a file for the students to write on as the video plays.
- Students go beyond calculating density by visually observing the relationship between densities of liquid solutions with different densities.
- Students predict where solids of known densities will float within a density column.
- 10 minutes: Stop and discuss how the order of the liquids is determined in the density column.
- Use Class Capture and Live Presenter for individuals/groups to discuss results with class.
- Optional – integrate art into the lesson by asking students to draw the density column. Use a different color for each layer. Use dots to represent individual molecules within the layers.

Technology Tips

- Students can use Scratchpad to calculate density of each liquid.

Summary Reflection Questions

- Why does ice float?
- Why is ice less dense than water?
- What is the biological importance of ice floating on water?

Kidney Stones, Gravity and the ISS

PD Objectives

- Learn how to complete an Events with Entry form of data collection while utilizing the "average over 10 seconds feature."
- Discuss how to embed tough-to-teach concepts such as gravity and space technology through this lesson.

Materials Needed/Set Up Requirements

- Science Materials include: 1 medicine dropper per group, a 1000 mL beaker, 1 electronic balance to measure the salt, 58.44 g of salt, 1 galloon distilled water, spoons, yellow food coloring, a cup that can hold at least 150mL of water (6 per group), 1 graduated cylinder 100mL per group
- 1 conductivity probe with EZ link per group, TI Nspire, Navigator (optional but recommended)
- *Kidney_Stones_Gravity_and_the_ISS.tns*

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Have participants work through the lab as if they were students. The entire experience will take them 45 minutes to do this through completion.
- After discussing the background information, have participants go to page 1.7 and have them plug in their probes. Discuss why plugging the probe into page 1.7 it will not make a new page since a Vernier DataQuest™ page is already open. This is helpful when using a TI-Nspire document so it does not mix up the student pages on the student worksheet.
- Review how to know the handheld is set to events with entry and go over the average over 10 seconds feature. This should already be set up in your TI-Nspire document.
- In advance, determine if you are going to find the astronauts conductivity as a group, or if each individual group will determine this. This is discussed in technology tips. It will save the instructor a lot of preparation time to do this as a whole group, by only making one class sample of each astronaut instead of one sample of each astronaut for each group.
- Each group will need a cup of stock solution (Salt water with yellow food coloring) at their table.
- On 2.2, participants will recreate the astronaut urine samples. They will place 100mL of distilled water into a cup. They will add in 1 mL of stock solution at a time to the distilled water, measuring the conductivity each time. Make it known to the participants that they are looking to find a close match of the conductivity to the known astronaut conductivity. From that information, they will be able to determine how much calcium is in the astronaut's urine.
- The conductivities will not be an exact match.

- For the math teachers, you could have them plot only increments of 5. For example, place 5 drops of the stock into the distilled water, 10 drops, then 15, etc. They can then create an equation and mathematically determine what the relationship is between calcium concentration and conductivity. They can then use their regression to determine the amount of calcium.

Technology Tips

- You will want to pre make the 1M NaCl H2O mixture in advance. Mix 58.44 g of salt with 1000 mL of distilled water, stir until it dissolves. Add some yellow food coloring to make it look like urine. This is your stock solution, which you will use to make the astronaut urine samples.
- To save time, instead of giving every group an astronaut urine sample, you can make one of each and have the groups share out the conductivity. This will then require each group to only have 2 cups instead of 6 (they would need 2 cups,: one for the stock solution you will provide them and one for the solution they will make).

Summary Reflection Questions

- Optional – Discuss the SAA (South Atlantic Anomaly) Look it up on Google if you are not familiar. It is great closing the lesson with this. When the space station goes over the area considered the SAA, all radio and visual communications with the ISS is lost. Mission control knows exactly when the signal will go out and when the signal will be reacquired, but no one knows why!

Getting Started with the TI-Nspire™ CX Navigator™ Teacher Software

PD Objectives

- Participants will explore basic features of the Documents Workspace of the TI-Nspire™ CX Navigator™ Teacher Software, such as adding applications, exploring menus and submenus, and viewing settings.

Materials Needed/Set Up Requirements

- Computer with TI-Nspire™ CX or TI-Nspire™ CX CAS Navigator™ Teacher Software

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- As participants move from the Calculator application to the Graphs application, ask them to compare the menus (Document Tools**)**. Participants should recognize that each application has its own unique menu.
- Though participants will not collect any data during this activity, they are asked to insert a page with the Vernier DataQuest™ application. The purpose is to expose participants to the data collection feature of the Teacher Software.
- Let participants know that when using the handheld, the Question application cannot be inserted
- Encourage participants to explore the various menus and submenus in the Document Tools tab, along with the Utilities, Page Sorter, TI-SmartView™ emulator, and Content Explorer tabs.
- As participants explore the various Document Views and TI-SmartView emulator views, discuss how each view might be helpful in the classroom.
- You may wish to discuss the difference between the Settings and the Document Settings and have participants explore the available options. Make sure participants are comfortable tabbing through fields and changing the settings.

Technology Tips

- Sometimes participants do not immediately notice the five icons in the Documents Toolbox. Consider emphasizing the location of these icons. Additionally, you may wish to point out the two locations of the Document Tools.

Summary Reflection Questions

- How does the Documents Toolbox change when working with different applications?
- How might the various Document Views and TI-SmartView options be helpful in the classroom?

Real Graphs

PD Objectives

- In this activity, participants will explore the plots of various data sets, looking for patterns.
- Participants will identify plots that appear to be functions and plots that appear to form a linear pattern.
- For plots that appear to form a linear pattern, participants will determine a function that fits the data in the form $y = mx + b$.
- Participants will determine if the linear relationships make sense in the context of the data used for the plot.

Materials Needed/Set Up Requirements

- TI-Nspire™ document for this activity: *Real_Graphs.tns*

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Ask participants to work in groups to explore this activity.
- Monitor participants' graphs using Class Capture as they explore graphs of various data sets. When you see an interesting plot, display that plot and ask the person who graphed the data to describe the possible relationship.
- After participants have been working for about 15 – 20 minutes, have them share (with the larger group) one example of the data sets that they selected to graph. You may wish to make one of the participants in the group the Live Presenter so that their graph can be displayed.
- Additionally, ask them to share their thoughts on whether the linear relationship made sense in the context of the data graphed.
- Discuss how the data sets could be used to explore linear versus non-linear relationships as well as linear relationships with positive or negative slopes.
- Additionally, discuss whether it is always possible to determine the independent variable for certain data pairs.

Technology Tips

- You may wish to show participants how to right click and remove a Y or X variable so that they can keep one of the variables, if desired, and select a different data set for the other axis.

Summary Reflection Questions

- How can this activity help students to understand that a pattern in the graph does not necessarily indicate a cause and effect relationship between the two variables?
- How can this activity help students understand the meaning of slope in a real context?
- How do you use "real-world" data to introduce functions and engage students?