**Purpose**: To learn about the Colligative Properties of Freezing Pt depression and Boiling Pt elevation.

**Materials**: Computer, Internet

**Procedures for Colligative Properties**:

1. Click on the following URL: <https://screencast-o-matic.com/watch/cbeYD16CUP>

2. Choose “Water” as the solvent, “100 grams” of water, “**SODIUM CHLORIDE (NaCl salt)**” as the solute, “10 grams” of sodium chloride, and “Hot bath” for the settings.

3. Click on start and wait for the simulation to finish.

4. Record the final temperature: \_\_\_\_\_\_\_\_\_\_\_\_

5. What is the normal boiling point of water? \_\_\_\_\_\_\_\_\_

6. What happened to the boiling point of water when the salt was added?

7. Hit “RESET” and keep all the same settings EXCEPT use the “COLD BATH” rather than the hot bath.

8. Click on start and wait for the simulation to finish.

9. Record the final temperature: \_\_\_\_\_\_\_\_\_\_\_\_

10. What is the normal freezing point of water? \_\_\_\_\_\_\_\_\_

11. What happened to the freezing point of water when the salt was added?

12. Hit “RESET” and choose “Water” as the solvent, “100 grams” of water, “**SUCROSE (sugar)**” as the solute, “10 grams” of sugar, and “Hot bath” for the settings.

13. Click on start and wait for the simulation to finish.

14. Record the final temperature: \_\_\_\_\_\_\_\_\_\_\_\_

15. What is the normal boiling point of water? \_\_\_\_\_\_\_\_\_

16. What happened to the boiling point of water when the sugar was added?

17. Hit “RESET” and keep all the same settings EXCEPT use the “COLD BATH” rather than the hot bath.

18. Click on start and wait for the simulation to finish.

19. Record the final temperature: \_\_\_\_\_\_\_\_\_\_\_\_

20. What is the normal freezing point of water? \_\_\_\_\_\_\_\_\_

21. What happened to the freezing point of water when the sugar was added?

22. Hit “RESET” and choose “Water” as the solvent, “100 grams” of water, “**CALCIUM CHLORIDE (CaCl2 salt)**” as the solute, “10 grams” of calcium chloride, and “Hot bath” for the settings.

23. Click on start and wait for the simulation to finish.

24. Record the final temperature: \_\_\_\_\_\_\_\_\_\_\_\_

25. What is the normal boiling point of water? \_\_\_\_\_\_\_\_\_

26. What happened to the boiling point of water when the salt was added?

27. Hit “RESET” and keep all the same settings EXCEPT use the “COLD BATH” rather than the hot bath.

28. Click on start and wait for the simulation to finish.

29. Record the final temperature: \_\_\_\_\_\_\_\_\_\_\_\_

30. What is the normal freezing point of water? \_\_\_\_\_\_\_\_\_

31. What happened to the freezing point of water when the salt was added?

32. Complete the table below by copying all the appropriate TEMPERATURES from the simulation:

|  |  |  |  |
| --- | --- | --- | --- |
| **Solute** | **NaCl** | **Sucrose** | **CaCl2** |
| Boiling Pt  |  |  |  |
| Boiling Pt Elevation |  |  |  |
| Freezing Pt |  |  |  |
| Freezing Pt Depression |  |  |  |

**Conclusions & Questions**

1. Of the three solutes, which one had the LEAST effect on boiling point and freezing point?

2. Look at the formulas of each of the solutes used in this simulation. Which has the largest mass?

3. Why did the salts raise the boiling point higher and lower the freezing point more than sugar?

ANSWER KEY

2. Choose “Water” as the solvent, “100 grams” of water, “**SODIUM CHLORIDE**” as the solute, “10 grams” of sodium chloride, and “Hot bath” for the settings.

3. Click on start and wait for the simulation to finish.

4. Record the final temperature: **101.58 C**

5. What is the normal boiling point of water? **100.0 C**

6. What happened to the boiling point of water when the salt was added?

***The normal boiling point of water went UP when solute was added. [boiling point elevation is a colligative property]***

7. Hit “RESET” and keep all the same settings EXCEPT use the “COLD BATH” rather than the hot bath.

8. Click on start and wait for the simulation to finish.

9. Record the final temperature: **-5.78 C**

10. What is the normal freezing point of water? **0.0 C**

11. What happened to the freezing point of water when the salt was added?

***The normal freezing point of water went DOWN when solute was added. [freezing point depression is a colligative property]***

12. Hit “RESET” and choose “Water” as the solvent, “100 grams” of water, “**SUCROSE (sugar)**” as the solute, “10 grams” of sugar, and “Hot bath” for the settings.

13. Click on start and wait for the simulation to finish.

14. Record the final temperature: **100.12 C**

15. What is the normal boiling point of water? **100.0 C**

16. What happened to the boiling point of water when the sugar was added?

***The normal boiling point of water went UP when solute was added. [boiling point elevation is a colligative property] … not as much as salt, however.***

17. Hit “RESET” and keep all the same settings EXCEPT use the “COLD BATH” rather than the hot bath.

18. Click on start and wait for the simulation to finish.

19. Record the final temperature: **-0.50 C**

20. What is the normal freezing point of water? **0.0 C**

21. What happened to the freezing point of water when the sugar was added?

***The normal freezing point of water went DOWN when solute was added. [freezing point depression is a colligative property] … not as much as salt, however.***

22. Hit “RESET” and choose “Water” as the solvent, “100 grams” of water, “**CALCIUM CHLORIDE (CaCl2 salt)**” as the solute, “10 grams” of calcium chloride, and “Hot bath” for the settings.

23. Click on start and wait for the simulation to finish.

24. Record the final temperature: **101.25 C**

25. What is the normal boiling point of water? **100.0 C**

26. What happened to the boiling point of water when the salt was added?

***The normal boiling point of water went UP when solute was added. [boiling point elevation is a colligative property] … not as much as salt, however.***

27. Hit “RESET” and keep all the same settings EXCEPT use the “COLD BATH” rather than the hot bath.

28. Click on start and wait for the simulation to finish.

29. Record the final temperature: **-4.57 C**

30. What is the normal freezing point of water? **0.0 C**

31. What happened to the freezing point of water when the salt was added?

***The normal freezing point of water went DOWN when solute was added. [freezing point depression is a colligative property] … not as much as salt, however.***

32. Complete the table below by copying all the appropriate TEMPERATURES from the simulation:

|  |  |  |  |
| --- | --- | --- | --- |
| **Solute** | **NaCl** | **Sucrose** | **CaCl2** |
| Boiling Pt  | 101.58 C | 100.12 C | 101.25 C |
| Boiling Pt Elevation | 1.58 C | 0.12 C | 1.25 C |
| Freezing Pt | -5.78 C | -0.50 C | -4.57 C |
| Freezing Pt Depression | 5.78 C | 0.50 C | 4.57 C |

**Conclusions & Questions**

1. Of the three solutes, which one had the LEAST effect on boiling point and freezing point?

 ***Sugar***

2. Look at the formulas of each of the solutes used in this simulation. Which has the largest mass?

 ***Sugar***

3. Why did the salts raise the boiling point higher and lower the freezing point more than sugar?

 ***The salts dissociate in water and form ions. Therefore, increasing the effective amount of solute in the solvent.***

***Final Summary***

*Colligative Properties 🡪 boiling point elevation, freezing point depression*

*A solute is added to a solvent to make a solution and this produces the colligative properties*

*Pure water boils @ 100 C ... but when NaCl was added it boiled at 101.58 C*

*Pure water boils @ 100 C ... but when sugar was added it boiled at 100.12 C*

*Pure water freezes @ 0 C ... but when NaCl was added it freezes at -5.78 C*

*Pure water freezes @ 0 C ... but when sugar was added it freezes at -0.5 C*

The salts affected colligative properties more than sugar because salts dissociate in water and form ions. Therefore, increasing the effective amount of solute in the solvent.

*Pure water boils @ 100 C ... but when NaCl was added it boiled at 101.58 C*

*Pure water boils @ 100 C ... but when sugar was added it boiled at 100.12 C*

*Pure water freezes @ 0 C ... but when NaCl was added it freezes at -5.78 C*

*Pure water freezes @ 0 C ... but when sugar was added it freezes at -0.5 C*