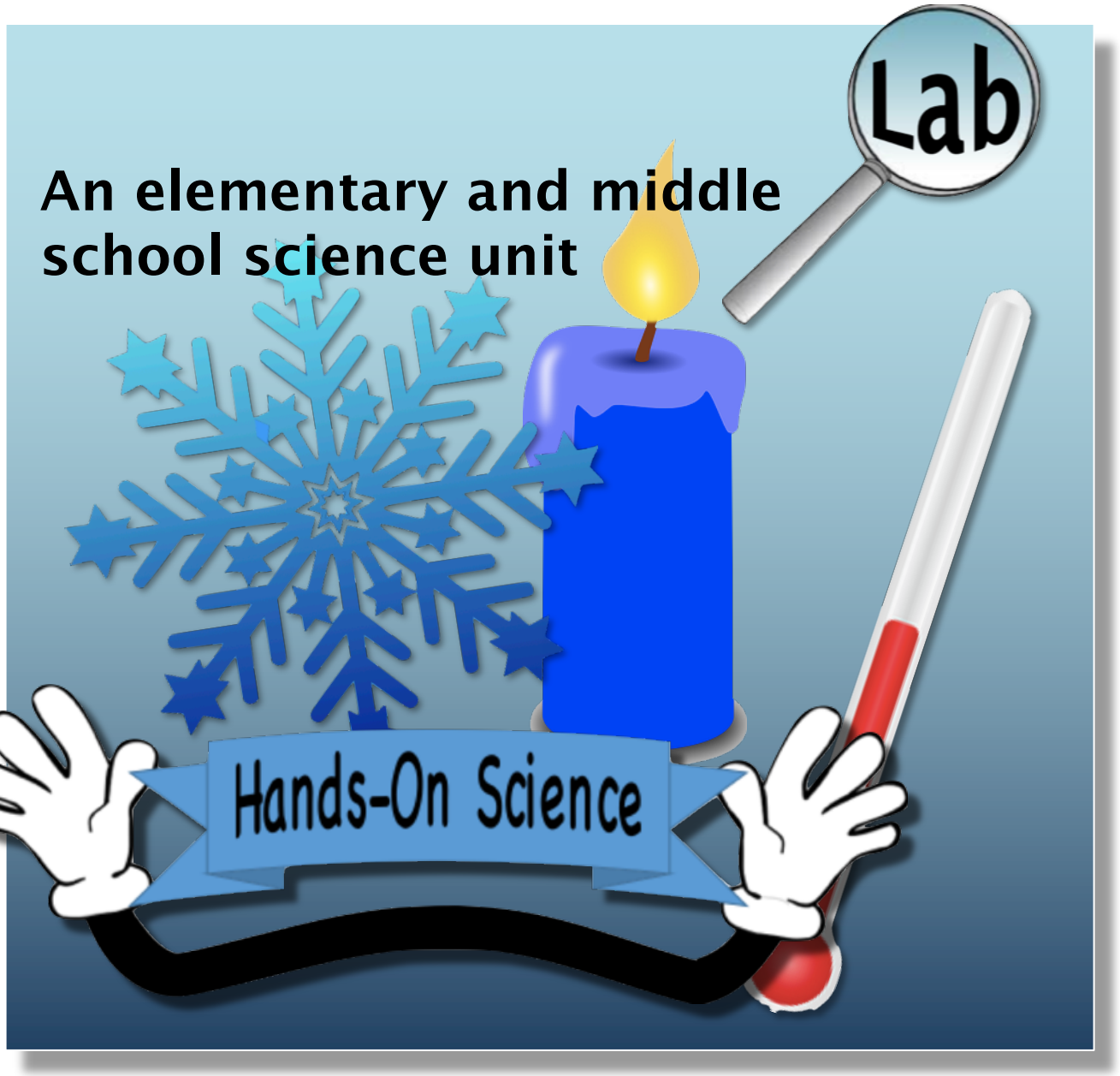
This material is copyrighted and protected by U.S. anti-piracy laws.

An elementary and middle school science unit



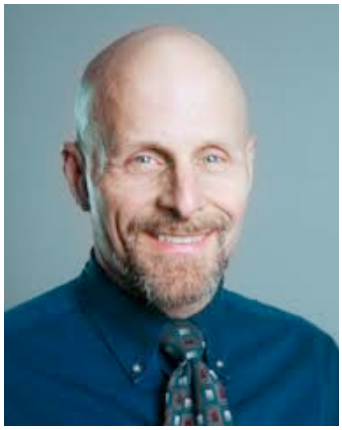
Teacher to Teacher Press

Join us!

Facebook: TeacherToTeacherPress

Twitter: @tttpress

YouTube /watchtttpress



PO Box 233, Millville, CA 96062
(530) 547-4687
brad@tttpress.com

Brad Fulton

Educator of the Year

- ♦ Consultant
- ♦ Educator
- ♦ Author
- ♦ Keynote presenter
- ♦ Teacher trainer
- ♦ Conference speaker

Known throughout the country for moti s co-authored over a dozen books that provide easy-to-teach yet mathematically rich activities for busy teachers while teaching full time for over 30 years. In addition, he has co-authored over 40 teacher training manuals full of activities and ideas that help teachers who believe mathematics must be both meaningful and powerful.

Seminar leader and trainer of mathematics teachers

- ♦ 2005 California League of Middle Schools Educator of the Year
- ♦ California Math Council and NCTM national featured presenter
- ♦ Lead trainer for summer teacher training institutes
- ♦ Trainer/consultant for district, county, regional, and national workshops

Author and co-author of mathematics curriculum

- ♦ Simply Great Math Activities series: six books covering all major strands
- ♦ Angle On Geometry Program: over 400 pages of research-based geometry instruction
- ♦ Math Discoveries series: bringing math alive for students in middle schools
- ♦ Teacher training seminar materials handbooks for elementary, middle, and secondary school

Available for workshops, keynote addresses, and conferences

All workshops provide participants with complete, ready-to-use activities that require minimal preparation and give clear and specific directions. Participants also receive journal prompts, homework suggestions, and ideas for extensions and assessment.

Brad's math activities are the best I've seen in 38 years of teaching!
Wayne Dequer, 7th grade math teacher, Arcadia, CA

"I can't begin to tell you how much you have inspired me!"
Sue Bonesteel, Math Dept. Chair, Phoenix, AZ

"Your entire audience was fully involved in math!! When they chatted, they chatted math. Real thinking!"
Brenda McGaffigan, principal, Santa Ana, CA

"Absolutely engaging. I can teach algebra to second graders!"
Lisa Fellers, teacher

References available upon request

Like my activities? How about giving me a favorable rating on the Teachers Pay Teachers website? Four stars would be much appreciated and would help me sleep better at night.

Like me even more? Then please don't make copies for your colleagues. I know it's tempting when they say, "Wow! Groovy activity! Can I have a copy?" But this is how I make my money, and why are they still saying "groovy" anyway?

If we make copies for our friends, can we honestly tell our students not to copy or take things that don't belong to them? (Ouch!)

Half priced site licensed copies are available on the TPT website. Please encourage them to take advantage of this affordable option. Okay?

Thanks, and happy teaching,

Brad 

Heat & Temperature

An Elementary & Middle School Science Unit

Overview:

This Hands-On Science unit helps students make sense of heat and temperature through a series of active participation lessons, demonstrations, and experiments. Your students will not only deepen their understanding of physics in these lessons, they will look forward to science and rave about it when their parents ask, "What did you do in school today?"

The unit consists of these interrelated components that provide a complete picture of heat and temperature and how these phenomena behave.

- What is temperature?
  - Tricky Temperatures
  - Can You Tell the Temp?
  - Seeing Temperature
  - Expansion and Contraction
  - Homemade Thermometer
- What is heat?
  - Ice Cube Race
- Heat Transfer
  - Matter Matters: Understanding Solids, Liquids, and Gasses
  - The Salted Ice Mystery
  - Conduction: The Butter Meltdown
  - Hot Cocoa Lab
  - Convection Snake
  - Radiation Lab
- Ice Melt Challenge

Each lesson can stand alone, so you can do some or all of them depending on your time and needs. They can also be implemented back to back or with breaks in between. An overview and materials list accompanies each lesson along with detailed instructions and complete explanations of the results. Student activity masters are included as well and can be bound into a science notebook that the students use throughout the unit.

Making a Thermometer

Overview:

Now that students understand expansion and contraction, they are ready to make a thermometer. Building this tool will give them a much greater understanding and appreciation of how this device works. They will see that as temperatures fluctuate, the liquid expands and contracts in the tube. Suggested variations for this lab allow for the integration of engineering, technology, and math for a comprehensive STEM activity.

Required Materials:

- ☒ Plastic water bottle
- ☒ Transparent straw
- ☒ Food coloring
- ☒ Modeling clay
- ☒ Water or isopropyl (rubbing) alcohol

Optional Materials:

- ☐ Thermometers

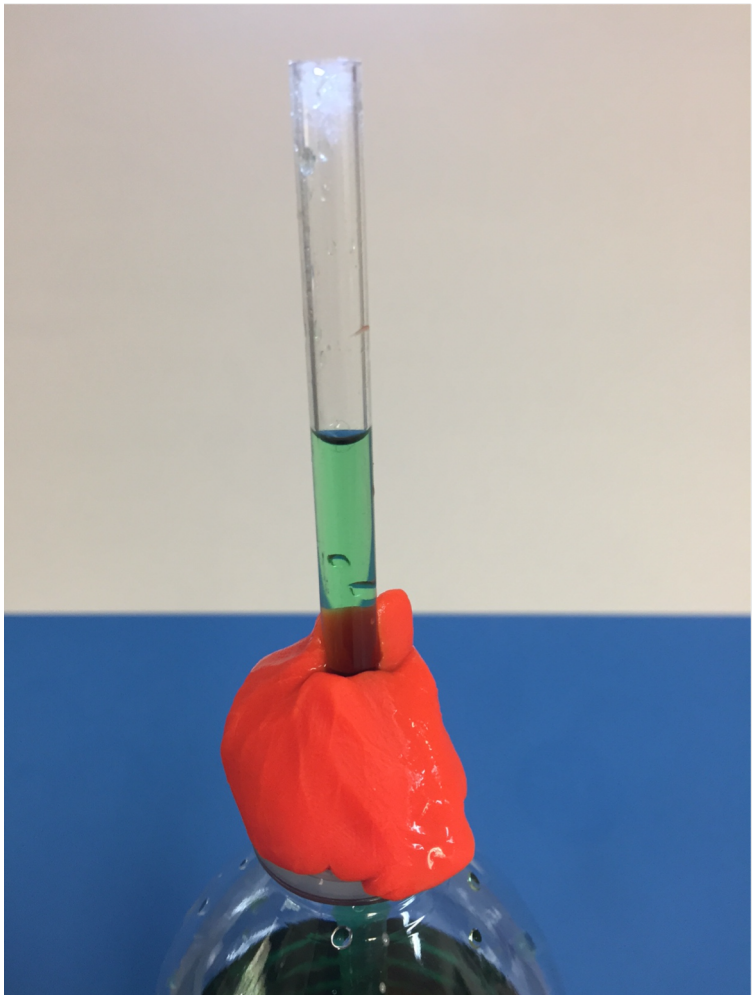
Procedure:

1. Provide each group with a bottle, a transparent straw, and a small lump of

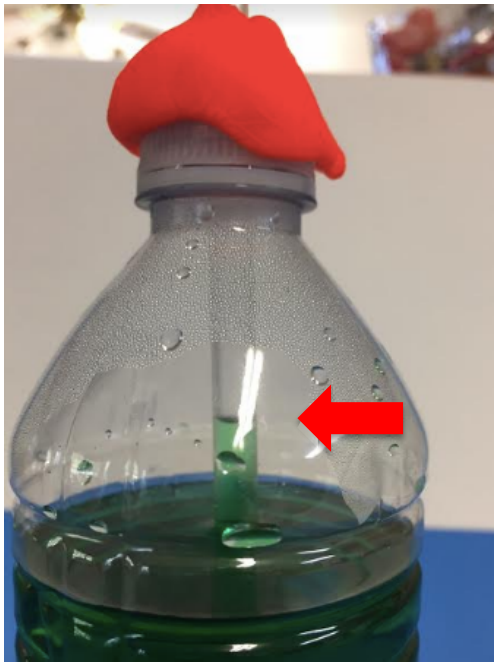
modeling clay as shown. The cap of the plastic bottle needs to have a hole that will accommodate the straw.

2. Fill the bottle about half to three-fourths full of water or alcohol and add food coloring. Mix well. Cap the bottle and insert the straw. Then seal the opening with modeling clay.

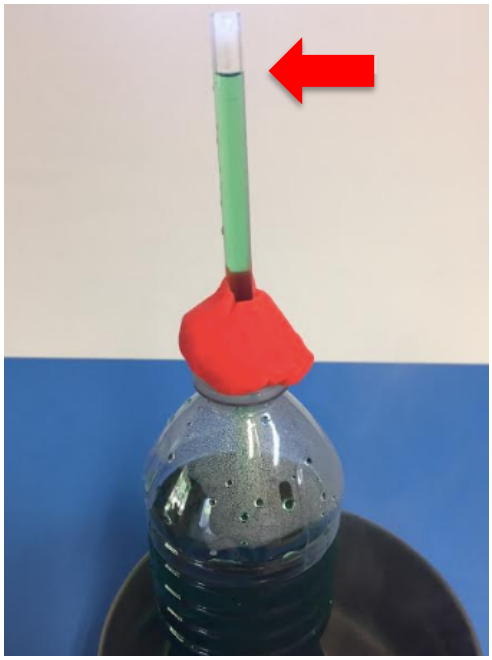
   I wanted the water level to be higher than the top of the bottle. To do this, I inserted the straw all the way down to fill as much of it as possible with liquid. Then I put my finger over the top of the straw. After raising the straw, I sealed the opening with the modeling clay and the air pressure held the level. This level represents a water temperature of 27º C.



3. Students should then place the thermometer in various locations. Obviously the greater the temperature differential, the easier it will be to observe it. They can place it in a refrigerator or on a sunny surface outdoors. However, it should not be placed in a freezer.



After sitting in the refrigerator



Sitting in a pan of hot water

4. If you would like to incorporate some research and technology into this activity, have students research why water is not used in thermometers. This could be done online, and results could be shared in a collaborative document or slide show.

   Thermometers typically use either mercury or alcohol for their liquids. These two liquids have a *higher expansion coefficient* than water does. That's a fancy way of saying they expand and contract more than water. Mercury is the only metal that is liquid at room temperature, and since metals expand and contract very well, it is a logical choice. However, alcohol can measure lower temperatures than mercury. Mercury becomes solid at -39º C. Alcohols remain liquid down to -90º C to -115º C depending on the type. Water on the other hand freezes at 0º C and actually expands when it does so! It also boils at 100º C and would be useless at temperatures higher than that.

5. Students can mark the various levels of the water on their straw with a permanent marker. Alternately, they can glue a piece of paper onto the straw. Water levels can be marked on the paper. The actual water temperature can then be written on the card also.

6. Another way to incorporate technology and mathematics is by having students learn how to convert Celsius and Fahrenheit temperatures. This can be done in many ways. The following formulas will convert the two measurement units.

   a. To convert Celsius to Fahrenheit:

   $$F = {}^{9}/_{5}C + 32$$

   Substituting the boiling point of water on the Celsius scale (100º C) gives us:

   $$F = {}^{9}/_{5}(100) + 32$$

   $$F = 180 + 32$$

   $$F = 212º$$

   b. To convert Fahrenheit to Celsius:

   $$C = {}^{5}/_{9}(F - 32)$$

   Putting the freezing point of water on the Fahrenheit scale (32º F) into the equation gives:

   $$C = {}^{5}/_{9}(32 - 32)$$

   $$C = {}^{5}/_{9}(0)$$

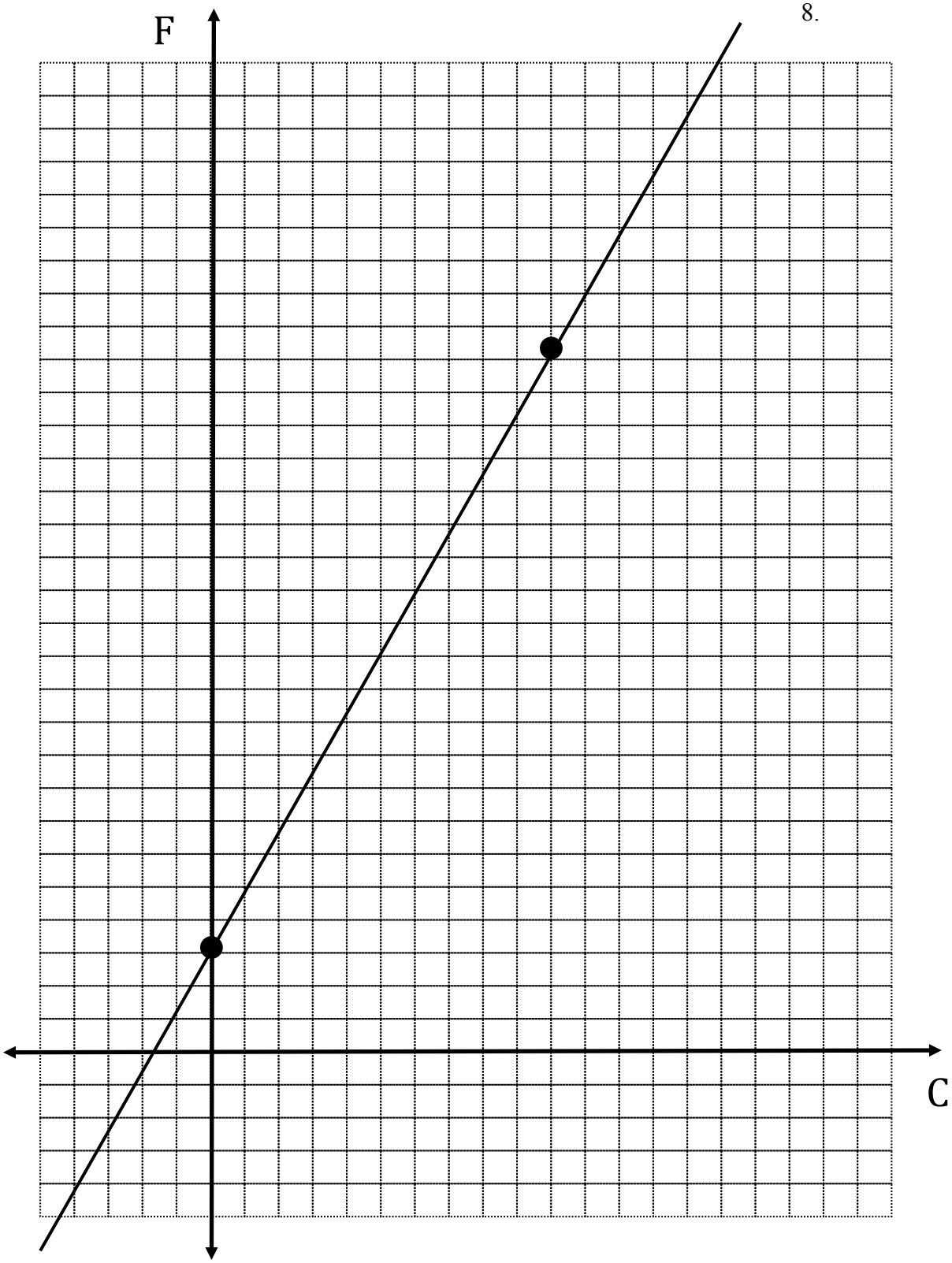
   $$C = 0º$$

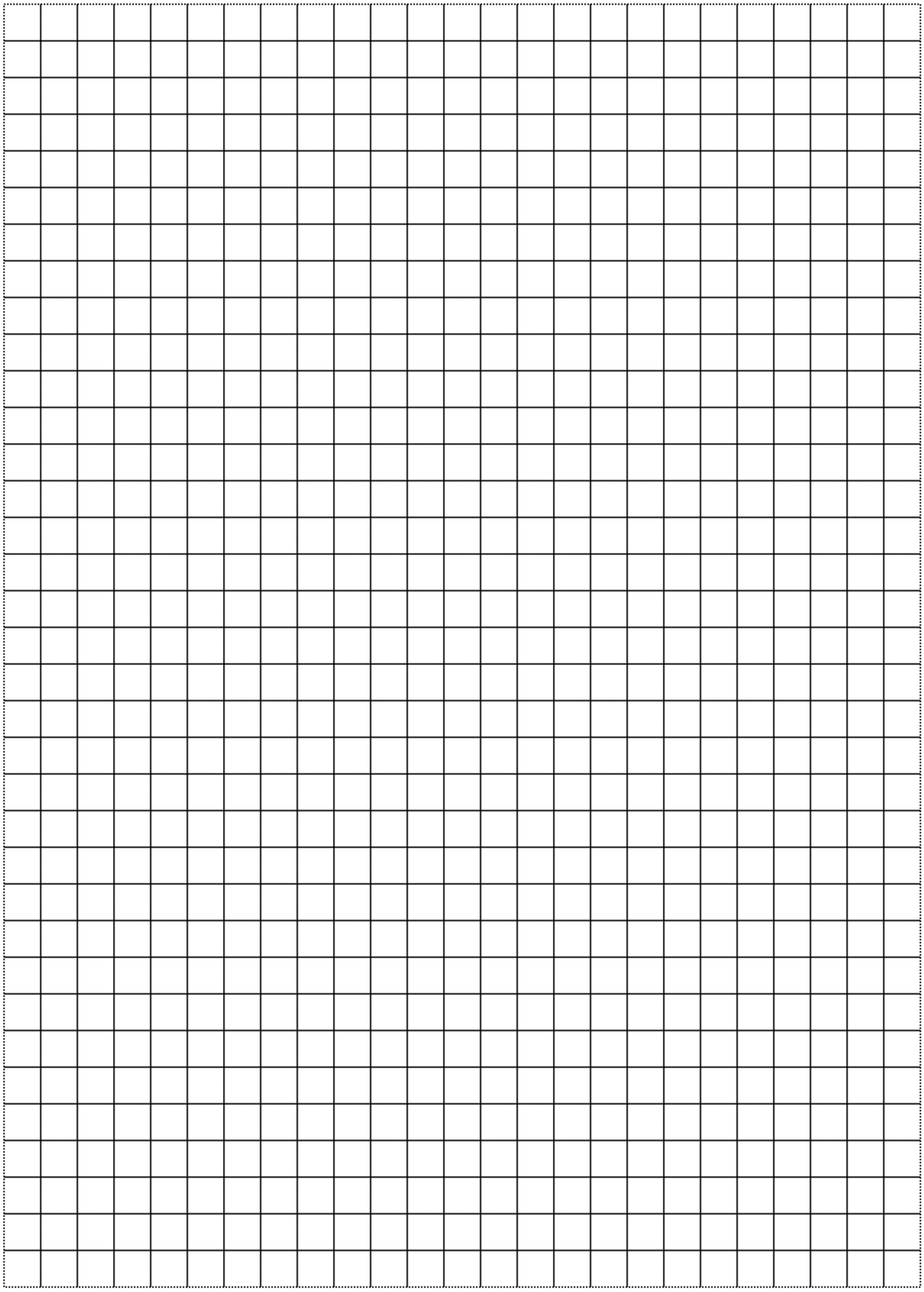
7. The two temperature scales can also be graphed. Placing Celsius on the x-axis and Fahrenheit on the y-axis allows us to graph a y-intercept of 32 and a slope of ${}^{9}/_{5}$ as shown on the following page.

   In the graph, both axes count by ten degrees. Two points have been added to the graph: the freezing (0, 32) and boiling (100, 212) points of water. Then a line joining these points graphs the temperature conversion. For example, 15º C corresponds to 59º F.

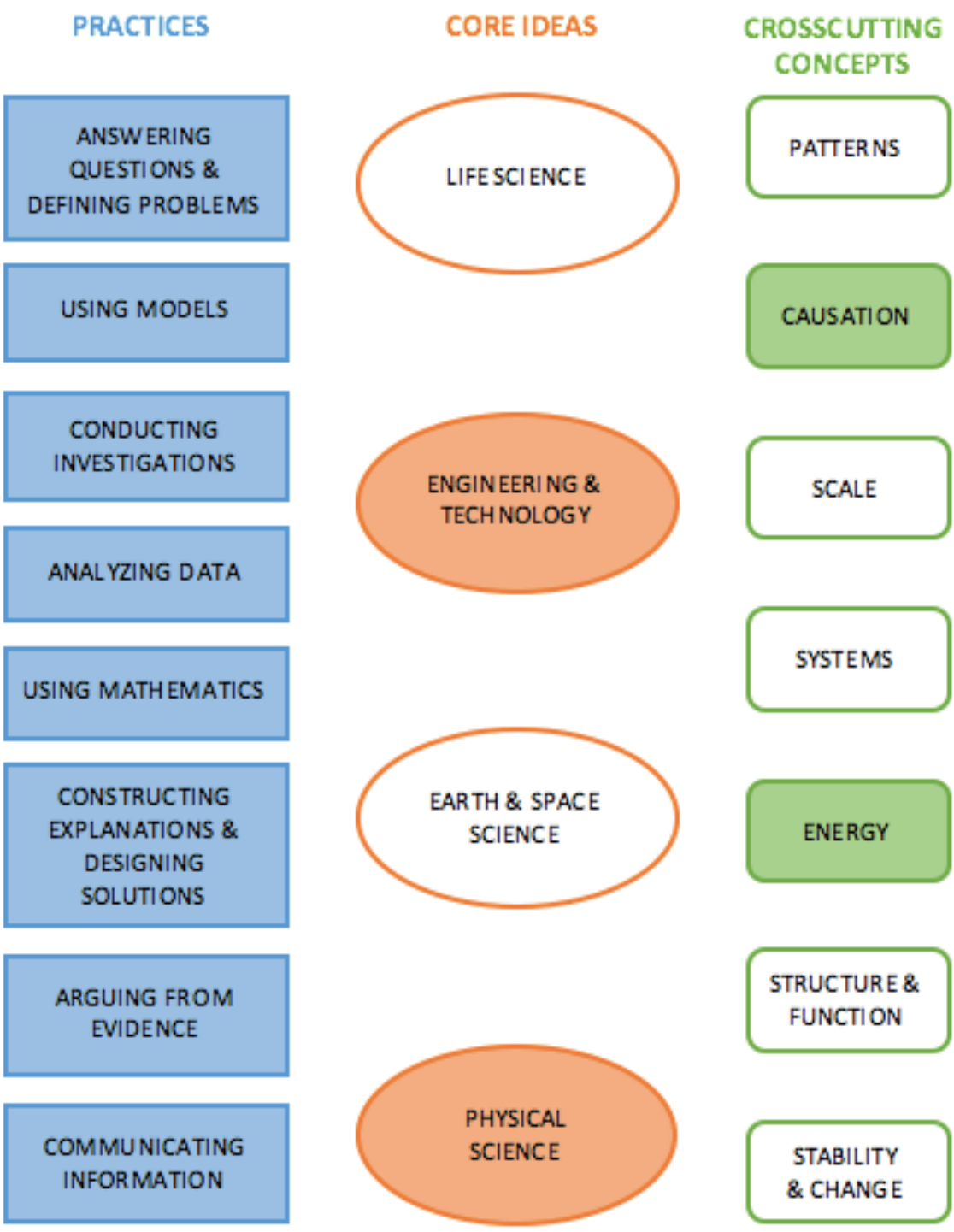
   A blank page of grid paper is provided so that your students can make their own graph.

8.





NGSS Alignment



This activity is one of 13 in the Heat and Temperature unit. Each activity in the full unit is an experiment you and your students can do in class. If you liked this activity, you might also like some of the other lessons available in my TeachersPayTeachers store. Simply search for "Brad Fulton".

You can also find many free and inexpensive resources on my personal website, www.tttpress.com. **Be sure to subscribe to receive monthly newsletters, blogs, and FREE activities.**

Similar ***S.T.E.M. ON A SHOESTRING*** activities include:

- *Slime Time* – A gooey lab involving Non-Newtonian fluids. Get the PowerPoint too!
- *Ramp Races* – An engaging and exciting way to teach students the principles of physics: forces, motion, speed, friction, and more!
- *Invisible Ink Lab* – Make hidden messages appear using the principles of chemistry and simple kitchen ingredients
- *Milk Lab* – Watch polar and non-polar molecules interact in this rainbow-hued lab. PowerPoint presentation available too!

Feel free to contact me if you have questions or comments or would like to discuss a staff development training or keynote address at your site.

Happy teaching,

Brad