

# Transformation 2013

## PBL 5E

### Planning Form

### Guide

PBL Title: How quenched is your thirst?

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School: Taylor High School

Subject: Chemistry

**Abstract:** Are sports drinks only for athletes? What do sports drinks really do for the body? In this lesson, students are tasked to write a magazine article for Runner's World magazine that uncovers the myth and the science behind sports drinks. The research reveals when and who should consume sports drinks and how to make a homemade sports drink. Through their research, students will discover the role of the various ingredients found in sports drinks, how electrolytic content is determined, which compounds in the ingredients provide the electrolytes, and much more. Scientific literacy is a key component of this challenge.

MEETING THE NEEDS  
OF STEM EDUCATION  
THROUGH PROBLEM  
BASED LEARNING

# Begin with the End in Mind

The theme or “big ideas” for this PBL:

Discuss electrolyte balance within the body. What are causes of imbalance? Are sports drinks only for athletes? What do sports drinks really do for the body in terms of electrolyte balance?

The students will analyze a consumer product as well as roles of electrolytes in the human body. Students will also identify where the common electrolytes fall on the periodic table and the characteristics of the elements of interest. They will also classify the characteristics of these elements on the periodic table and discuss the difference between ions and elements.

TEKS/SEs that students will learn in the PBL:

3B Make responsible choices in selecting everyday products and services using scientific information.

3C Evaluate the impact of research on scientific thought, society, and the environment.

4C Investigate and identify properties of mixtures ~~and pure substances~~

4D describe the physical and chemical characteristics of an element using the periodic table and make inferences about its chemical behavior.

8B investigate ~~and compare~~ the physical ~~and chemical~~ properties of ionic ~~and covalent~~ compounds

11A identify common elements and compounds using scientific nomenclature.

12C Evaluate the significance of water as a solvent in living organisms ~~and in the environment~~

Key performance indicators students will develop in this PBL:

- Describe and categorize chemically the components of various popular “sports drinks.” ; recognize sugars by name (end in “ose”); recognize common salts (NaCl)
- Determine the physiological role of these components in the human body (role of electrolytes in hydration, carbohydrates for energy).
- Make the connection between the terms element and ion
- Make the connection between placement on periodic table and role as an electrolyte in the human body
- Understand that conductivity measures the total soluble salts contained within a liquid solution
- Explain scientifically how the marketing claims for these drinks are supported (or not).

- Determine under what conditions each of the “sports drinks” might be useful to the consumer.
- Create a sport drink using what they have learned and market their product.

21st century skills that students will practice in this PBL:

[www.21stcenturyskills.org](http://www.21stcenturyskills.org)

#### Critical Thinking and Problem Solving

Framing, analyzing and synthesizing information in order to solve problems and answer questions

#### Creativity and Innovation

Acting on creative ideas to make a tangible and useful contribution to the domain in which the innovation occurs

#### Media Literacy

Examining how individuals interpret messages differently, how values and points of view are included or excluded and how media can influence beliefs and behaviors.

STEM career connections and real world applications of content learned in this PBL:

Careers in sports science; decisions regarding use and production of consumer products

# The Problem

After spending several years working the Sport's Desk of the *Austin Statesman*, you have landed the job of your dreams as a writer for *Runners' World* magazine. The job is fantastic! Since high school, where you had excelled in sports, you have been a consistent runner, participating in local races and those assigned to you for your job. For your last assignment, you had run and reported on the Austin Marathon—it was a *blast!*

As if reading your mind, your boss Rose walked in just then with a bottle of Gatorade® in one hand and a list of several other sports drinks in the other.

“We’ve been getting a lot of inquiries about the different sports drinks on the market, including Gatorade®. Do you know anything about them?” Rose asked.

“I know that people use them for various reasons,” you replied. “It seems they’re primarily used by athletes to restore electrolytes as they practice and compete. Other people use them more casually, as a flavorful drink.” That’s about all I know.”

“That seems to be about all any of us knows,” Rose said.

“For your next assignment,” Rose continued, “I want you to find out what each of the ingredients in these drinks is and what it does for a runner or for a non-athlete. You need to be very accurate in your analysis—determine what each component really does for the body, not what the marketers want you to believe it does. Then look at the marketing claims of some of these drinks and see if the scientific facts match up to them. Many of our readers are using these drinks with some general notion that they’re helpful, but they’re basing their use of them on no scientific information. I’ve got the marketing claims and a short list of questions that should get you started. When you research these, be sure to document all your sources of information, keeping in mind that all resources are not equal. Here’s the information.”

With that, Rose left the office. You looked over the list. “Guess I’ll have to brush up on my biochemistry. No problem. I’m interested in knowing if my running would be improved or if I’d feel better after a run by drinking this stuff.”

# Map the PBL

Performance Indicators	Already Learned	Taught before the project	Taught during the project
1. Describe and categorize chemically the components of various popular “sports drinks.” ; recognize sugars by name (end in “ose”); recognize common salts (NaCl)			X
2. Determine the physiological role of these components in the human body (role of electrolytes in hydration, carbohydrates for energy).			X
3. Make the connection between the terms element and ion.			X
4. Make the connection between placement on periodic table and role as an electrolyte in the human body			X
5. Understand that conductivity measures the total soluble salts contained within a liquid solution			X
6. Explain scientifically how the marketing claims for these drinks are supported (or not).			X
7. Determine under what conditions each of the “sports drinks” might be useful to the consumer.			X
8. Apply what is learned to create a sport drink			X
9.			

# Team-Building Activity

It is important that teachers provide team-building activities for students to help build the 21<sup>st</sup> Century Skills that are necessary for success in the workforce. Team-building helps establish and develop a greater sense of cooperation and trust among team members, helps students adapt to new group requirements so that they can get along well in a new group, serves to bring out the strengths of the individuals, helps identify roles when working together, and leads to effective collaboration and communication among team members so that they function as an efficient, productive group. Our students are often not taught how to work in groups, yet we assume that they automatically know how. Use team-building activities with your students so that you can see the benefits which include improvement in planning skills, problem solving skills, decision making skills, time management skills, personal confidence, and motivation and morale.

Check out:

<http://www.wilderdom.com/games/InitiativeGames.html>

for some fun team building activities.

# 5E Lesson Plan

**PBL Title:** How quenched is your thirst?

**TEKS/TAKS objectives:** 3BC, 4CD, 8B, 11A, 12C

## Engage Activity

\*\*\*If possible, work with the ELA teacher to help with library research, proper documentation, and how to write a magazine article. Also, collect data in the science classroom and “crunching” the numbers in the math classroom.\*\*\*

Begin class by showing a sports drink commercial  
([http://www.gatorade.com/film\\_and\\_downloads/commercials/](http://www.gatorade.com/film_and_downloads/commercials/))

Ask the students to respond to the following questions in their journal; then discuss as a class:

What is the purpose of a commercial?  
Do commercials tell the whole story?  
Do you drink sports drinks? Which ones?  
When do you drink sports drinks?  
Why do you drink sports drinks?  
Are sports drinks good for you?

Introduce the problem to students:

After spending several years working the Sport’s Desk of the *Austin Statesman*, you have landed the job of your dreams as a writer for *Runners’ World* magazine. The job is fantastic! Since high school, where you had excelled in sports, you have been a consistent runner, participating in local races and those assigned to you for your job. For your last assignment, you had run and reported on the Austin Marathon—it was a *blast!*

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“For your next assignment,” Rose continued, “I want you to find out what each of the ingredients in these drinks is and what it does for a runner and for a non-athlete. You need to be very accurate in your analysis—determine what each component really does

for the body, not what the marketers want you to believe it does. Then look at the marketing claims of some of these drinks and see if the scientific facts match up to them. Many of our readers are using these drinks with some general notion that they're helpful, but they're basing their use of them on no scientific information. In the article, I'd like you to include an original recipe for a home-made sports drink. Provide a means for readers to give us feedback on your recipe. I've got a short list of questions that should get you started. When you research these, be sure to document all your sources of information, keeping in mind that all resources are not equal. Here's the information."

With that, Rose left the office. You looked over the list. "Guess I'll have to brush up on my biochemistry. No problem. I'm interested in knowing if my running would be improved or if I'd feel better after a run by drinking this stuff."

Ask the students, *when we say that something "rehydrates" us, what does that mean? What is an electrolyte?*

Short list of questions:

1. What is the final product(s) you will submit?
2. What is the nature (compound, mineral, sugar, element, vitamin, etc.) of each ingredient listed on the sports drink bottles?
3. What is the physiological role of each in the human body?
4. Which ingredients provide electrolytes? How do you test electrolytic behavior?
5. How are the terms "ion" and "element" related?

### Engage Activity Products and Artifacts

Journal entry

### Engage Activity Materials/Equipment

Computer, internet connection, student journals, problem as handout for students

### Engage Activity Resources

Adapted from: [http://www.sciencecases.org/energy\\_drinks/energy\\_drinks.asp](http://www.sciencecases.org/energy_drinks/energy_drinks.asp)

### Explore Activity

Students, working in teams, create "a know" and "a need to know" list for the task. Using two flip charts or two columns on a single flip chart, students as a group list everything

that they know about the problem. Encourage students to list all the observations that can make about the topic. Then repeat the process for the “need to know” column. The result is two lists, one that demonstrates what the students know and understand, and one that contains a list of investigations that must take place. As investigations are conducted throughout the remainder of the lesson and reveal more information about the problem, both lists will continue to evolve as items are added or crossed off.

Using a round robin technique, each team shares what is recorded on their lists. They may also add to their lists as different questions arise or they may cross something off their list if it is addressed in the discussion.

Monitor the process and guide the students to ensure they address the requirements of the problem and the chemistry content TEKS that have been identified:

1. Find out what each of the ingredients in these drinks is and what it does for a runner and for a non-athlete.
2. Look at the marketing claims of some of these drinks and see if the scientific facts match up to them.
3. Short list of questions

#### **Explore Activity Products and Artifacts**

Know/Need to Know lists

#### **Explore Activity Materials/Equipment**

Chart paper, markers

#### **Explore Activity Resources**

None

#### **Explain Activity**

Using a round robin technique, each team shares what is recorded on their know/need to know lists. They may also add to their lists as different questions arise or they may cross something off their list if it is addressed in the discussion.

Monitor the process and guide the students to ensure they address the requirements of the problem:

1. Find out what each of the ingredients in these drinks is and what it does for a runner and for a non-athlete.

2. Look at the marketing claims of some of these drinks and see if the scientific facts match up to them.
3. Short list of questions

From their “Need to Know” lists, teams will develop a “Project Planning Brief”, pages 2-3 of the document available online at [http://www.bie.org/files/BIE\\_PBLimpltools.pdf](http://www.bie.org/files/BIE_PBLimpltools.pdf). Guide the student teams to “divide and conquer” the research. Additionally, be sure students include artifacts of the writing process such as notes in journal from research with citations and rough draft(s) of magazine article. Students can use this document as a guide to create a planning document in their journals.

### Explain Activity Products and Artifacts

Project Planning Brief

### Explain Activity Materials/Equipment

Project Planning Brief handout, student journals

### Explain Activity Resources

Round Robin technique:

[http://www.tki.org.nz/r/esol/esolonline/classroom/teach\\_strats/listening\\_round\\_e.php](http://www.tki.org.nz/r/esol/esolonline/classroom/teach_strats/listening_round_e.php)

### Elaborate Activity

Provide students general guidelines for writing the magazine article (appendix 1).

Students execute the activities identified on their Project Planning Brief. Several internet links are provided in the resources. You may want to provide these to students so their time spent on the internet is guided. Be prepared to have materials available that students may need as they execute their plan. Some items to have on hand include:

1. Labels from a variety of sports drinks bottles
2. Conductivity probes or conductivity apparatus
3. Magazines containing advertisements for a variety of sports drinks
4. Copies of Runner’s World magazines; internet access to Runner’s World nutrition and weight loss articles available at <http://www.runnersworld.com/channel/0,7119,s6-242-0-0-0,00.html>
5. Water, drinking and distilled
6. Sugar
7. Artificial sweeteners
8. Table salt
9. Salt substitute, potassium based
10. Fruit juices, variety

11. Baking soda
12. Textbooks
13. Computers with internet access
14. Magazine article writing guides

### Elaborate Activity Products and Artifacts

The artifacts will be determined by the student Project Planning Brief, “What will I/we do? And “How will we do it?”; they will be different for each team.

### Elaborate Activity Materials/Equipment

Conductivity probe (available from Vernier at [www.vernier.com](http://www.vernier.com)), see list suggested in activity

### Elaborate Activity Resources

Magazine article writing resources:

[\*The Magazine Article, How to Think It, Plan It, Write It\*](#) by Peter Jacobi (Indiana University Press). Dr. Jacobi regularly teaches at Folio seminars which is where editors of the major magazines get additional training. He teaches magazine writing at Indiana University.

[\*Basic Magazine Writing\*](#) by Barbara Kevles (Writer's Digest Books). This book covers seven different types of articles.

[\*Handbook of Magazine Article Writing\*](#) (Writer's Digest Books). Here is a compilation of some of the best articles about magazine writing from past issues of *Writer's Digest* magazine in one volume.

[\*Complete Idiot's Guide to Publishing Magazine Articles \(Paperback\)\*](#)

Homemade sports drink recipes:

<http://www.davidhays.net/running/sportsdrink.html>

<http://newsok.com/homemade-sports-drink-pairs-honeydew-kiwi/article/3292036/?tm=1220398922>

[http://www.wcpo.com/content/recipes/kids/story.aspx?content\\_id=e70edb44-6c19-44c5-ac84-0a478e9e0732](http://www.wcpo.com/content/recipes/kids/story.aspx?content_id=e70edb44-6c19-44c5-ac84-0a478e9e0732)

<http://www.diet-coaching.com/hmsport.html>

<http://www.webmd.com/hw-popup/rehydration-drinks?navbar=hw86827>

What's in a sports drink?:

[http://www.fda.gov/ohrms/dockets/dailys/02/Apr02/041902/02p-0168\\_cp00001\\_vol1.pdf](http://www.fda.gov/ohrms/dockets/dailys/02/Apr02/041902/02p-0168_cp00001_vol1.pdf)

<http://www.edrinks.net/sports-drinks/>

[http://www.hornetjuice.com/sports\\_drinks\\_index.html](http://www.hornetjuice.com/sports_drinks_index.html)

[http://www.diet-coaching.com/sport\\_i.html](http://www.diet-coaching.com/sport_i.html)

[http://www.atg.wa.gov/teenconsumer/health\\_and\\_safety/sports\\_drinks.htm](http://www.atg.wa.gov/teenconsumer/health_and_safety/sports_drinks.htm)

<http://www.ameribev.org/all-about-beverage-products-manufacturing-marketing-->

[consumption/americas-beverage-products/sports-drinks-provide-hydration/whats-inside/index.aspx](http://consumption/americas-beverage-products/sports-drinks-provide-hydration/whats-inside/index.aspx)  
[http://en.wikipedia.org/wiki/Sports\\_drink](http://en.wikipedia.org/wiki/Sports_drink)  
[http://fcs.tamu.edu/health/Health Education Rural Outreach/Health Hints/2006/spring06/energy-and-sports-drinks.php](http://fcs.tamu.edu/health/Health_Education_Rural_Outreach/Health_Hints/2006/spring06/energy-and-sports-drinks.php)  
<http://www.answers.com/topic/gatorade>  
<http://btc.montana.edu/olympics/nutrition/eat15.html>

What electrolytes do:

<http://ask.yahoo.com/20010813.html>  
<http://www.cfsan.fda.gov/~dms/fddehydr.html>

When should you drink a sports drink:

[http://www.gatorade.com/hydration/fluid\\_loss\\_calculator/](http://www.gatorade.com/hydration/fluid_loss_calculator/)

Sample Sports Drinks labels

<http://purchase.esc2.net/MRPC/SoleSource/PDF/gameonsportsnutrition.pdf>

FDA Food Labeling Guide: <http://www.cfsan.fda.gov/~dms/2lg-4.html>

How to read a sports drink label:

[http://www.scfpt.com/Education/How to Read a SD Label.pdf](http://www.scfpt.com/Education/How_to_Read_a_SD_Label.pdf)

## Evaluate Activity

The final evaluation is the completed magazine article and evaluated using the rubric provided.

The sports drink formula may also be evaluated. Have students name their sports drink, create a nutritional label and “bottle” their beverage for a class tasting. If possible, bring in an authentic audience for the tasting. For example, a local beverage manufacturer, a beverage formulator, a coach, etc.

Debrief about the chemistry involved, specifically the chemistry content noted in the TEKS identified for this lesson. Also, include information about careers that require science in sports: <http://btc.montana.edu/olympics/nutrition/eat15.html>

Additionally, have students individually complete the “Progress Report Following an Investigation” form available on pages 12-13 of the document available online at [http://www.bie.org/files/BIE\\_PBLimpltools.pdf](http://www.bie.org/files/BIE_PBLimpltools.pdf).

## Evaluate Activity Products and Artifacts

Magazine article  
Sports drink developed  
Progress Report Following an Investigation

## Evaluate Activity Materials/Equipment

Ingredients to make sports drink, water bottles for sports drinks, labels for sports drinks

**Evaluate Activity Resources**

See web resources in elaborate section

## Plan the Assessment

Engage Artifact(s)/Product(s): <b>Journal entry</b> Uses complete sentences, thorough
Explore Artifact(s)/Product(s): <b>Know/Need to Know lists</b> (entered in individual journal) Copied accurately into journal, neat, easy to read, organized
Explain Artifact(s)/Product(s): <b>Project Planning Brief</b> (completed individually) Brief is completed thoughtfully and thoroughly
Elaborate Artifact(s)/Product(s): Several of the artifacts will be determined by the student <b>Project Planning Brief</b> , “What will I/we do? And “How will we do it?” Brief is completed thoughtfully and thoroughly
Evaluate Artifact(s)/Product(s): <b>Magazine article</b> (same score for each team member) - Includes all points noted in problem; meets the audiences needs, readability <b>sports drink developed</b> (same score for each team member) – nutrition label complete and accurate (calculations shown in journal), creative name, bottled neatly; <b>Progress report following investigation</b> – complete, thoughtful, insightful

# Rubrics

## Journal Entry

DIRECTIONS: Read each statement below. Indicate from the following rating scale that best reflects your assessment of the student's work.

1=Weak 2=Somewhat Weak 3=Average 4= Strong 5=Very Strong

1. The topic of the journal entry meets the requirements of the assignment.

1 2 3 4 5

4. The organization of the journal entry is clear and easy to follow.

1 2 3 4 5

5. The journal entry flows smoothly from one idea to another.

1 2 3 4 5

6. The spelling, grammar, and punctuation in the journal are accurate.

1 2 3 4 5

7. The journal entry is neatly handwritten.

1 2 3 4 5

8. The effort put forth has demonstrated the full potential of the student's capability.

1 2 3 4 5

Total Score: \_\_\_\_\_/40 x 100 = \_\_\_\_\_%

## Know/Need to Know Lists

DIRECTIONS: Read each statement below. Indicate from the following rating scale that best reflects your assessment of the student's work.

1=Weak 2=Somewhat Weak 3=Average 4= Strong 5=Very Strong

1. The list generated is exhaustive and reflects the types of information required to be successful at the task.

1 2 3 4 5

Total Score: (\_\_\_\_\_)3/15 x 100 = \_\_\_\_\_%

## Project Planning Brief

DIRECTIONS: Read each statement below. Indicate from the following rating scale that best reflects your assessment of the student's work.

1=Weak 2=Somewhat Weak 3=Average 4= Strong 5=Very Strong

1. The list generated is exhaustive and reflects the types of information required to be successful at the task.

1   2   3   4   5

Total Score: (\_\_\_\_\_)3/15) x 100 = \_\_\_\_\_%

## Sports Drink Magazine Article Rubric

Team \_\_\_\_\_

Date \_\_\_\_\_

<b>Goals</b>	 Off Target	 On Target	 Bulls-Eye
Report Submitted On-Time	1	2	3
Cover	1	2	3
Sports drink ingredients included and role described	1	2	3
Sports drinks marketing claims vs. science evidence	1	2	3
Organization of Ideas	1	2	3
Audience (Runner's World subscribers) needs met	1	2	3
Original homemade sports drink recipe included	1	2	3
References	1	2	3
Tally		+	+
Total Score			= <u>    </u> 24

# Appendix 1

## Sports Drink Magazine Article

You have been tasked to write a report in the *form* of a magazine article- research can be from books, magazines, interviews with experts, and/or internet.

Here are a few things to consider as it relates to the final product:

- **Strong Lead** Authors of magazine articles look to create an interesting or exciting leading sentence that will draw you in and make you want to read more. Use a fact or ask a question.
- **Endings** Restate what you thought was most important here. You can even offer your opinion. Maybe relate your closing with the fact or question that was in your lead sentence.
- **Title** Use your imagination here. Sometimes a creative title may draw the reader in.
- **Layout** Two samples are shown below. Your report must be desktop published; you can use text boxes and insert your pictures. You are encouraged to make your own format, be creative and have fun. Here are a few samples you could use to get started. If you need specific help, let me know or consult your ELA teacher.

Title	
Text	Picture
	Caption
	Text
Graph, Chart, or Illustration	
Caption	

Title	
Text _____	
_____	
_____	
_____	
_____	
_____	
_____	
_____	
_____	
Picture	
	Caption
_____	
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# Story Board

	Day 1	Day 2	Day 3	Day 4	Day 5
<b>Week 1 Activities</b>	<ul style="list-style-type: none"> <li>Engage (video clip, introduce problem)</li> <li>Explore (create know/need to know lists),</li> <li>Explain (debrief know/need to know lists)</li> </ul>	<ul style="list-style-type: none"> <li>Explain (generate Project Planning Brief)</li> <li>Elaborate (begin executing Project Planning Brief)</li> </ul>	<ul style="list-style-type: none"> <li>Elaborate (research per brief)</li> </ul>	<ul style="list-style-type: none"> <li>Elaborate (research per brief)</li> </ul>	<ul style="list-style-type: none"> <li>Elaborate (research per brief)</li> </ul>
	Day 6	Day 7	Day 8	Day 9	Day 10
<b>Week 2 Activities</b>	<ul style="list-style-type: none"> <li>Evaluate(write article/develop sports drink)</li> </ul>	<ul style="list-style-type: none"> <li>Elaborate (write article/develop sports drink)</li> </ul>	<ul style="list-style-type: none"> <li>Elaborate (write article/develop sports drink)</li> </ul>	<ul style="list-style-type: none"> <li>Elaborate (write article/develop sports drink)</li> </ul>	<ul style="list-style-type: none"> <li>Evaluate (magazine article due, sports drink presentation and tasting event, complete progress report following investigation )</li> </ul>