# Do I Really Need Electrolyte Supplements for a Healthy Lifestyle?

Group Member 1:

Group Member 2:

Group Member 3:

Group Member 4:

Group Member 5:

Instructions:

* Please enter your first and last name as it appears on the eLC roster.
* Your UGA myID is a combination of letters and numbers (example: mine is jmj81738). Do *not* enter your 81x number.
* Your completed worksheet has to be submitted to Gradescope:
  + You can use an app (Adobe Acrobat Reader recommended) fill in the fillable pdf.
  + One group member should upload the filled-out pdf to Gradescope.
  + They then need to go into their submission and add all other group members.
* The following criteria must be met to be eligible for full credit:
  + You must make sure the pages are in the correct order and have the same layout as the original worksheet when submitting to Gradescope.
  + Answers must be written in the corresponding answer boxes.

Learning Outcomes:

By the end of this case study students should be able to

* + Apply the concept of aqueous solutions to different electrolyte mixtures
  + Classify substances as strong, non-electrolytes, strong/weak acids and bases, and ionic vs. molecular compounds
  + Predict the electrical conductivity of different substances in an electrolyte solution
  + Determine and write out the hydration reaction of different ionic compounds including ionic compounds with polyatomic ions
  + Differentiate and write out the dissociation reaction equation of strong and weak acids in water
  + Analyze experimental data provided

Story[1]:

In the past couple of years electrolyte supplements also known as hydration boosters have gained a lot of traction on the news and social media. Influencers have advertised electrolyte supplements as being part of a low maintenance “healthy lifestyle”. Electrolyte supplements are marketed as either drinks, powders, or tablets. Traditionally, electrolyte supplements are used by athletes to replenish fluids lost through sweat. Some electrolyte formulations are indicated for conditions such as vomiting and diarrhea which are known as oral rehydration solutions (ORS). Electrolytes can also support nerve and muscle function, maintain blood pressure, consumed by individuals on a low carbohydrate diet, contain vitamins, and even some claim it can be a part of a beauty routine to provide glow and hydration. But one question remains; do we really need electrolytes as a part of a healthy lifestyle or are there other alternative sources of electrolytes? In this case study we will examine the contents of five electrolyte supplements and look closely at their ingredients namely Gatorade™, Liquid I.V.®, LMNT, Pique®, and Pedialyte Advanced Care® Plus. We will also be analyzing experimental data to evaluate the if additives besides electrolytes are necessary. You can refer to the pre-case activity resources before your group starts working through this case study. Following the resources, you will work through a series of questions and then determine if you need to take electrolytes on regular basis or are they just limited to certain conditions.

Pre-case Activities:

Visit the websites and watch the videos (links are provide below) to learn more about electrolytes**.**

<https://www.today.com/health/diet-fitness/can-you-take-too-many-electrolytes-rcna204065>

<https://www.heart.org/en/news/2024/06/19/electrolytes-can-give-the-body-a-charge-but-try-not-to-overdo-it>

<https://www.theguardian.com/lifeandstyle/2024/sep/30/the-electrolytes-boom-a-wonder-supplement-or-an-unnecessary-expense>

<https://www.youtube.com/watch?v=uqEO1Xc2P64&t=800s>

<https://abcnews.go.com/GMA/Wellness/video/beneficial-electrolyte-supplements-boost-hydration-122608760>

Ingredients and Nutrition Information:

* Pedialyte Advanced Care® Plus Orange Breeze

Serving Size: 33.8 fl oz (1L)

|  |  |  |  |
| --- | --- | --- | --- |
| Ingredients | Minerals | | Nutrition Information |
| Water, Dextrose, Galactooligisaccharides. Less than 0.5% of: Salt, Citric Acid, Potassium Citrate, Natural and Artificial Flavor, Sucralose, Acesulfame Potassium, Zinc Gluconate, and Yellow 6 | Potassium | 780 mg | Calories: 100 |
| Total Fat: 0 g |
| Sodium | 1380 mg | Total Carbohydrates: 27 g |
| Zinc | 7.8 mg | Dietary Fiber: 2 g |
| Total Sugars: 19 g |
| Chloride | 1770 mg | Protein: 0 g |

* Gatorade™ Cool Blue Thirst Quencher

Serving Size: 12 fl oz (360 mL)

|  |  |  |
| --- | --- | --- |
| Ingredients | Nutrition Information | More Information |
| Water, Sugar, Dextrose, Citric Acid, Sodium Citrate, Natural and Artificial Flavor, Salt, Monopotassium Phosphate, Modified Food Starch, Glycerol Ester of Rosin, Blue 1 | Calories: 80 | % Juice: 0 |
| Total Fat: 0 g |
| Total Carbohydrates: 22 g | Caffeine: 0 mg |
| Sodium: 160 mg |
| Potassium: 50 mg | Phosphorus: 30 mg |
| Protein: 0 g |

* Liquid I.V.® Hydration Multiplier in Lemon-Lime

Serving size: one powder stick pack (16 g) in 500 mL water

**Nutrition and Ingredients:** Sugar (pure cane sugar, dextrose), Citric acid, Salt, Potassium Citrate, Sodium Citrate, Natural Flavors, Potassium Phosphate Dibasic, Silicon Dioxide, Rebiana (Stevia Leaf Extract), Ascorbic Acid (Vitamin C), Niacinamide (Vitamin B3), Pantothenic Acid (Vitamin B5), Pyridoxine Hydrochloride (Vitamin B6), Cyanocobalamin (Vitamin B12)

* LMNT in Citrus Salt

Serving size: one powder stick pack (6 g) in 32 fl oz of water

|  |  |  |  |
| --- | --- | --- | --- |
| Ingredients | Minerals | | Nutrition Information |
| Salt (Sodium Chloride), Citric Acid, Magnesium Malate, Potassium Chloride, Natural Lemon and Lime Flavors, Stevia Leaf Extract | Potassium | 200 mg | Calories: 10 |
| Total Fat: 0 g |
| Vitamin D | 0 mcg | Total Carbohydrates: 2 g |
| Magnesium | 60 mg | Sodium: 1000 mg |
| Total Sugars: 19 g |
| Calcium | 0 mg | Protein: 0 g |
| Iron | 0 mg | Cholesterol: 0 mg |

* Pique® B•T Fountain ⎜Beauty Electrolyte

Serving Size: 1 Sachet (3.75 g) in 16 fl oz of water

|  |  |
| --- | --- |
| Ingredients | Nutrition Information |
| Coconut Water Powder, Pink Himalayan Salt, Citric Acid, Yuzu Raspberry and Other Natural Flavors, Silica, Beet Juice Powder, Monk Fruit Extract | Calcium (as Calcium Malate): 30 mg |
| Magnesium (as Magnesium Glycinate): 100 mg |
| Sodium (as Sodium Citrate and Sodium Chloride): 150 mg |
| Potassium (Potassium as Potassium Citrate and Potassium Chloride): 150 mg |
| Phytoceramides (as Wheat Seed Extract): 30 mg |
| Sodium Hyaluronate (Premium Form of Hyaluronic Acid: 30 mg) |

## Part I: Background Assessment Questions

1. What type of solution best describes both Gatorade™ and Pedialyte Advanced Care® based on the solvent? Hint: look at the first ingredient on the list.
2. Name any three ingredients from the five brands of electrolyte supplements that can be classified as *electrolytes* in aqueous solutions.
3. Based on your knowledge, which substances do you expect to be *non-electrolytes*? Select any that apply.
4. Dextrose (C6H14O7)
5. Sodium citrate (Na3C6H5O7)
6. Monopotassium phosphate (KH2PO4)
7. Galactooligosaccharides ((C6H10O5)n)
8. Citric acid (C6H7O7H)
9. Potassium chloride
10. Silicon dioxide (SiO2)
11. Write out the dissociation equation of potassium citrate (K3C6H5O7), citric acid (C6H7O7H) and potassium chloride in water and classify them as ionic or molecular compounds.

K3C6H5O7:

C6H7O7H:

KCl:

1. How would the dissociation of citric acid differ from the dissociation of an acid such as nitric acid? Assume water is the solvent in both cases.
2. Based on the components of the electrolyte supplements, do you expect them to be electrically conductive or non-conductive? Explain your reasoning and assume all the supplements are in an aqueous solution.
3. Rank the following in order of increasing conductivity (lowest to highest conductivity): Gatorade™, distilled water and tap water. Why did you arrange them in this order?
4. Liquid I.V. contains a few vitamins such as vitamin C, B6, B12, etc. in addition to electrolytes. Is there a correlation between vitamins and electrolytes? Cite your sources.

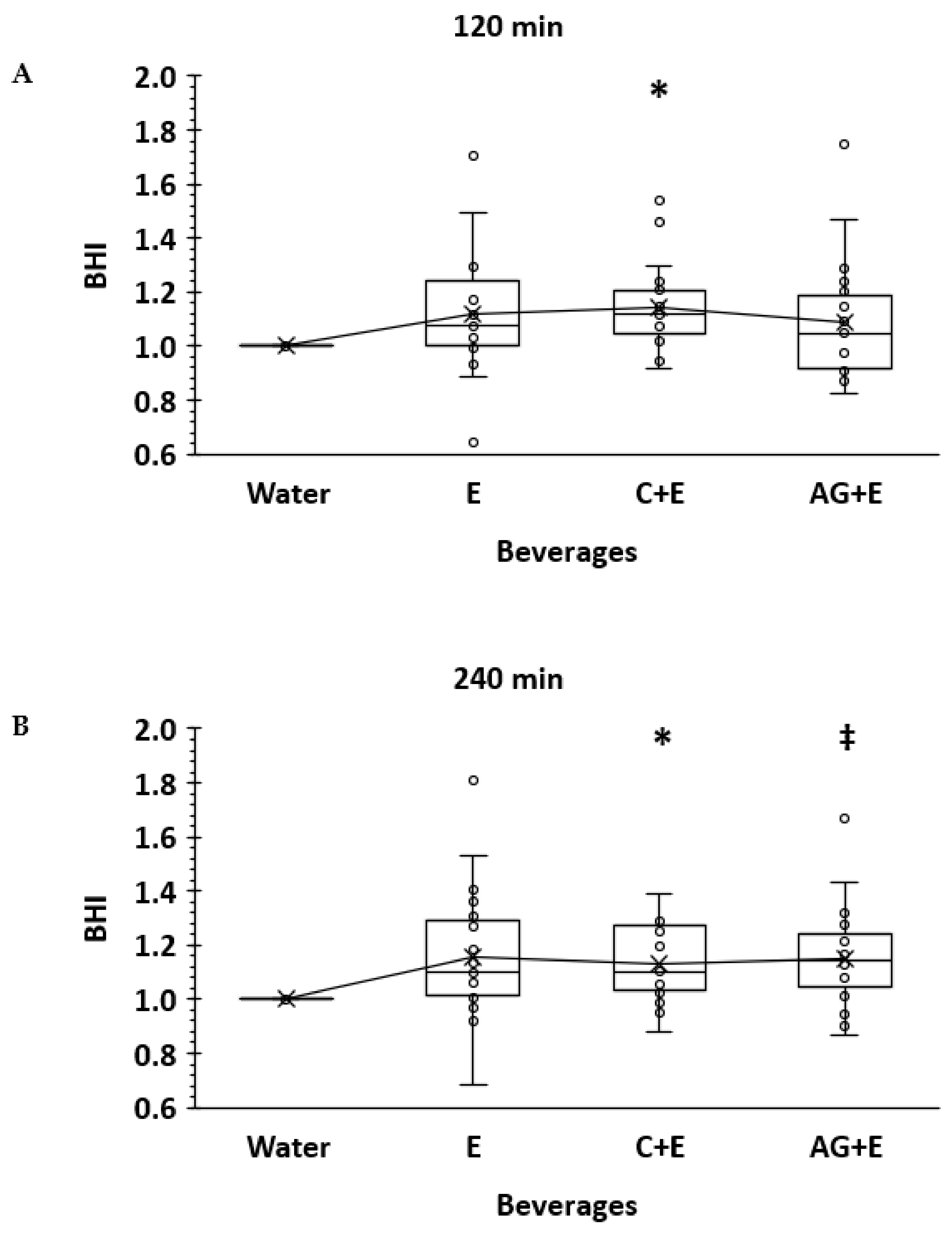
## Part II: Case Study Questions

*Make sure to cite any references that will be included in your work to support your answers.*

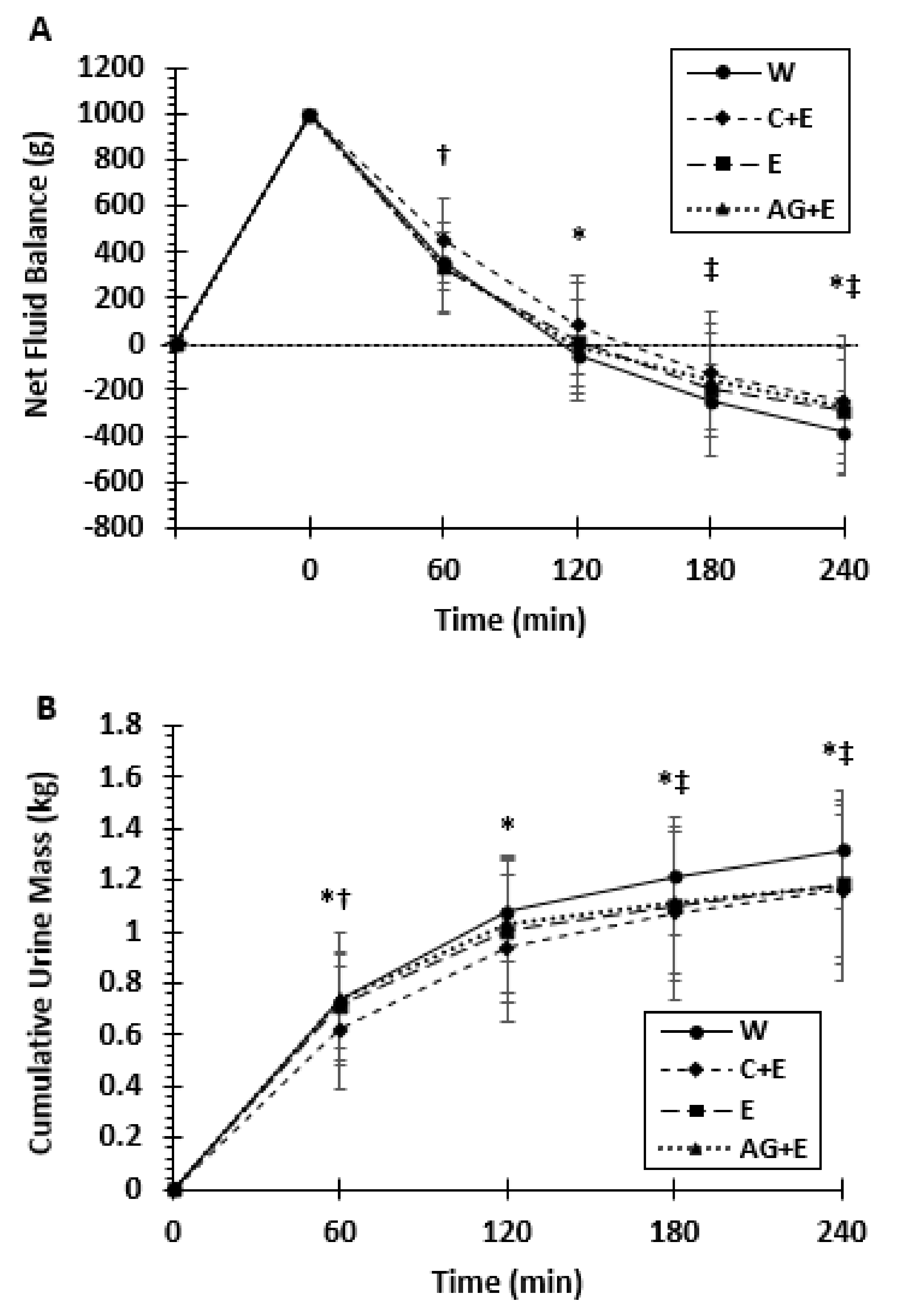
1. Do you think we need to consume electrolyte supplements on regular basis or obtaining can we obtain our electrolyte needs from other sources and why do you think so? Include examples when you can.
2. Why are electrolyte supplements recommended after strenuous exercise rather than water?
3. Do you think there are benefits to adding hyaluronic acid and/or ceramides to electrolyte supplements? Is there any scientific evidence supporting these benefits?
4. Three-year-old Jamie is suffering from lethargy and was brought into a pediatrician’s office after a bout of vomiting and diarrhea. The weather has been very warm lately and Jamie has not been eating or drinking for the past couple of days. The pediatrician suspects that Jamie is suffering of dehydration. Which electrolyte supplement would you recommend and why based on Jamie’s condition?
5. If you were to design your own electrolyte supplement, what ingredients would you use and why? How would you test the effectiveness of your electrolyte supplement?

## Part III: Analyzing Experimental Data

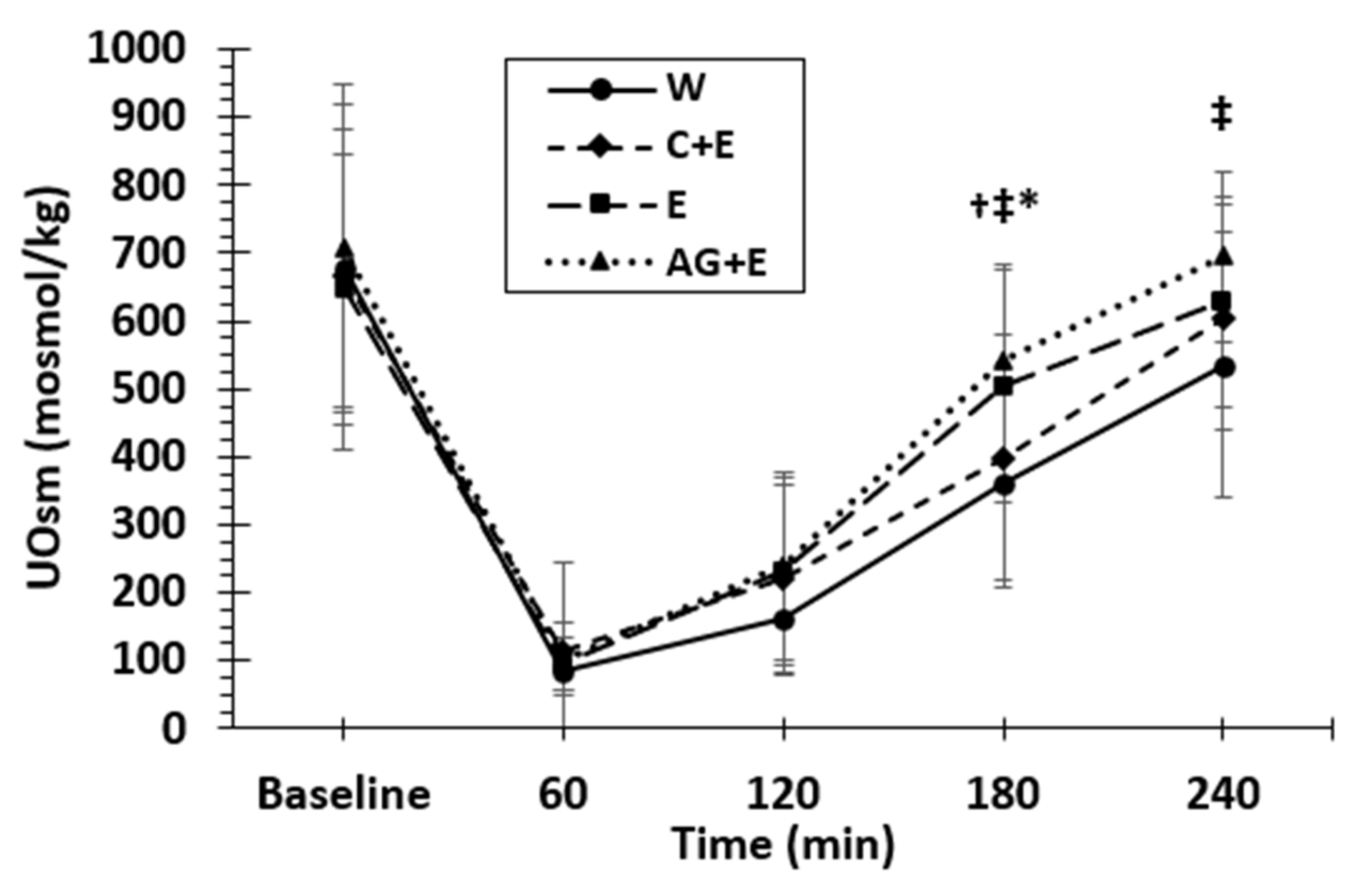
Studies have been conducted in the past few years to measure and compare the short-term hydration properties of drinks including electrolyte supplements using a scale known as beverage hydration index (BHI).[2] BHI simply measures the ability of an electrolyte supplement for fluid retention compared to water.[3] A few of the evidence to evaluate the BHI index of electrolyte supplements is the urine mass measured in kilograms and urine concentration measured in milliosmoles. In the plots below, water (W), a supplement containing electrolytes (E), a supplement containing carbohydrates (fructose and sucrose) plus electrolytes (C+E), and a supplement containing alanyl- glutamine dipeptide (AG+E) which shows supporting evidence of rehydration following exercise.[4] Using this information coupled with the plots below answer the following questions.



**A**



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**C**

1. From the data provided, is there evidence that supports that additives such as carbohydrates and/or dipeptides such as alanyl- glutamine dipeptide are better for rehydration versus electrolytes alone? Which piece of data provided supports this?
2. How would you design an experiment to compare the BHI of athletes before and after exercise? Reference the studies above and the reading before class.
3. If you hypothetically were to develop a home hydration kit, what measurements would be most useful and why? Reference the studies above and the reading before class.

# References

1. Hibbard, L., *Case studies for general chemistry: teaching with a newsworthy story.* Journal of Chemical Education, 2019. **96**(11): p. 2528-2531.

2. Maughan, R.J., et al., *A randomized trial to assess the potential of different beverages to affect hydration status: development of a beverage hydration index.* The American journal of clinical nutrition, 2016. **103**(3): p. 717-723.

3. Millard-Stafford, M., et al., *The beverage hydration index: influence of electrolytes, carbohydrate and protein.* Nutrients, 2021. **13**(9): p. 2933.

4. Hoffman, J.R., et al., *Examination of the efficacy of acute L-alanyl-L-glutamine ingestion during hydration stress in endurance exercise.* Journal of the International Society of Sports Nutrition, 2010. **7**(1): p. 8.