



Getting Started with TI-Nspire™ Middle Grades Science

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Materials for Institute Instructor*

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Nspired Learning Exploration**PD Objectives**

- To get participants excited about how TI-Nspire™ technology can be used in the science classroom.

Materials Needed/Set Up Requirements

- Light_Me_Up.tns

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- This is intended to be the first activity on Day 1. You want to engage the participants and get them excited about the power of TI-Nspire technology.
- You may want to demonstrate the TI-Nspire™ document rather than sending it to participants. This allows you to “wow” the participants without getting too bogged down in the details of how to use the TI-Nspire handheld in the first activity of Day 1.
- The Student Activity and Teacher Notes for *Light Me Up* are available at Science Nspired > Chemistry > Chemical Bonding > Electrolytes & Nonelectrolytes.

Technology Tips**Summary Reflection Questions**

- How can this activity, and activities like this, help your students learn science?
- Will this activity “wow” your students?

TI-Nspire™ CX CAS Introduction**PD Objectives**

- Get participants comfortable with TI-Nspire technology.
- Develop an understanding of the applications present on the device.
- Explore simple uses of the applications.
- Develop initial understanding of the function of the top third of the handheld.
- Explore page management.

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Do not dig into the applications deeply.
- Introduce the applications and avoid the menu button until near the end of the applications.
- Pick one method to add pages/applications to the document at first.
- Teach one method of moving between pages.
- Stress that it is a touch pad not a touch screen.

Summary Reflection Questions

- How would you present this activity to your students?
- What other questions would you like them to focus in on?
- What are discussion questions that you would hope this leads to?

Evaporation**PD Objectives**

- Effective use of the Vernier® DataQuest™ applicaiton and the TI-Nspire™ Lab Cradle™.
- Exploring the nature and needs of evaporation and the changing of state from an energy perspective.
- Exploring the other applications of the TI-Nspire document environment: Lists & Spreadsheet, Data & Statistics, Notes, Calculator, and Question (pre-lab, formative Quick Polls, summative assessment.)

Materials Needed/Set Up Requirements

- Three Stainless Steel TI Temperature Probes per group
- One Vernier/TI Lab Cradle per group
- Room temperature water and various (50%, 70%, 91%) Isopropyl Alcohol, about 50 ml per group.
- Cups or containers 100-250 ml, at least 3 per group
- Paper towels
- Support systems for the probes as they hang in air to drip off the liquids. Ring Stands, tape. etc.
- Safety Glasses

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Spend time on experimental design.
- Let the participants explore the time needed to get to a stopping or slowing of the change in temperature.
- Rates of change and how to compare them.
- Striking data and ethical behavior.
- Bring closure to the experiment asking why we did this and what does it mean.

Technology Tips

- Start a new Document before plugging/attaching the Lab Cradle.
- If the students get non sequitur readings or displays on the Vernier DataQuest app, run a New Experiment.
- Store each Run using the File Cabinet, or create a New Problem as you move from one Target to another.
- Plug in one Temperature probe at a time and plan the order (ch 1 = Air, ch 2 = Water, etc...)
- Have the students name the file the same so that you can collect them through the TI-Nspire™ Navigator™ system, or better yet, create a blank TI-Nspire document or one with some of the instructions in it and send it to the class.

Summary Reflection Questions

- Could one do this experiment without a Control, two Controls?
- What other liquids could be used?
- Could one dilute a single concentration of Alcohol and look at 70%, 35%, etc...?
- How sophisticated would you get with your class as you explore the rate of change in temperature? Newton's Law of Cooling?
- Where is the Chemistry, the Biology, and the Physics in this lab?
- Since this Cooling event is exponential, why do many look at it as a Linear? Consider the Calculus point of view.

Walk a Line**PD Objectives**

- This activity uses the Calculator-Based Ranger 2™ data collection device to collect time and distance data. The Vernier DataQuest™ application is used to collect and analyze the data.

Materials Needed/Set Up Requirements

- CBR 2™ data collection device

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives


- Have the participants do this activity in groups of two. If you have an odd number of participants, you can be a partner or you can have a group of three. Encourage all participants to experience both roles in the activity—the walker and the handheld operator. Each group will need one CBR 2 with USB CBR 2™-to-handheld cable.
- Participants do not need much experience or preparation for this activity. The application will start when the CBR 2 is connected to the TI-Nspire™ CAS handheld. Point out how to start the data collection by clicking the **Play** button in the bottom-left corner of the screen.
- This activity is designed to be participant-led. Encourage them to read the directions and explore the Vernier DataQuest app. It should be pretty intuitive, especially if they have used the Vernier EasyData™ application in the past.
- Note the discussion of the difference between velocity and speed in the Teacher Notes. This activity provides an opportunity for students to explore velocity and understand that velocity involves direction as well as magnitude.
- Some participants may want to talk about the velocity graph that is displayed in the default settings of Vernier DataQuest along with the position graph. For this activity, the ideal velocity graph would be a horizontal line with a value of the velocity. Since walkers do not move at a perfectly constant rate, the velocity graph is wavy but approximately horizontal.
- An extension to the activity would be to calculate the average of the velocity data (found in the menu of the Vernier DataQuest™ app) and compare it with the slope. Participants could even graph a horizontal line with this value as a model for the velocity data to see how it fits with the data. Advanced mathematics teachers or calculus teachers may want to find the area under the velocity graph and compare it with the change in position or discuss how this activity could help explain the average value of a function.
- Using the CBR 2 with a computer requires the use of the mini-standard USB adaptor to plug the CBR 2 into a computer with TI-Nspire™ computer software. This adapter will convert your CBR 2 USB cable to a standard USB connection so that the device can be connected to the computer.

Technology Tips

- Check to make sure everyone is able to connect the CBR 2 and that the Vernier DataQuest™ app runs upon connection.

Summary Reflection Questions

- What kinds of interactions did we just experience?
- Why is it important to have students make a prediction about what the graph will look like before they collect the data?
- What is the value of real-time data collection? **Note:** Research shows that students understand graphs more when they see the graph as the data is collected rather than after the data is collected.
- What mathematics and science topics are covered in this activity?
- What are some potential extensions, questions, or assessment ideas that would help make connections between the mathematics and science in this activity?
- How could you change the experiment for different classes?
- How might you encourage students to explore further?
- How do we ensure that students have opportunities to display their understanding of the concepts explored in this activity?

Match Me
PD Objectives <ul style="list-style-type: none"> Participants will use the Vernier DataQuest™ application and a Calculator-Based Ranger 2™ (CBR 2™) to match a position-versus-time graph that is randomly generated in the Vernier DataQuest app. Participants will experience first-hand the value of this type of activity in helping students interpret slope and y-intercept in a real context.
Materials Needed/Set Up Requirements <ul style="list-style-type: none"> One CBR 2 and one USB CBR 2-to-calculator cable for each group of two participants.
Main Focus – Suggested Questions/Strategies for Accomplishing Objectives <ul style="list-style-type: none"> Have the participants work in groups of two for this activity. If you have an odd number of participants, you can be a partner or have a group of three. Encourage all participants to experience both roles in the activity—the walker who matches a graph and the TI-Nspire handheld operator. Participants do not need much preparation for this activity. The Vernier DataQuest should start when the CBR 2 is connected to the handheld. This activity is designed to be participant-led. Refer participants to the last section in the Teacher Notes where there are directions for creating position or velocity matches. They can create a graph to be matched and try it out.
Technology Tips <ul style="list-style-type: none"> You may wish to point out how to start the data collection by clicking the Start Collection  arrow in the lower-left corner of the screen The Vernier DataQuest app can be opened in the same way that any other TI-Nspire app is opened if it does not start automatically.
Summary Reflection Questions <ul style="list-style-type: none"> Could this activity be used as a performance assessment? What concepts do students need to understand in order to match a position versus time graph? Some students create graphs where the slopes match but the first part of the graph is shifted above or below the given graph. What information does this give about the starting position? How might an activity of this type help students learn to better attend to properties of a graph, e.g., the scale used on an axis?

Boyle's Law**PD Objectives**

- Participants will become familiar with TI-Nspire™ technology and the Vernier DataQuest™ application.
- Participants will use a Vernier gas pressure sensor to make pressure measurements.
- Using the data and graph, the type of mathematical relationship between pressure and volume of the confined gas can be determined.

Materials Needed/Set Up Requirements

- Participants will need a TI-Nspire™ CAS handheld, Vernier EasyLink® USB sensor interface or TI-Nspire Lab Cradle, Vernier gas pressure sensor, and a plastic syringe.
- Boyles_Law.tns or Boyles_Law_MG.tns

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- You may want to do this activity in two parts. Initially the activity could be done without the *Boyles_Law.tns* document as an introduction to Events with Entry data collection with all participants doing the activity together. The second part, as a Boyle's Law extension, would be to do the activity individually or in pairs using the *Boyles_Law.tns* document.

Technology Tips

- Progress can be monitored using the Class Capture feature of TI-Nspire™ Navigator™ System.

Summary Reflection Questions

- Discuss how the animation in the TI-Nspire document helps students understand at the molecular level the pressure of gases. This is a good pre-lab activity.
- Did you have issues with:
 - the technology?
 - the directions in the TI-Nspire document?
 - the calculations?
- What did you like about this activity?
- What did you not like that you would want to improve?
- Where would this activity fit into your curriculum?

Nailing Density**PD Objectives**

- Relate slope of mass vs. volume to density.
- Enter data into a Lists & Spreadsheet page.
- Plot mass vs. volume in a Data & Statistics page.
- Analyze data in a Data & Statistics page using a movable line, function plot, and linear regression.
- Calculate a column in a Lists & Spreadsheet page (mass/volume).

Materials Needed/Set Up Requirements

- Nailing_Density_PD.tns
- Five (5) different-size nails of the same material
- 0.01 g balance
- 10- or 50-mL graduated cylinder (depending on the size of the nails)

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- If balances are not available to measure the mass, use the following chart to provide the masses of common nails.

Size	2d	3d	4d	5d	6d	7d
Mass (g)	0.52	0.80	1.44	1.67	2.51	2.82

Size	8d	9d	10d	12d	16d	20d
Mass (g)	4.28	4.73	6.57	7.09	9.26	15.12

Technology Tips

- Alternately the Vernier DataQuest™ application can be used to plot and analyze the data.

Summary Reflection Questions

- Discuss why determining density from a plot of total mass vs. total volume is better than from a plot of mass vs. volume for the individual nails or from the mean of the densities of all of the nails.
- Did you have any issues with:
 - the technology?
 - the directions in the TI-Nspire document?
 - the calculations?
- What did you like about this activity?
- What did you not like that you would want to improve?
- Where would this activity fit into your curriculum?

Introduction to the TI-Nspire™ Navigator™ System

PD Objectives

- Introduce the TI-Nspire Navigator System to participants.
- Make participants aware of Quick Polls, sending documents, and the Live Presenter feature.

Materials Needed/Set Up Requirements

- Navigator_Introduction.tnsp
- Nav_Quick_Polls.tns
- Nav_Data_Collection.tns
- TI-Nspire™ Lab Cradle
- Temperature probe

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Open the PublishView™ document and use it to guide the activity.
- Send out each question in the *Nav_Quick_Polls.tns* as Quick Polls. Discuss how this could be used in their class to gather feedback.
- Ask teachers about how they get students' feedback on lessons that they have done on prior days.
- How do you assess students on a daily basis?
- How can you guide the class through an activity without touching the technology?
- Send the participants the *Nav_Data_Collection.tns* and make a participant the Live Presenter. Talk them through how to setup the handheld to collect the temperature data.

Technology Tips

Summary Reflection Questions

- How would you modify this activity for your students?
- How do you see yourself using the TI-Nspire Navigator System at this time?
- How could using the TI-Nspire Navigator System strengthen your teaching?

Instructor Notes

Body Mass Index

PD Objectives

- Explore the body mass index (BMI) calculator.
- Students will model data with a moveable line to determine the relationship between weight and percent body fat.
- Teachers will add a Lists & Spreadsheet page, assigning variables to columns and entering data.
- Teachers will add a Data & Statistics page plotting two sets of data.
- Teachers will answer different question types.

Materials Needed/Set Up Requirements

- Body_Mass_Index.tns

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Talk to teachers about their predications of what affect weight has on percent body fat. “Is it a linear or non-linear relationship?”
- Discuss defining appropriate variables. As examples, column A could be defined as **Weight**, column B as **My_BF**, and column C as **Your_BF**.
- Plot both data sets of percent body fat.
- Have participants color or define the difference in color between the two graphs.
- Which graph represents the taller person? The graph with the lesser y-intercept is the taller person.
- Focus on the slope of the graph and how it relates to percent body fat divided by weight in pounds.
- Discuss the y-intercept and that a person that has a mass of zero doesn't exist.

Technology Tips

Summary Reflection Questions

- How would you present this activity to your students?
- What other questions would you like them to focus on?
- What are discussion questions that you would hope this leads to?

Science Handheld Skills**PD Objectives**

- Become comfortable with the Home Screen, the Calculator and Notes applications, and Keypad features.
- Use basic features of the Calculator and Notes apps for Science.
- Expose participants to the unit conversion aspects of the TI-Nspire CX CAS, as well as interacting with text.

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Describe a learning curve for new TI-Nspire users and encourage beginners through their difficulties.
- Work through the handout at a pace suitable for participants.
- Show basic TI-Nspire skills and features in the context of the activity: Undo, escape, menu selections, changing pages...
- Encourage discussion on the science viewpoint for the context examples used.
- Encourage questions and sharing of “discoveries.”

Technology Tips

- This lesson requires the use of CAS. Suggest to teachers that they can use the CAS version of their teacher software (which is installed when they install the Regular Flavor software) to demonstrate and discuss if they do not have the CAS handhelds.
- Create the Question presented in the Student document. Send it as a file and/or a Quick Poll. The purpose is to show the Question types and how to answer them. Make it a Self-Check and show how they can check their answers. The Correct answer is D.
- Have the participant's key in the text, or you can copy and paste and send them the file. The purpose is to give them text to interact with by the use of Bold, Italics, and Underline and/or the use of color text and fill.
- When participants mix the use of the underscore and the Units environment they will get an error because they key in the underscore and then pull the unit name which comes with the underscore so they get something like $_ _ \text{lbf}$ ($_ _ \text{lbf}$).

Summary Reflection Questions

- How can the Document nature of TI-Nspire be useful?
- What features would you like to learn about?
- Which do you prefer, Unit Analysis, or the actual use of units? Why?

Radioactive Decay
PD Objectives <ul style="list-style-type: none"> Participants will become familiar with TI-Nspire™ CX technology by working with the Lists & Spreadsheet application to develop an understanding of exponential decay and the idea of half-life.
Materials Needed/Set Up Requirements <ul style="list-style-type: none"> Radioactive_Decay_MG.tns Bag of M&M's® paper towels paper cups
Main Focus – Suggested Questions/Strategies for Accomplishing Objectives <ul style="list-style-type: none"> Participant groups of two or three will count out the number of M&M's in a bag or cup. Participants will pour the M&M's onto a towel, remove any candies with an M facing up, and recount what remains. Participants will use the Lists & Spreadsheet application to record the trials and the number of M&M's remaining. They will graph their data using the Data & Statistics application and analyze the non-linear aspect of the function. When they have gathered their data and have their analysis, send them a Quick Poll of their analysis and gather the entire class data. Observe students' graphs to be sure they are calculating and interpreting their model correctly. Take Class Captures and send Quick Polls to check their understanding of the concept of age estimation. Extension option: Radioactive Dating lesson from Science Nspired (Earth Science > Earth's Surface > Earth's History) <ul style="list-style-type: none"> In this simulation, isotopes of different atoms decompose and give off radioactivity in the process. Have participants observe how the known rate at which isotopes decay is used to estimate the age of a fossil. Then they will play a game to check their understanding of radioactive dating.
Technology Tips <ul style="list-style-type: none"> Monitor participants' progress using Quick Poll, Class Capture, and Live Presenter. Collect and review the TI-Nspire document and save it to the Portfolio.
Summary Reflection Questions <ul style="list-style-type: none"> What is the relationship between number of candies and trials? What does each value in the model represent? Y-intercept? X-intercept? Where does this activity fit into your curriculum? How would you use this technology in your classroom?

Instructor Notes

- Where can you find additional support/resources?
- What questions would you ask your students during the activity to start them thinking along the correct path?
- What questions would you ask when summarizing the activity?
- What extension would go well with this activity?
- How might you encourage students to explore further?
- How can this activity assist students to better understand this topic at a higher cognitive level?

Fahrenheit vs. Celsius**PD Objectives**

- Collect data using the TI-Nspire™ Lab Cradle with two Vernier EasyTemp® USB temperature sensors.
- Use the Vernier DataQuest™ application to:
 - Modify collection mode (events w/ entry).
 - Modify setup sensors (change units).
 - Graph (change axes).
 - Perform a linear regression.

Materials Needed/Set Up Requirements

- Fahrenheit_vs_Celsius_PD.tns
- TI-Nspire Lab Cradle
- 2 Vernier EasyTemp® USB temperature sensors
- Containers of water at different temperatures (ice water, room temperature, and hot water)

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Ask participants to predict graph of degrees Fahrenheit vs. degrees Celsius before collecting the data.

Technology Tips

- Observe participants' graphs to be sure they are calculating and interpreting the slope correctly.

Summary Reflection Questions

- What is the relationship between degrees Fahrenheit and degrees Celsius? Celsius and Fahrenheit?
- Where does this activity fit in your curriculum?
- How would you use this technology in your classroom?
- What questions would you ask your students during the activity to start them thinking along the correct path?
- What questions would you ask when summarizing the activity?
- What extension would go well with this activity?
- How might you encourage students to explore further?
- How can this activity assist students to better understand this topic at a higher cognitive level?

Getting Started with the TI-Nspire™ Family of Teacher Software

PD Objectives

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

Materials Needed/Set Up Requirements

- Computer with TI-Nspire Teacher Software

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- As participants explore the Welcome Screen, encourage them to move their cursors over each icon to see a description of the given feature. This is a universally helpful skill when exploring the TI-Nspire Teacher Software.
- As participants move from the Calculator application to the Graphs application, ask them what happens to the menus in the Documents Toolbox under the Document Tools tab. Participants should recognize that each application has its own unique menu.
- Encourage participants to explore the various menus and submenus in the Document Tools tab. Also, encourage participants to explore the Utilities, Page Sorter, TI-SmartView™ emulator for TI-Nspire, 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.
- 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 briefly to the data collection features of the Teacher Software.
- When exploring the Document Settings, discuss the options available in each field. Make sure participants are comfortable tabbing through fields and changing the settings.

Technology Tips

- Sometimes participants do not immediately see the five icons in the Documents Toolbox. Consider emphasizing the location of these icons.

Summary Reflection Questions

- What types of features are available in the Documents Toolbox?
- How does the Documents Toolbox change when working with different applications?
- How might the various Document Views and the TI-SmartView emulator options be helpful in the classroom?

Carousel**PD Objectives**

- The following activities are provided so that participants can explore one or more activities that are most relevant to their classrooms:
 - The River of Life
 - Sound and Waves
 - How Much Does It Weigh?
 - Energy of a Roller Coaster
 - Rolling Rates
- Participants can use the Teacher Notes for each activity to find topics for discussion.

Materials Needed/Set Up Requirements

- The_River_of_Life_MG.tns
- Sound_and_Waves.tns
- How_Much_Does_It_Weigh.tns
- Energy_of_a_Roller_Coaster.tns
- Rolling_Rates.tns

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Have a participant use TI-Nspire™ Teacher Software or TI-Nspire™ Navigator™ Teacher Software to send all TI-Nspire™ documents to participants.
- Participants will select one or more activities to work on in pairs or groups. Activities are from various resources, and individual Teacher Notes give an overview of each activity.
- Use Quick Poll to see that all activities have been selected.

Technology Tips**Summary Reflection Questions**

- What is the science? Where does the content fit in your curriculum?
- Does the TI-Nspire aid in the learning of the science concepts taught in the activity?
- Is this activity suited for hands on data collection by the student or is a simulation a better choice?
- Which components of an interactive classroom are evident in the execution of the activity?
- What role does the technology play in students' understanding of the science concepts?

Vernier – That’s the Way the Ball Bounces: Height and Time for a Bouncing Ball

PD Objectives

- Use the Vernier DataQuest™ application to do the following:
 - Zero and reverse sensor setup for the Motion Detector.
 - Select data.
 - Create a mathematical model in vertex form.
 - Perform a quadratic regression in standard form.
 - Relate the vertex form and standard form of a quadratic equation

Materials Needed/Set Up Requirements

- CBR 2™
- Ball (the size of a racquetball or basketball)
- Have the participants work in pairs.

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Pre-lab: sketch a graph of height vs. time for a bouncing ball
- First do the experiment without zeroing or reversing the sensor to show that data is “backwards”.
- In your analysis use the model $a(x - h)^2 + k$. Select **Menu > Analyze > Model**. *This step is different from the handout.*
- Next, perform a quadratic regression and compare the equations. Show that the two equations are equivalent.

Technology Tips

- Participants may have to do the data collection several times before getting good results

Summary Reflection Questions

- Why is it beneficial to have your students make a pre-lab sketch of height vs. time?
- What are the advantages of doing the model before doing the regression?

Creating Lab Reports**PD Objectives**

- Participants will become familiar with PublishView™ documents.
- Participants will know and be able to create the various lab reports.
- Participants will know how to insert images into documents.
- Participants will know the various types of Questions available in the TI-Nspire™ Teacher Software.

Materials Needed/Set Up Requirements

- Lab_Report_Template.tnsp
- Biology_Lab_Report_Sample.tnsp
- Chemistry_Lab_Report_Sample.tnsp
- Physics_Lab_Report_Sample.tnsp
- Example jpg image files

Main Focus – Suggested Questions/Strategies for Accomplishing Objectives

- Go over the components of a PublishView document and applications.
- Demo the sample lab report PublishView documents using the Teacher Software and, if possible, the TI-Nspire™ Document Player on the web.
- Illustrate how to access a picture file from your computer or via the web and insert into documents to increase real world applications and engagement.
- Review the various question types and uses in both documents as well as in Quick Polls.

Summary Reflection Questions

- Did you have issues with:
 - the technology
 - the directions in the TI-Nspire™ document?
 - the calculations
- What did you like about this activity?
- What did you not like that you would want to improve?
- Where would this activity fit into your curriculum?