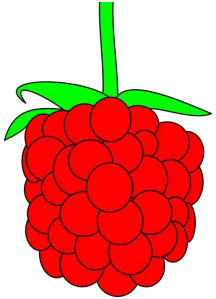
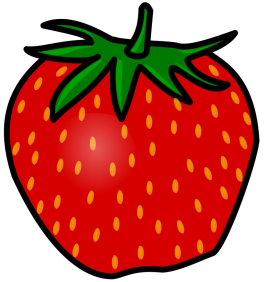
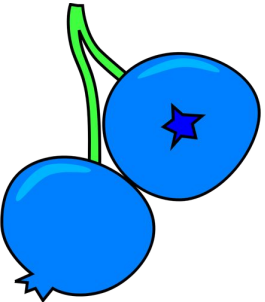
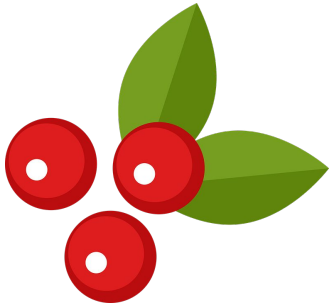


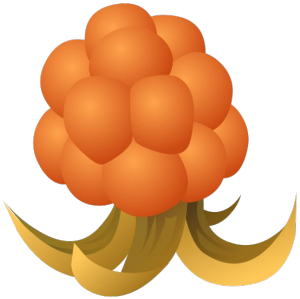


Turn & Talk: What’s your favorite berry?

And what makes it taste the best?

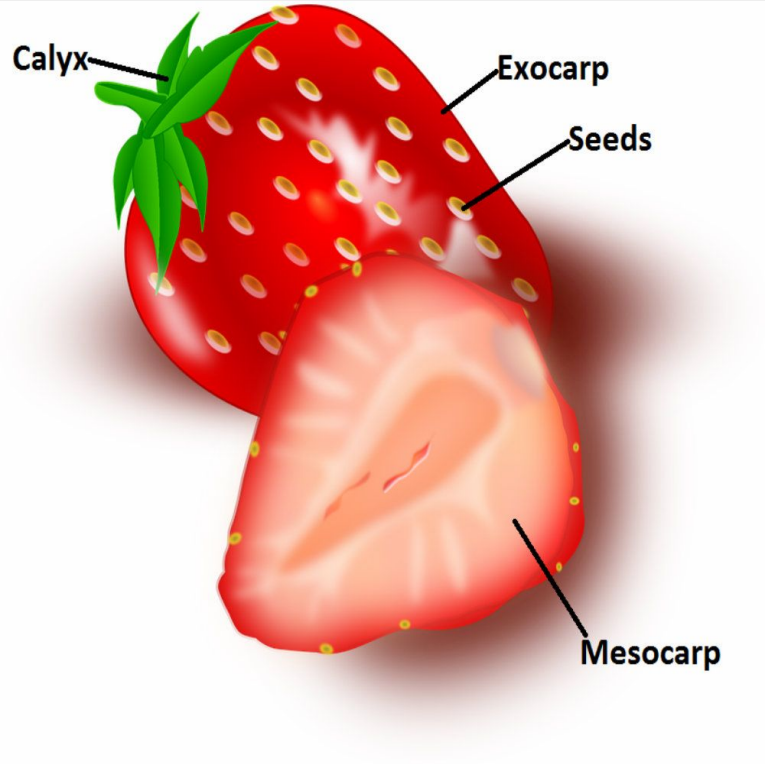






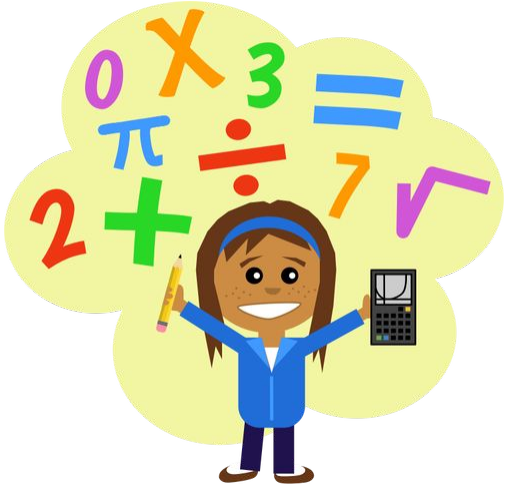
What makes up a berry?

- Sugar
- Water
- Other Organic Materials (Seeds, etc.)



Objectives: Students will be able to…

- Analyze berry data by
  - Analyzing a graph of Berry Weights
  - Calculating the percentage of water in a berry species
  - Creating and analyzing a graph displaying class calculated data



What do you think of when you think of “The Arctic” or “Alaska”?

Atigun Pass cuts through the snowy mountains of the Brooks Range on the Dalton Highway, Alaska.

A group of hikers from Toolik Field Station walk through a green field along the Atigun River, Alaska.

What food do you think grows in the Arctic?

Photos by Elizabeth Backman (PolarTREC 2021), Courtesy of ARCUS

Berries in the Arctic:
An important food source for animals and people alike!

Liza Backman (R) and Sarah Ansbro (L) harvest berries at Chandalar Shelf, Dalton Highway, AK.
Photo by Jeremy May, Courtesy of Elizabeth Backman (PolarTREC 2021), Courtesy of ARCUS

What types of berries are there?

- The arctic is home to several different berry species!
- The five berry species that we will be focusing on are:
  - *Empetrum nigrum (EN)*
  - *Arctous alpina (AA)*
  - *Vaccinium uliginosum (VU)*
  - *Vaccinium vitis-idaea (VVI)*
  - *Rubus chamaemorus (RC)*

Task! Can you find…

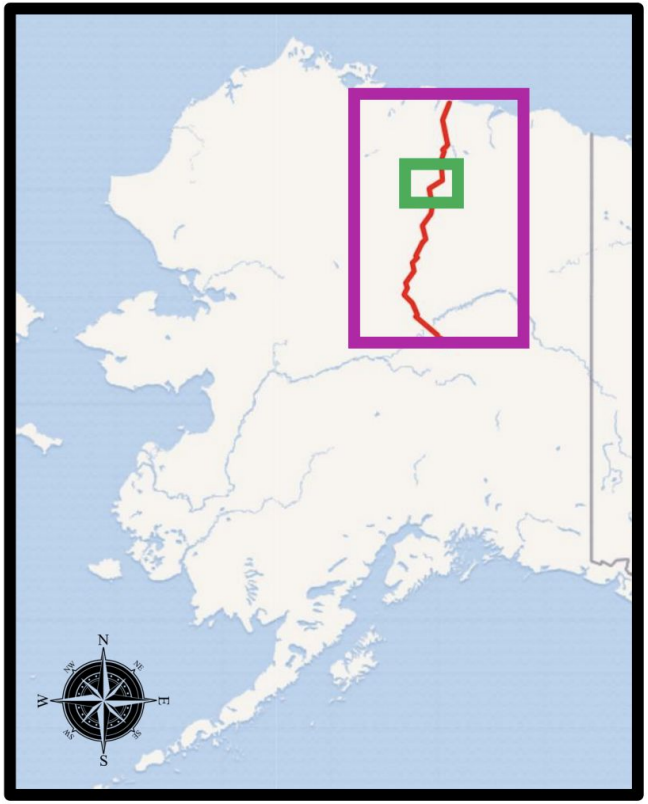
1. The Iñupiaq (native) name of these 5 species?
2. The common name of these 5 species?
3. One use for each species?

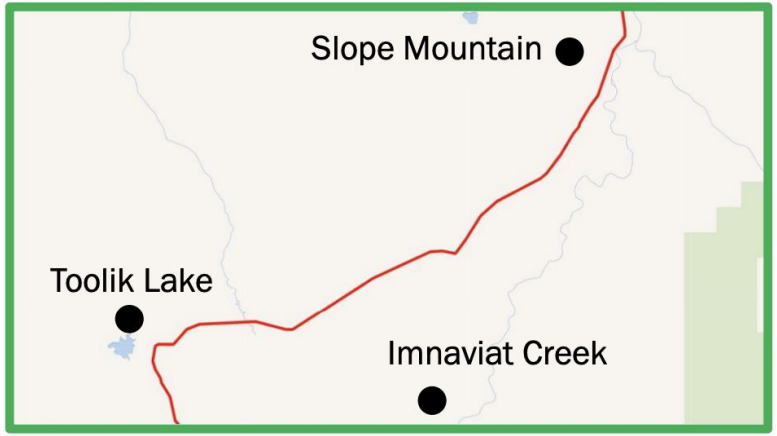
Need help? Click Here!

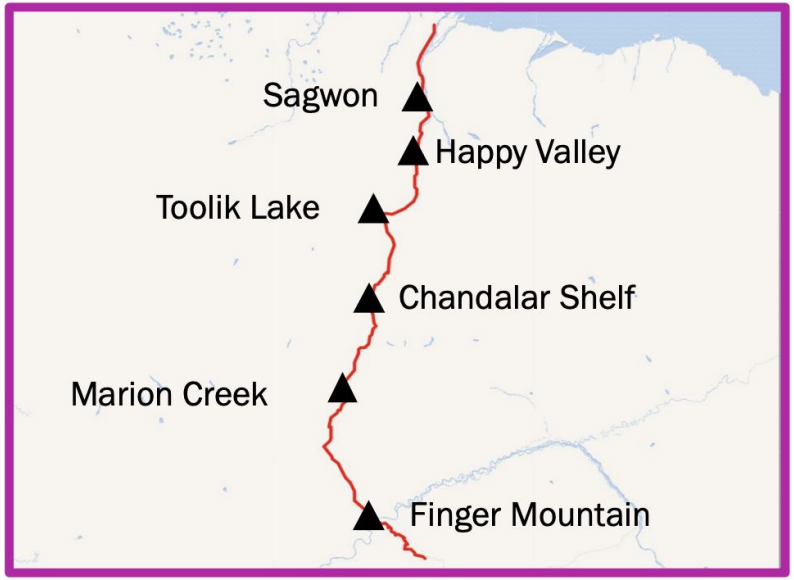
<u>Big Question:</u>
How is climate change affecting berry growth and nutritional value?

Let’s talk data collection!

Where are scientists collecting berry data?





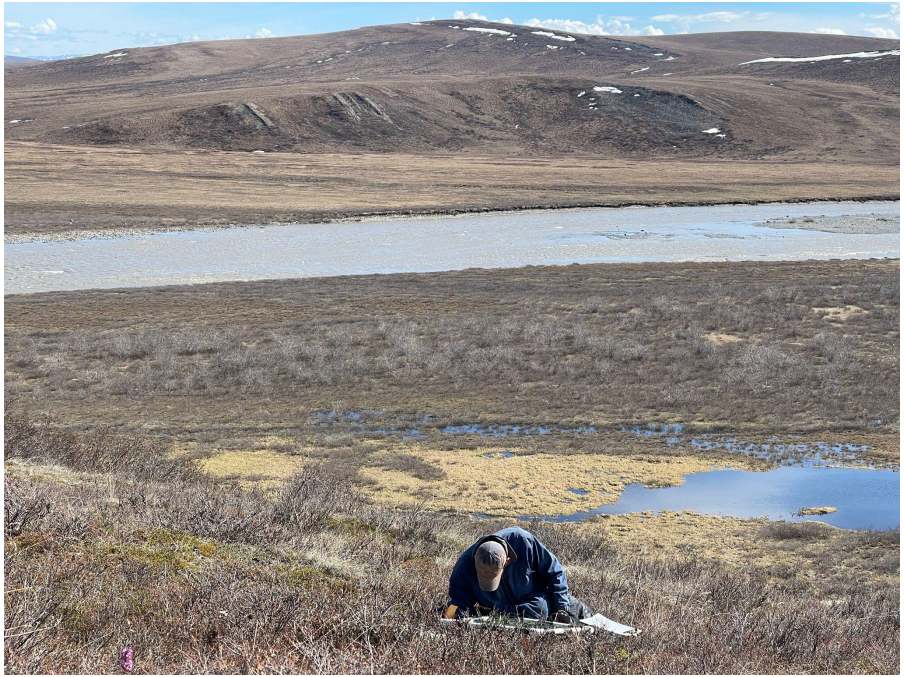


How often do scientists collect berry data?

- At most sites, Berry Monitoring is completed once in the "spring" (June) and once in the "fall" (August).
  - For three sites (Toolik, Imnavait Creek, and Slope Mountain), data has been collected since 2016
  - For all other sites, data has been collected since 2021

- In 2021, ***weekly*** data collection for the Imnavait Creek location began and ran for approximately 9 weeks
  - This data collection process was slightly different than what will be presented, but follows a similar concept.

How do scientists collect berry data?



Jeremy May counts berries on a slope near the Sagavanirktok River. Dalton Highway, Alaska.

Photo by Elizabeth Backman (PolarTREC 2021), Courtesy of ARCUS

In the field…

- First, a random area is selected
- Berries in that location are **counted** and **harvested**
- Berries are **separated by species** and **stored for further analysis**
- This happens 12x **per location**

How do scientists collect berry data?

Back at the lab…

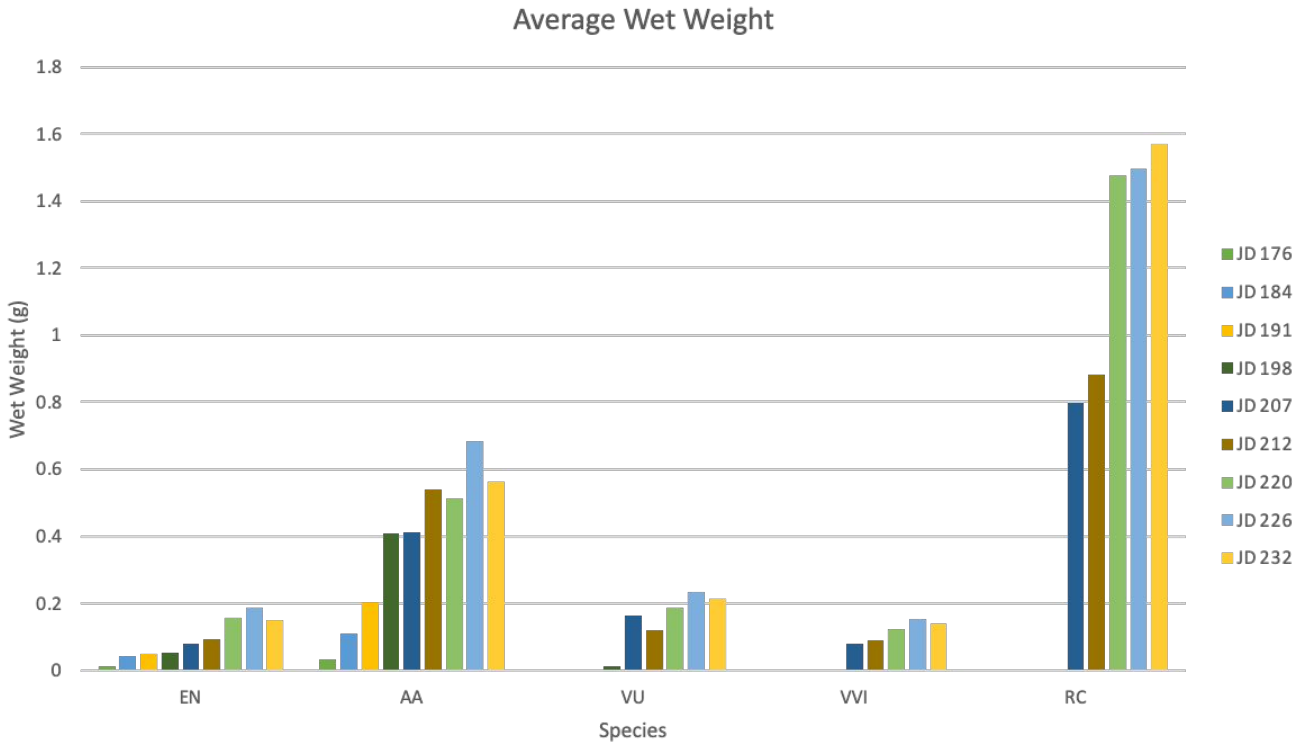
- Berries are re-counted by species
- Berries are massed
  - “Fresh/Wet Mass”
- Berries are dried out in a dehydrator
- Berries are weighed again
  - “Dry Mass”
- Berries are sent to another lab with proper equipment for more analysis
  - Sugar Content
  - Organic Content

Liza Backman (L) and Sarah Ansbro (R) weigh and measure berries harvested for the annual spring berry survey. Toolik Field Station, Alaska.

Photo by Jeremy May (PolarTREC 2021), Courtesy of ARCUS

Berry Data

Task 2: Analyzing a Graph



Trend: Berries are getting bigger over time

- Question: Why are they getting bigger?
  - More specific question: What part of the berry is changing as they get bigger?
    - Water content?
    - Sugar content?
    - Something else?

<u>Think About It…</u> Think back to the methods we discussed earlier, which of these variables do you think we monitored the most closely during the season? Why? (*Hint: Which did we do in the lab?)*

Finding water content

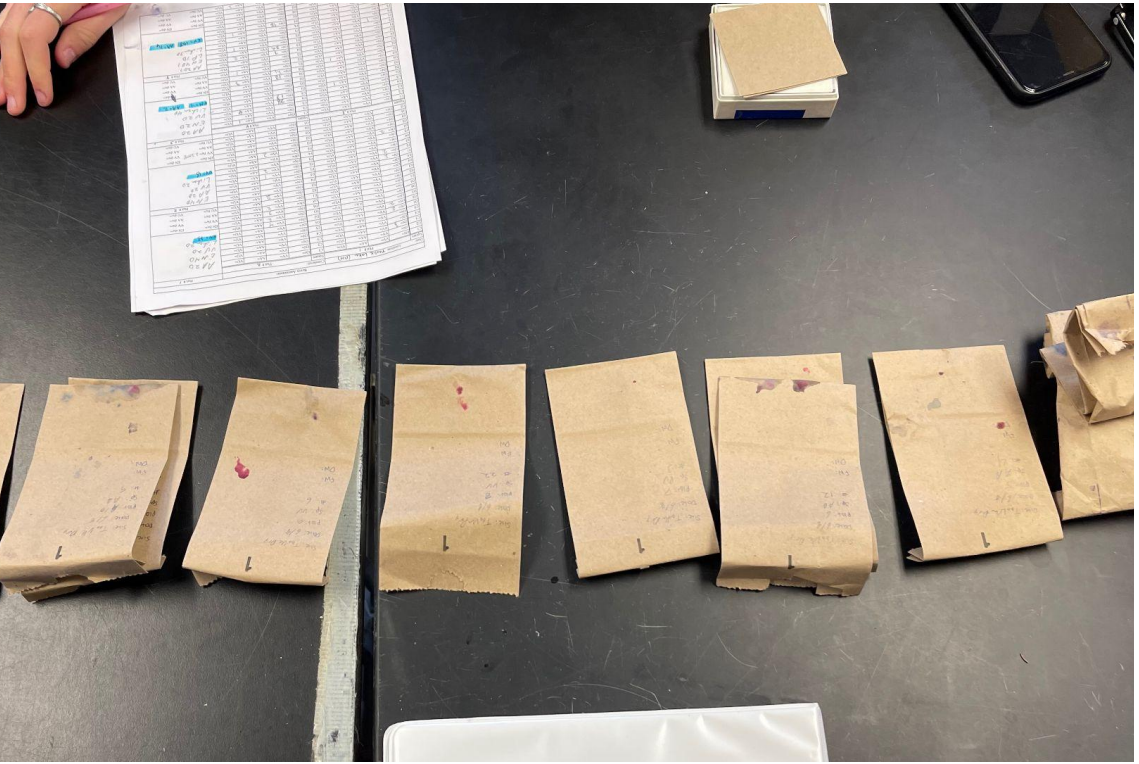
Procedure

1. Mass fresh berry (containing water)
2. Dry berry using a dehydrator
3. Mass dry berry (without water)

Task 3: Methods to Math!

On page 2 of your worksheet, you will be using the above procedure to help you analyze sample data and figure out how scientists process raw data.

After harvesting berries for the annual spring berry survey, they are recounted and massed. Later, the berries will be dried and then massed again to determine water loss. Toolik Field Station, Alaska. Photo by Elizabeth Backman (PolarTREC 2021), Courtesy of ARCUS



Sarah Ansbro recounts berries collected during the annual spring berry survey. Toolik Field Station, Alaska. Photo by Elizabeth Backman (PolarTREC 2021), Courtesy of ARCUS

How much data??

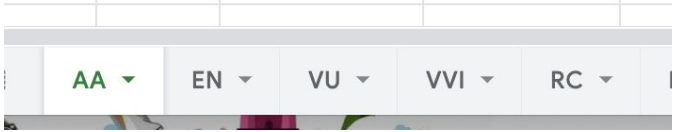
- The data we will be looking at is coming was taken **weekly (over 9 weeks)** at one location
- For each berry species (5 total), roughly 20 samples were collected each week.
- 5*20*9 = 900 specimens were analyzed… That's a LOT OF DATA!
- Luckily, we're going to take a look at only the average of the 20 samples for each day

Task #4: Processing and Analyzing Data

You and your group will be assigned one species that you're in charge of. For all data associated with that species, you will need to:

1. Calculate the Mass of H_2O
2. Calculate the % Composition of H_2O
3. Record the data you and your peers collect on your species' tab on the class spreadsheet IN THE YELLOW BOXES ONLY

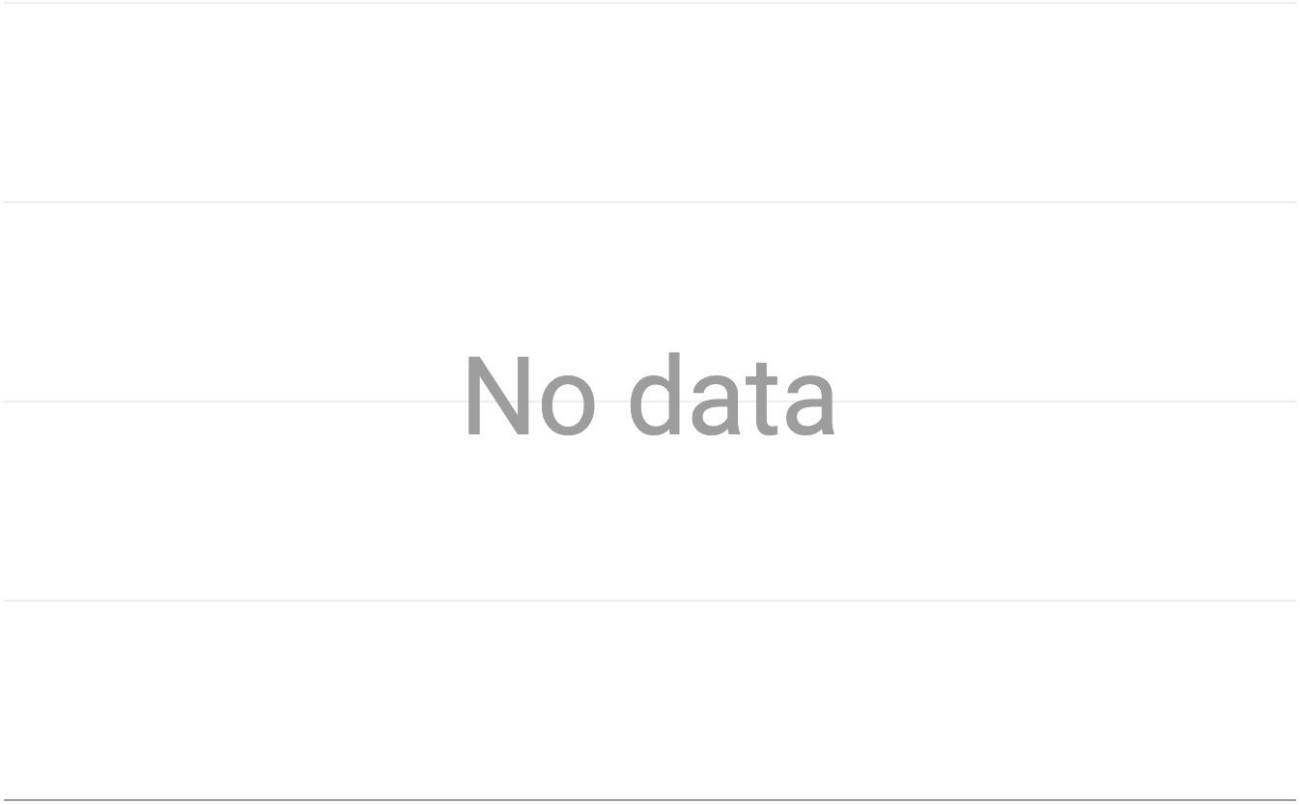
FOUND AT BOTTOM OF SPREADSHEET



Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
0.0342	0.0049		
0.1105	0.0140		
0.2031	0.0273		
0.4081	0.0550		

4. Use the graph that is created to answer the analysis questions on your worksheet

Our Class Graph



Data for Arctuous Alpina					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
176	AA	0.0342	0.0049		
184	AA	0.1105	0.0140		
191	AA	0.2031	0.0273		
198	AA	0.4081	0.0550		
207	AA	0.4109	0.0582		
212	AA	0.5412	0.0880		
220	AA	0.51158	0.076465		
226	AA	0.68314	0.09231		
232	AA	0.564905	0.07945		

No data

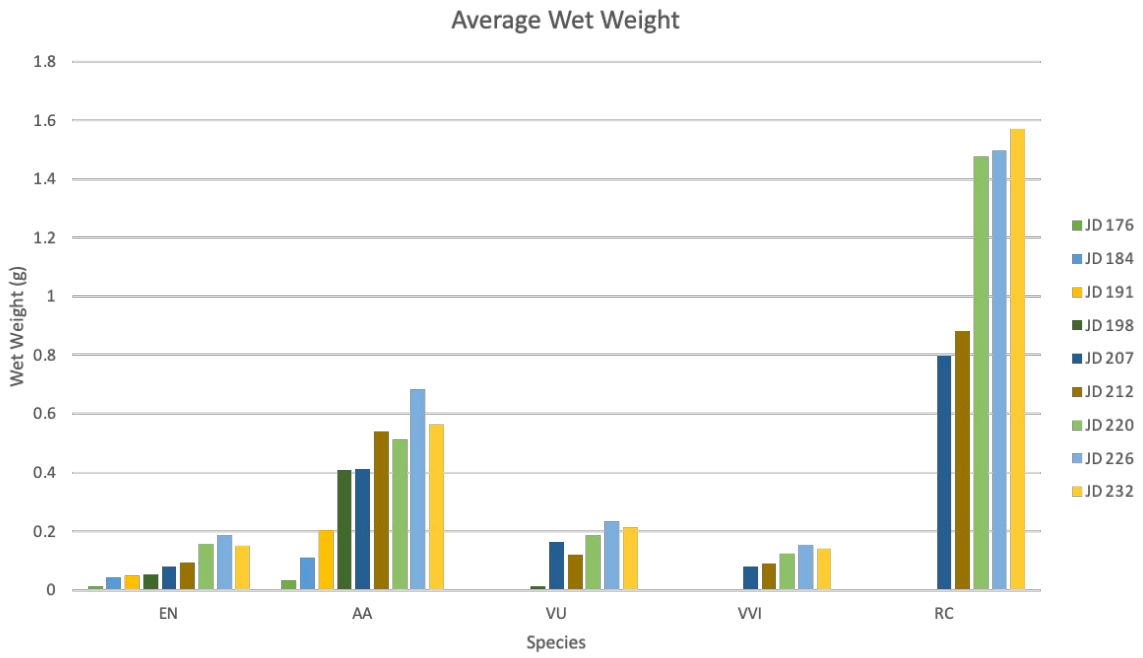
Name: _____ Date: _____

Arctic Berries

Task 1: Species of Interest. Fill in the table below for each of the five species of interest. You may want to use this website as a starting place for your research: https://bit.ly/3MNo5W4

Species Name	Iñupiaq Name	Common Name	One Use

Task 2: Analyzing a graph. Annotate the graph with your teacher!



1. What trend do you notice within each species?

2. What do you notice when you compare data across species?

Task 3: Methods to Math!

The following data table shows 5 samples of Empetrum Nigrum taken on the same day at the same location. This is only a portion of the full amount of data taken.

Julian Day	Species	Fresh Weight (g)	Dry Weight (g)	H_2O (g)	% H_2O
176	Empetrum nigrum	0.0202	0.0026	0.0176	87.13
176	Empetrum nigrum	0.0163	0.0026	0.0137	84.05
176	Empetrum nigrum	0.0183	0.0030		
176	Empetrum nigrum	0.0089	0.0018		

Use the data table above and the data collection method to answer the following questions:

1. What are the two **quantitative measurements** *(in other words, measurements that contain numbers)* collected in the initial method?

   _____ and _____

2. What mathematical operation (addition, subtraction, multiplication, or division) was done with the two measurements from question 1 to calculate the mass of water in each berry (H_2O (g))? Show your work for at least one row.

3. Write an equation to calculate the mass of the water. You must use two quantitative measurements from question one and the operation you chose in question two.

   Mass of Water =

4. Use your equation to fill in the mass of water column *H_2O (g)* for the bottom two rows.

5. The general equation to find a percentage is shown below

General % Equation
$\% = \frac{Part}{Whole} x\ 100$
% H_2O Equation

   a. To find the percent of water, what data would we use as the "part"?

   b. What data do we use as the "whole"? *Not sure? Test it!*

   c. Rewrite the equation using the variables that you selected as the "part" and the "whole" in the box to the right.

6. Use your equation to fill in the percent water composition column *% H_2O* for the bottom two rows.

7. Think back to Task 2. Why might we want to use **percentages** when comparing water content instead of **mass**?

Task 4: Data Processing and Analysis

1. Your teacher will let you know what berry species your group is responsible for and will bring over your team's raw data.
   a. My group is in charge of the _____ species
2. As a team, calculate the following for each Julian Day. Use the space below to show your work for at least **one** set of data.
   a. Mass of H_2O (g)
   b. % of H_2O
3. Under your teacher's direction, add your calculated data into the class spreadsheet. Make sure you are on the tab with your species and are only entering data into the YELLOW BOXES. The graph of your data should automatically populate. You will be using it to answer the following analysis question.

Analysis

1. Looking at the graph for your species…
   a. What patterns or trends do you see in your species graph?
   b. Does this surprise you? Why or Why not?
2. Now, click on the spreadsheet tab labelled "DO NOT EDIT: Full Class Data". (*Remember, tabs are found at the bottom in Google Sheets)*
   a. Is the pattern you found in your species the same across different species?
   b. Does this surprise you? Why or Why not?
3. Remember, our bigger question was what part of the berry was changing as the berry mass grew.
   a. Based on your graphs, did the water content of the berry increase over time?
   b. What does this imply about the part of the berry that is changing as they get bigger?

Name: _____ Date: _____

Arctic Berries Check for Understanding

Directions: Use your skills to help fill in the following table. Show your work and/or make sure you reference the equations you are using to fill in the missing data.

Data for Rubus Chamaemorus					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
207	RC	0.6552	0.1010		
207	RC	0.3658	0.0625		
207	RC	0.4197	0.0630		

Name: _____ Date: _____

Arctic Berries Check for Understanding

Directions: Use your skills to help fill in the following table. Show your work and/or make sure you reference the equations you are using to fill in the missing data.

Data for Rubus Chamaemorus					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
207	RC	0.6552	0.1010		
207	RC	0.3658	0.0625		
207	RC	0.4197	0.0630		

Name: _____ Date: _____

Arctic Berries Check for Understanding

Data for Rubus Chamaemorus					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
207	RC	0.6552	0.1010		
207	RC	0.3658	0.0625		
207	RC	0.4197	0.0630		

1. Fill in the missing parts of the table above. Show your work or reference the equations that you used in the space given below.

2. Which berry species is represent in this set of data? How do you know?

3. Is the data above representing berries from multiple days or from the same day?. How do you know?

4. Describe any patterns or trends you see in % H_2O for this data set.

5. Why do we use % H_2O (as opposed to mass H_2O) when we are comparing data in this scenario?

6. **<u>Reflect</u>**: Fill in the table below to rate your understanding of the skills we learned during the berry lessons. (1 = I need help, 5 = I can teach it!)

Skill	Rating (Circle one!)
I can calculate mass of water and % of water in berry samples.	1 2 3 4 5
I can analyze graphs of berry data	1 2 3 4 5

Species Data: Cut each data table to give to each group of students

Data for Arctuous Alpina					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
176	AA	0.0342	0.0049		
184	AA	0.1105	0.0140		
191	AA	0.2031	0.0273		
198	AA	0.4081	0.0550		
207	AA	0.4109	0.0582		
212	AA	0.5412	0.0880		
220	AA	0.51158	0.076465		
226	AA	0.68314	0.09231		
232	AA	0.564905	0.07945		

Data for Empetrum Nigrum					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
176	EN	0.0128	0.0022		
184	EN	0.0442	0.0042		
191	EN	0.0512	0.0085		
198	EN	0.0520	0.0106		
207	EN	0.0804	0.0134		
212	EN	0.0920	0.0152		
220	EN	0.155675	0.02167		
226	EN	0.187455	0.02372		
232	EN	0.15104	0.0177		

Species Data: Cut each data table to give to each group of students

Data for Rubus Chamaemorus					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
207	RC	0.7995	0.1215		
212	RC	0.8823	0.1359		
220	RC	1.4766	0.2283		
226	RC	1.4955	0.2193		
232	RC	1.5719	0.2474		

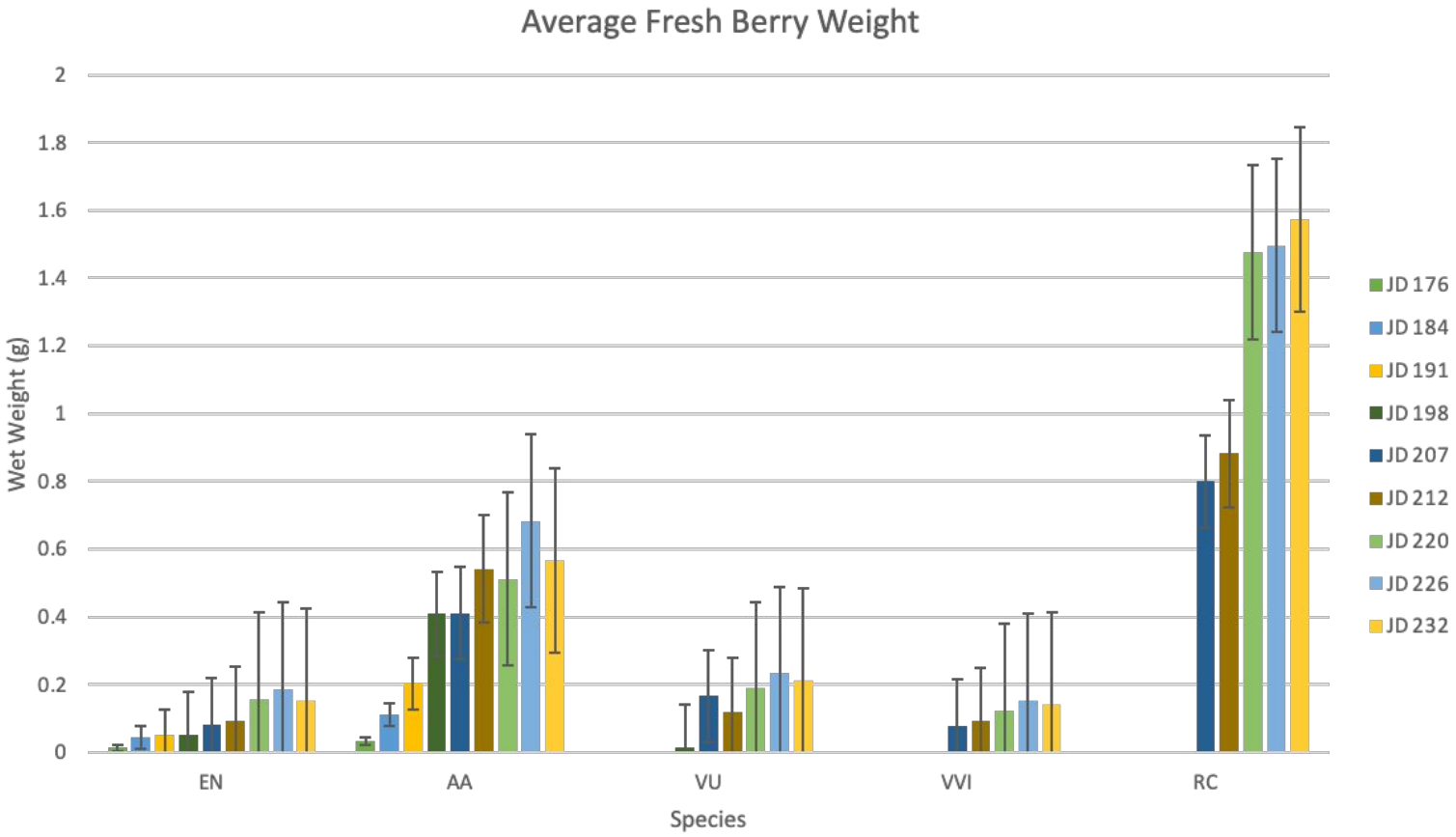
Data for Vaccinium vitis-idaea					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
207	VVI	0.0791	0.0097		
212	VVI	0.0909	0.0122		
220	VVI	0.1231	0.0163		
226	VVI	0.1530	0.0224		
232	VVI	0.1416	0.0199		

Data for Vaccinium uliginosum					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
198	VU	0.0141	0.0032		
207	VU	0.1653	0.0167		
212	VU	0.1200	0.0130		
220	VU	0.1888	0.0173		
226	VU	0.2331	0.0208		
232	VU	0.2127	0.0190		

Task 1: Species of Interest. Fill in the table below for each of the five species of interest. You may want to use this website as a starting place for your research: https://bit.ly/3MNo5W4

Species Name	Iñupiaq Name	Common Name	One Use

Task 2: Analyzing a graph. Annotate the graph with your teacher!



Use the graph from slide 2 to answer the following.

What trend do you notice within each species?

What do you notice when you compare data across species?

Task 3: Methods to Math!

The following data table shows 5 samples of *Empetrum nigrum* taken on the same day at the same location. This is only a portion of the full amount of data taken. Use this data to answer questions on the following slides.

Julian Day	Species	Fresh Weight (g)	Dry Weight (g)	H_2O (g)	% H_2O
176	Empetrum nigrum	0.0202	0.0026	0.0176	87.13
176	Empetrum nigrum	0.0163	0.0026	0.0137	84.05
176	Empetrum nigrum	0.0183	0.0030		
176	Empetrum nigrum	0.0089	0.0018		

Use the data table on the previous slide and the data collection method your teacher shared to answer the following questions:

What are the two **<u>quantitative measurements</u>** *(in other words, measurements that contain numbers)* collected in the initial method?

What mathematical operation (addition, subtraction, multiplication, or division) was done with the two measurements from question 1 to calculate the mass of water?

Use the data table on Slide 4 and the data collection method your teacher shared to answer the following questions:

Write an equation to calculate the mass of the water. You must use two quantitative measurements from question one and the operation you chose on the previous slide.

Mass of water =

Use your equation to fill in the mass of water column H_2O (g) for the bottom two rows on Slide 4.

Use the data table on Slide 4 and the data collection method your teacher shared to answer the following questions:

The general equation to find a percentage is shown below

General % Equation

$$\% = \frac{Part}{Whole} x\ 100$$

% H_2O Equation

To find the percent of water, what data would we use as the "part"?

What data do we use as the "whole"? *Not sure? Test it!*

Rewrite the equation using the variables that you selected as the "part" and the "whole" in the box to the right.

Use your equation to fill in the percent water composition column (% H_2O) for the bottom two rows.

Use the data table on Slide 4 and the data collection method your teacher shared to answer the following questions:

Think back to Task 2. Why might we want to use percentages when comparing water content instead of mass?

<u>Reflect</u>.

How confident do you feel (on a scale of 1-5, 1 meaning you need some extra help, 5 meaning you can teach the class) with calculating % H_2O content? Why?

Task 4: Data Processing and Analysis

Your teacher will tell you and your group which berry species you are in charge of processing for the next few slides.

Note: you only need to complete ONE of the next few slides.

My group is processing the species…

Click on your group's species ID below to take you to your data table!

AA	EN	VU	VVI	RC

Complete the following table for Arctuous alpina.

Data for Arctuous alpina					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
176	AA	0.0342	0.0049		
184	AA	0.1105	0.0140		
191	AA	0.2031	0.0273		
198	AA	0.4081	0.0550		
207	AA	0.4109	0.0582		
212	AA	0.5412	0.0880		
220	AA	0.51158	0.076465		
226	AA	0.68314	0.09231		
232	AA	0.564905	0.07945		

Click here when finished!

Complete the following table for Empetrum nigrum.

Data for Empetrum nigrum					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
176	EN	0.0128	0.0022		
184	EN	0.0442	0.0042		
191	EN	0.0512	0.0085		
198	EN	0.0520	0.0106		
207	EN	0.0804	0.0134		
212	EN	0.0920	0.0152		
220	EN	0.155675	0.02167		
226	EN	0.187455	0.02372		
232	EN	0.15104	0.0177		

Click here when finished!

Complete the following table for Vaccinium uliginosum

Data for Vaccinium uliginosum					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
198	VU	0.0141	0.0032		
207	VU	0.1653	0.0167		
212	VU	0.1200	0.0130		
220	VU	0.1888	0.0173		
226	VU	0.2331	0.0208		
232	VU	0.2127	0.0190		

Click here when finished!

Complete the following table for Vaccinium vitis-idaea

Data for Vaccinium vitis-idaea					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
207	VVI	0.0791	0.0097		
212	VVI	0.0909	0.0122		
220	VVI	0.1231	0.0163		
226	VVI	0.1530	0.0224		
232	VVI	0.1416	0.0199		

Click here when finished!

Complete the following table for Rubus chamaemorus

Data for Rubus chamaemorus					
Julian Day	Species ID	Fresh Weight (g)	Dry Weight (g)	H2O (g)	% H2O
207	RC	0.7995	0.1215		
212	RC	0.8823	0.1359		
220	RC	1.4766	0.2283		
226	RC	1.4955	0.2193		
232	RC	1.5719	0.2474		

Click here when finished!

Under your teacher's direction, add your calculated data into the class spreadsheet. Make sure you are on the tab with your species and are only entering data into the YELLOW BOXES. The graph of your data should automatically populate. You will be using it to answer the following analysis questions.

Looking at the graph **<u>for your species…</u>**
What patterns or trends do you see in your species graph?

Does this surprise you? Why or Why not?

Now, click on the spreadsheet tab labelled “DO NOT EDIT: Full Class Data”. (Remember, tabs are found at the bottom in Google Sheets)

Is the pattern you found in your species the same across different species?

Does this surprise you? Why or Why not?

Remember, our bigger question was what part of the berry was changing as the berry mass grew.

Based on your graphs, did the water content of the berry increase over time?

What does this imply about the part of the berry that is changing as they get bigger?