Growing Up on Ice
Lesson

B-030 Research Team

The B-030 Research team consists of 7 women. From left to right Dr. Linnea Pearson (co-principal investigator), Erin Brodie (veterinary technician), Dr. Heather Liwanag (principal investigator), Bridget Ward (PolarTREC teacher), Emma Weitzner (graduate student researcher), Heather Harris (field veterinarian) and Emily Whitmer (field veterinarian).

Meet the Weddell Seal Pups!

Mr. Goodbar

Caramello

Smartie

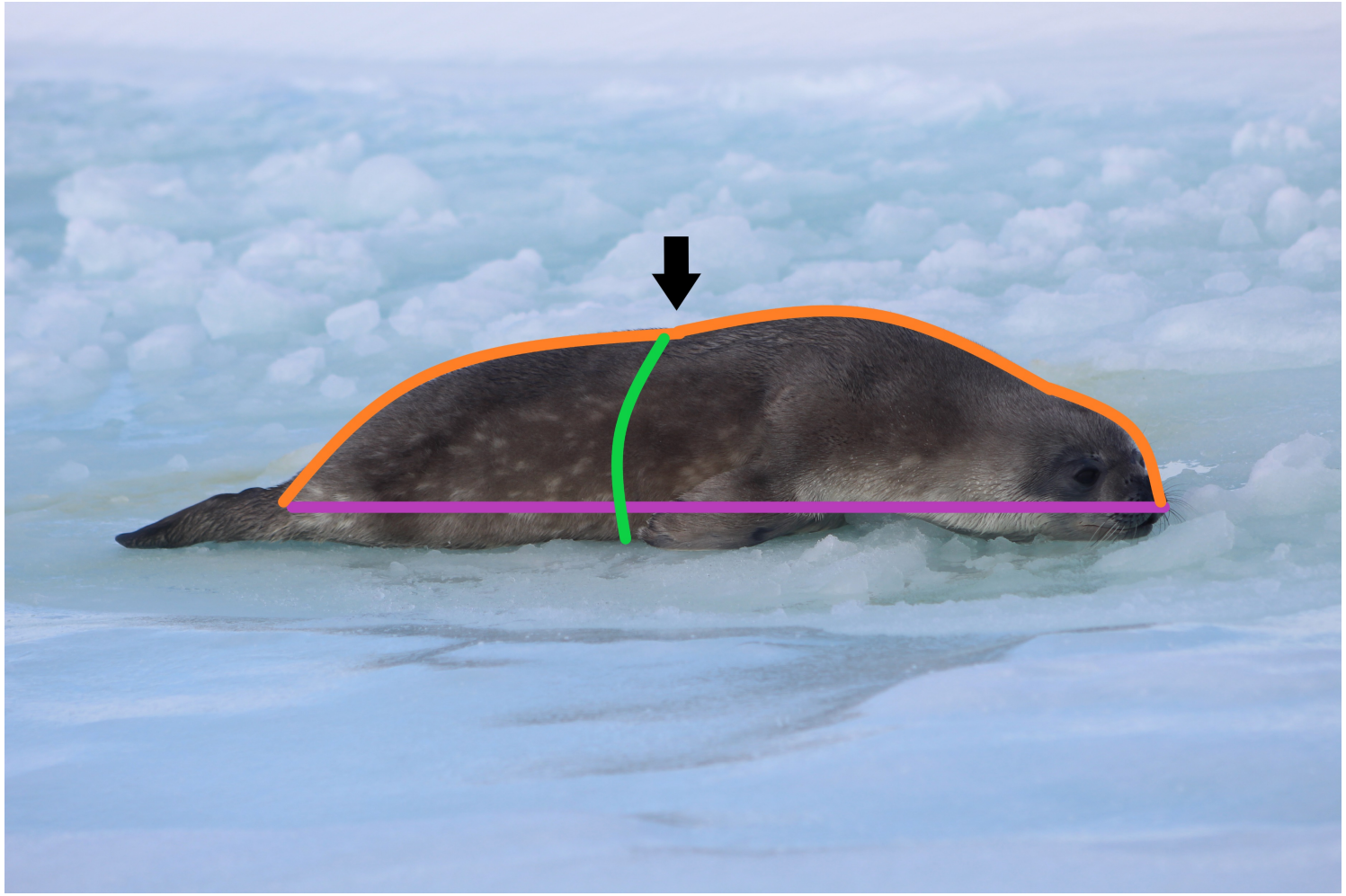
Sweetart

Charleston Chew

Twix

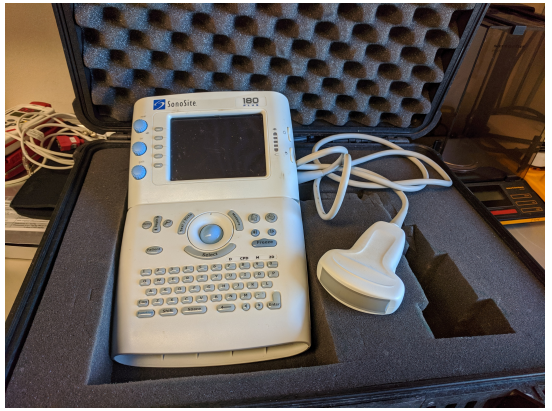
These pictures were taken under ACA Permit number 2018-013 M#1 and MMPA Permit Number 21006-01

Measuring Weddell Seal Pups

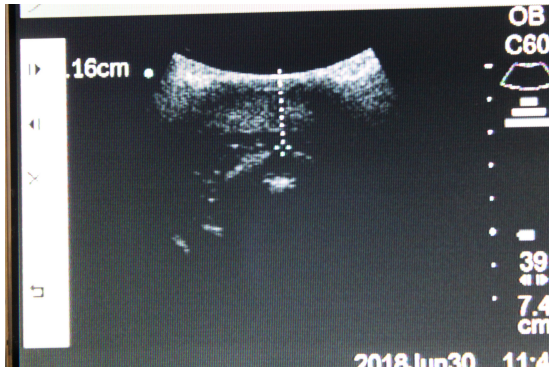


Measurements:

- Straight length nose to tail
- Curve length nose to tail
- Blubber depth at the dorsal sternum location
- Sternum girth. Girth is measured around the body.



Blubber depth is measured by ultrasound.



Mass is measured with a scale.

These pictures were taken under ACA Permit number 2018-013 and M#1 MMPA Permit Number 21006-01

TEACHERS AND RESEARCHERS EXPLORING AND COLLABORATING

PolarTREC Lesson Resource

Growing Up on Ice

Bridget Ward

Weddell Seals: Growing Up on Ice

PolarTREC Expedition Page
https://www.polartrec.com/expeditions/weddell-seals-growing-up-on-ice

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Overview

This is a STEM-based lesson. Students will analyze Weddell seal pup growth data, collected by the Growing Up on Ice, B-030, research team.

Objectives

This lesson is Algebra 1 based. Students will apply skills to:

1. Analyze data
2. Represent and solve equations graphically
3. Draw a line of best fit
4. Write equations based on data
5. Construct a graph including title, labeling axis, plotting data

Lesson Preparation

- Provide students with PDF of Weddell seal pups data cards (in Lesson Materials) for each group.
- Print copies of worksheets for class (if virtual omit graphing section or use web application.
- Color pencils/markers, rulers, calculators may be useful. If using for stats class or computer apps class modify Excel file, it contains answers.

Procedure

- Students should be divided into groups of four (though activity can be modified to work in smaller groups or alone).
- Provide each student with a worksheet, questions 1-7 are answered without Weddell seal pup data cards. The data cards include the data to construct graphs.

Extension

- Microsoft Excel: Students can use data to construct graphs in Excel.
- Students can insert trend lines and calculate slope and y-intercept and interpret what each means. Slope being growth rate and y-intercept, being predicted size at birth.
- Statistics students can evaluate if these equations are “acceptable” and support their claim with evidence.

Transferability

Data can be used to build models of Weddell seal pups growing.

Resource Details

Date

28 June 2020

Region

Antarctic

Completion Time

About 1 period

Grade

High school and Up

Permission

Download and Share

Location

Antarctica

Expeditions

Weddell Seals: Growing Up on Ice

Author(s)

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Heather Liwanag

Related Members

Bridget Ward

Heather Liwanag

Materials

Weddell seal pup data cards

Weddell seal pup student worksheet

Growing Up on Ice Lesson Intro PPT

Resources

- Additional information about Weddell seals along with maps where data were collected can be found at https://icyseals.com/education
- Lesson Materials include data, graphs, trendlines, and R2 values.

Assessment

Student worksheets including graph construction will be assessed.

Author/Credits

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Weddell seal pup data for statistics or computer science

Topic

Life Science

Earth Science

Environmental Studies

Polar Science

Mr. Goodbar
Date of Birth: October 20, 2019 (approximate)
Age: 1 Week Old
Straight Length nose to tail: 121 cm
Curve Length nose to tail: 138 cm
Mass: 36.5 kg
Blubber Depth Dorsal Sternum: 1.42 cm

Fun Fact: When the pups are born, they have a layer of baby fur, called lanugo, and they have almost no blubber.

Mr. Goodbar

Age: 3 Weeks Old
Straight Length nose to tail: 134 cm
Curve Length nose to tail: 154 cm
Mass: 65 kg
Blubber Depth Dorsal Sternum: 2.4cm

Fun Fact: Mr. Goodbar was often found resting in the same position as his mom.

Mr. Goodbar

Age: 5 Weeks Old
Straight Length nose to tail: 147 cm
Curve Length nose to tail: 159 cm
Mass: 88 kg
Blubber Depth Dorsal Sternum: 3.15 cm

Fun Fact: Weddell seals can dive up 2,300 feet (700 meters) deep. That is about 59 big yellow school buses long!

Mr. Goodbar

Age: 7 Weeks Old
Straight Length nose to tail: 152 cm
Curve Length nose to tail: 168 cm
Mass: 102.5 kg
Blubber Depth Dorsal Sternum: 3.5 cm

Fun Fact: About 40% of an adult Weddell seal's mass will be blubber. This blubber layer is around 5.08 cm.

Caramello

Date of Birth: October 13, 2019 (approximate)
Age: 1 Week Old
Straight Length nose to tail: 127 cm
Curve Length nose to tail: 140 cm
Mass: 51 kg
Blubber Depth Dorsal Sternum: 1.49 cm

Fun Fact: Weddell Seal pups shiver to help stay warm!

Caramello

Age: 3 Weeks Old
Straight Length nose to tail: 136 cm
Curve Length nose to tail: 153 cm
Mass: 65 kg
Blubber Depth Dorsal Sternum: 2.95 cm

Fun Fact: Caramello got his name because he was a mellow little pup. He stuck close to his mom and seemed to have an easygoing personality.

Caramello

Age: 5 Weeks Old
Straight Length nose to tail: 142 cm
Curve Length nose to tail: 163 cm
Mass: 85.5 kg
Blubber Depth Dorsal Sternum: 2.72 cm

Fun Fact: Weddell seals can stay underwater for up to 80 minutes. They could hypothetically watch the entire original Disney movie, The Jungle Book, while underwater, without taking a breath!

Caramello

Age: 7 Weeks Old
Straight Length nose to tail: 153 cm
Curve Length nose to tail: 158 cm
Mass: 83 kg
Blubber Depth Dorsal Sternum: 3.01 cm

Fun Fact: How to tell seals and sea lions apart:
Seals have an ear hole and sea lions have an ear with a flap. Seals scoot on their belly when moving across land and sea lions use their flippers to “walk”.

Smartie

Date of Birth: October 26, 2019 (approximate)
Age: 1 Week Old
Straight Length nose to tail: 121 cm
Curve Length nose to tail: 136 cm
Mass: 41 kg
Blubber Depth Dorsal Sternum: 2.07 cm

Fun Fact: Weddell seal pups are usually born starting the second week of October, when the average temperature is around -19° Celsius (-2.2 ° Fahrenheit) and the average wind speed is 11 mph. However, the conditions can be much colder and wind speed can get much higher.

Smartie

Age: 3 Weeks Old
Straight Length nose to tail: 136 cm
Curve Length nose to tail: 152 cm
Mass: 79 kg
Blubber Depth Dorsal Sternum: 2.57 cm

Fun Fact: Smartie was always by his mom's side. She could get him to go in the water, but it took a while for him to be willing to start his diving lessons.

Smartie

Age: 5 Weeks Old
Straight Length nose to tail: 145 cm
Curve Length nose to tail: 165 cm
Mass: 102 kg
Blubber Depth Dorsal Sternum: 3.77 cm

Fun Fact: Weddell seals see in low light conditions below the sea ice due to a special structure in their eyes called the tapetum lucidum Have you ever seen your pet dog or cat in a dim room, and it seemed like their eyes were glowing? This glow is caused by their tapetum lucidum eye layer.

Smartie

Age: 7 Weeks Old
Straight Length nose to tail: 155 cm
Curve Length nose to tail: 165 cm
Mass: 107.5 kg
Blubber Depth Dorsal Sternum: 3.4 cm

Fun Fact: Weddell seals favorite food is fish, especially Antarctic cod and Antarctic silverfish. They also eat squid, octopus, and crustaceans like krill or prawns.

Charleston Chew

Date of Birth: October 17, 2019 (approximate)
Age: 1 Week Old
Straight Length nose to tail: 126 cm
Curve Length nose to tail: 141 cm
Mass: 42.5 kg
Blubber Depth Dorsal Sternum: 2.2 cm
Fun Fact: Weddell seals are unusual because they learn how to swim from their moms. Most seals learn how to swim and dive entirely on their own, with no help from mom.

Charleston Chew

Age: 3 Weeks Old
Straight Length nose to tail: 139 cm
Curve Length nose to tail: 150 cm
Mass: 66 kg
Blubber Depth Dorsal Sternum: 2.75 cm

Fun Fact: Charleston Chew was feisty pup who was quick to snap at nearby animals, including other pups and even his mom!

Charleston Chew

Age: 5 Weeks Old
Straight Length nose to tail: 148 cm
Curve Length nose to tail: 167 cm
Mass: 96.5 kg
Blubber Depth Dorsal Sternum: 3.18 cm

Fun Fact: Weddell seal whiskers help them to detect water disturbances caused by their prey so that they are able to find food, even in complete darkness.

Charleston Chew

Age: 7 Weeks Old
Straight Length nose to tail: 150 cm
Curve Length nose to tail: 169 cm
Mass: 101.5 kg
Blubber Depth Dorsal Sternum: 3.79 cm

Fun Fact: Weddell seals were named for Sir James Weddell, a British sealing captain in the 1820s.

Sweetart

Date of Birth: October 18, 2019 (approximate)

Age: 1 Week Old
Straight Length nose to tail: 127 cm
Curve Length nose to tail: 137 cm
Mass: 43.5 kg
Blubber Depth Dorsal Sternum: 1.65 cm
Fun Fact: Weddell seals have their pups on the fast ice because it keeps them safe from their primary predator, killer whales. Because they have no land predators, they are not afraid of humans.

Sweetart

Age: 3 Weeks Old
Straight Length nose to tail: 139 cm
Curve Length nose to tail: 155 cm
Mass: 64.5 kg
Blubber Depth Dorsal Sternum: 2.53 cm

Fun Fact: Sweetart had both a lively and a sweet side. She liked to stay tucked behind the snow drifts and sea ice pressure ridges.

Sweetart

Age: 5 Weeks Old
Straight Length nose to tail: 141 cm
Curve Length nose to tail: 158 cm
Mass: 74.5 kg
Blubber Depth Dorsal Sternum: 2.75 cm

Fun Fact: Weddell seals exhale before they dive under water and collapse their lungs. They store oxygen in their blood and muscles to help them make long dives.

Sweetart

Age: 7 Weeks Old
Straight Length nose to tail: 147 cm
Curve Length nose to tail: 169 cm
Mass: 90 kg
Blubber Depth Dorsal Sternum: 3.01 cm

Fun Fact: Weddell seals can have seal lice! The seal lice are not zoonotic, meaning they don't infest people. The team combed through the pups' fur to collect samples of the lice to study further.

Name: _____

Growing Up On Ice: Early Development of Weddell Seal Pups

1. How many seal images appear in the presentation?

2. Identify a characteristic of living conditions at McMurdo Station that you found interesting and explain why is valuable to residents.

3. Analyze the graph: **Temperature at McMurdo Station Antarctica.**
a. How have temperatures changed from mid-September to the end of October?

b. Evaluate how this temperature change impacts Weddell seal:

4. Suppose you were traveling out on the sea ice to conduct research, would you prefer to drive a snowmobile or PistenBully? Support your choice with details from the presentation.

5. List the two main questions the research team is investigating:

6. Explain one characteristic of Weddell seal pups that aid in maintaining a stable body temperature.

7. Contrast the internal oxygen stores between Weddell seals and humans.

8. Write one question you have for the research team:

9. If you were on the Growing up on Ice research team what would you investigate about Weddell seals that would help answer 1 of the teams research questions.

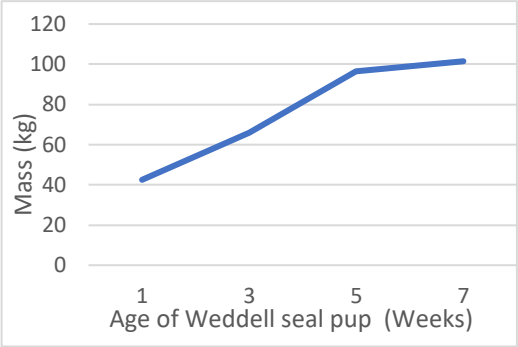
Name: _____

Growing Up on Ice - Student Worksheet

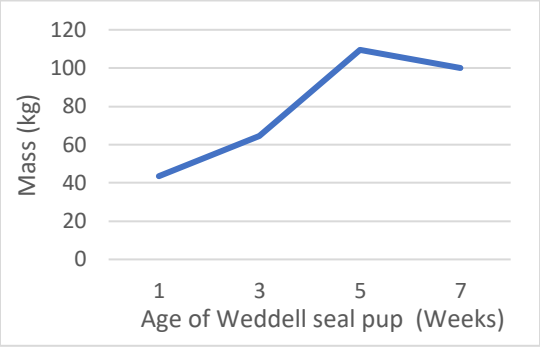
Weddell seals live around Antarctica, they are the southern-most breeding mammal. In September and October, soon to be mother seals haul out onto the sea ice and have a single pup. These pups are born between 1.2-1.5 (4-5 feet) long and weighing 22-30 kg (48-66 lb). Weddell seal pups, being mammals, rely on their mother's milk for food. Their mom's milk is mostly fat, about 50%. The pups turn this fat rich milk into blubber layer, which is responsible for most of their growth. Around 7 weeks old the pups wean, which means they stop relying on their mom's milk. In 2019 research team B-030, collected data on multiple Weddell seal pups, every two weeks, for the seven weeks the pups lived with their mothers. Each of the seal pups researched was named after a type of candy.

The research team thinks the seal pup, Twix, weaned before the age of 7 weeks old, because he began losing mass after week 5.

A.



B.

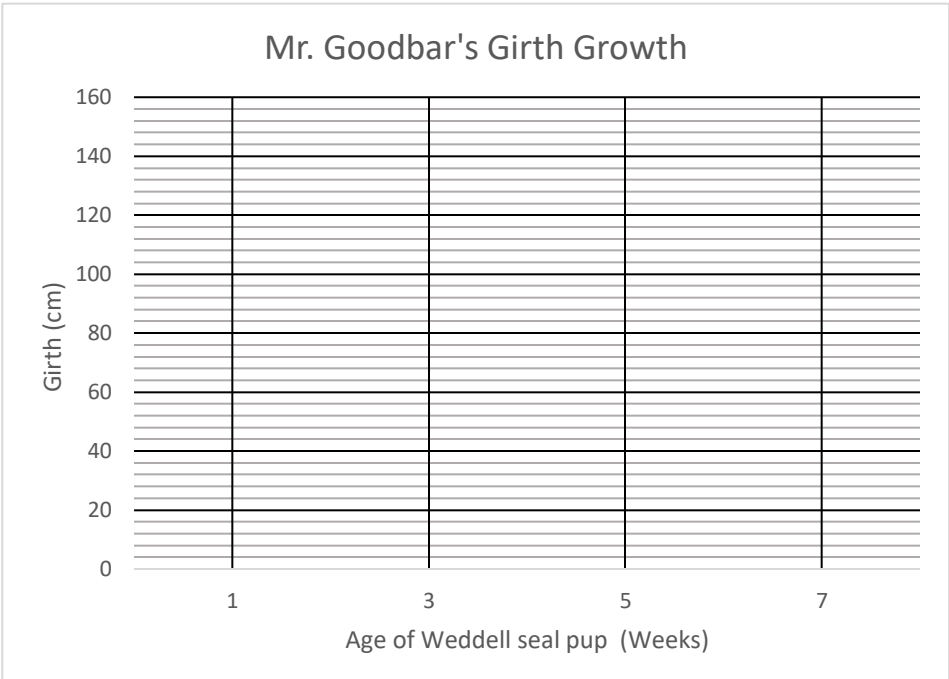


1. Which of the line graphs correctly represents Twix's mass data for the 7 weeks?

2. Explain why you chose that answer:

3. One of the measurements the researchers recorded was girth, the distance around the seal. Using the data below, draw the line of best fit on the graph below for Mr. Goodbar's sternum girth growth. Show your work!

Age (weeks)	Girth (cm)
1	90
3	106
5	120
7	



4. Use the line of best fit you drew to predict Mr. Goodbar's sternum girth for week 7.

5. Write the linear equation of line of best fit, which represents Mr. Goodbar's sternum girth growth over 7 weeks:

6. What does the y-intercept for this data set represent?

7. What does the slope represent for this data set represent?

8. Mr. Goodbar's actual sternum girth for week 7 was 122 cm. How is this different from your prediction?

Obtain the Weddell seals data cards. In your group assign each member 1 data set to analyze: mass, straight length nose to tail, curve length nose to tail, or blubber depth dorsal sternum. Have each person construct a graph to represent the data.

Before constructing your graph answer the following questions:

9. Which variable will be placed on the X-axis? _____

10. Which units will be used to measure this variable? _____

11. What is the data range for the X-axis? _____

12. The graph is 10 squares by 10 squares. What will your scale be on the X-axis? (How much will each square on the graph represent?

13. Which variable will be placed on the Y-axis? _____

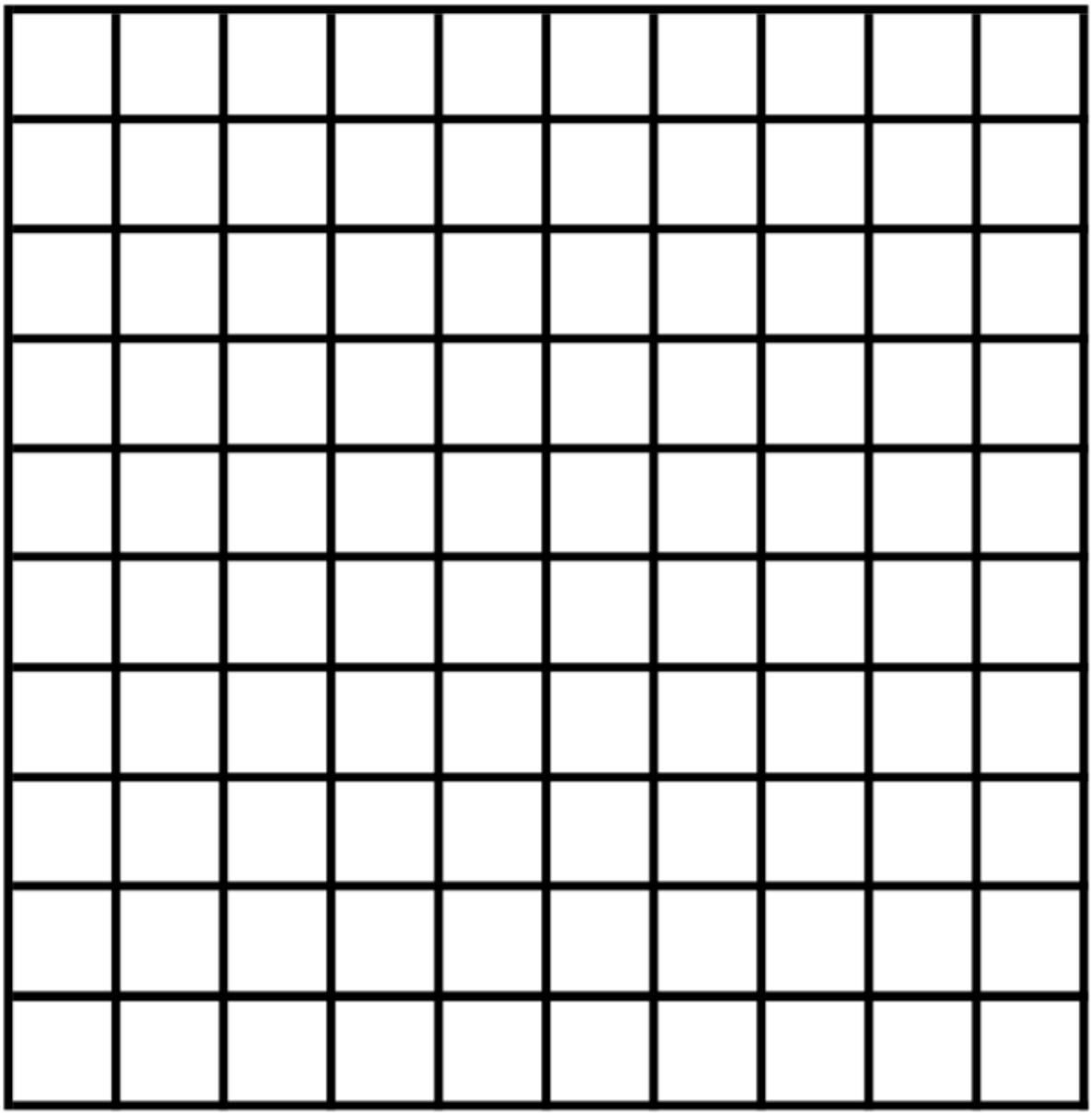
14. Which units will be used to measure this variable? _____

15.What is the data range for the Y-axis? _____

16. The graph is 10 squares by 10 squares. What will your scale be on the X-axis? (How much will each square on the graph represent?

17. Explain which is the dependent variable and which is the independent variable:

Construct your line graph on the next page. Make sure to include a title, label the X-axis and Y-axis, scale, plot data points, connect data points with a line, and make a key.



Answer the following questions by comparing data from your group members' graphs.

18. Pick 1 growth variable to compare: _____

Which Weddell seal pup grew at the fastest rate? Support your claim with data as evidence

19. Looking at the mass, straight length nose to tail, curve length nose to tail, and blubber depth at the dorsal sternum, was the biggest seal pup at seven weeks the biggest for each category? Explain

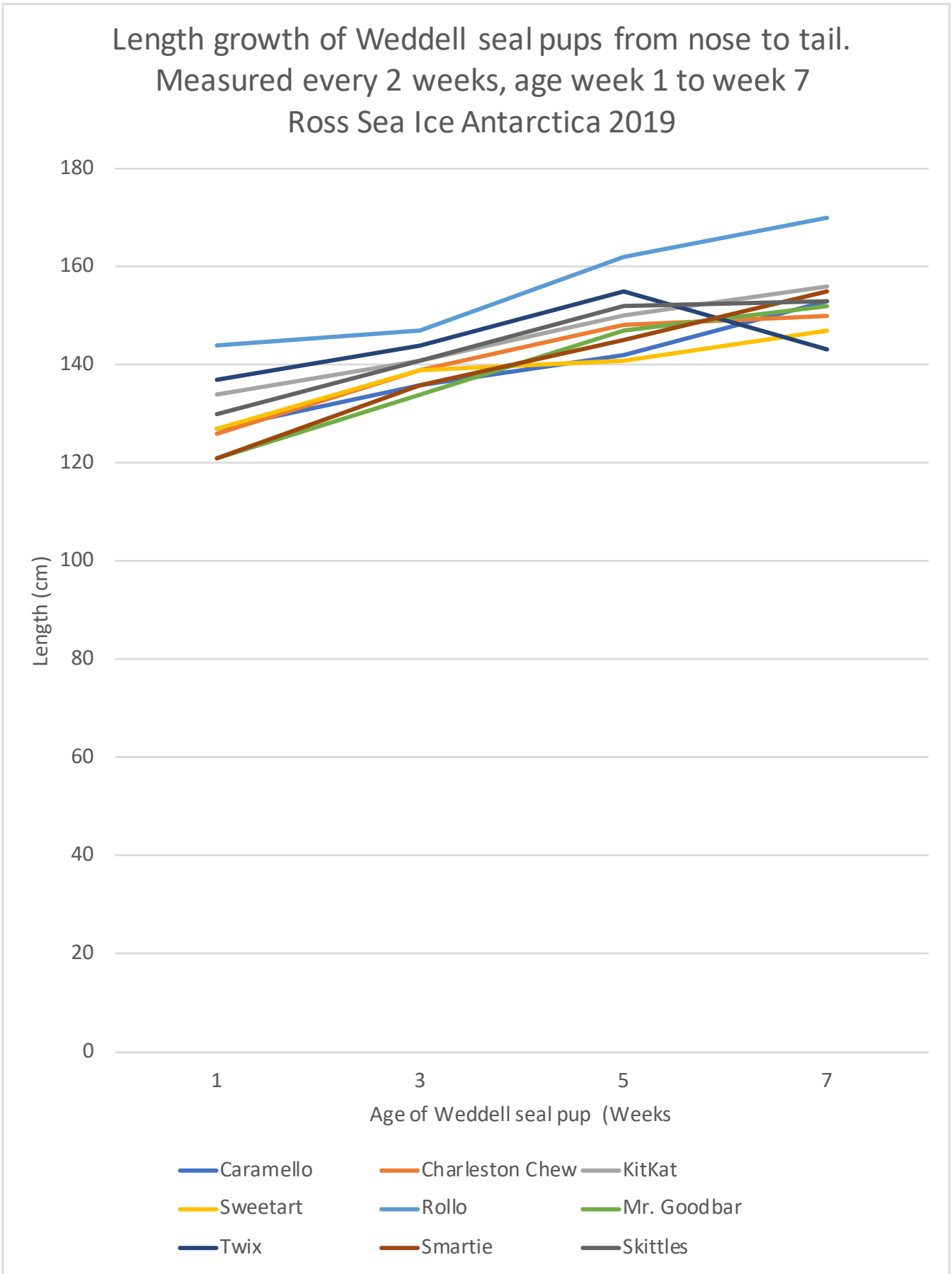
20. Did any of the seal pups decrease in size over the seven weeks? (Support your claim, using data as evidence.)

21. Weddell seals are fully grown at 3 years old, approximately 157 weeks. The equation, $y = 14.95x + 30.75$, represents the mass gain of the Weddell seal pup Sweetart for weeks 1-7. Using this equation determine the predicted mass (kg) of Sweetart at week 157:

22. An adult Weddell seal has an actual mass around 545 kg. Why do you think Weddell seal growth is not linear?

Week	Name	Mass	Std Length_cm	Curve Length_cm	Blubber_depth_Dorsal_Sternum_cm
			Standard length -	Total curvilinear length - hugs the	
1	Caramello	51	127	140	1.49
1	Charleston Chew	42.5	126	141	2.2
1	KitKat	40.5	134	144	1.91
1	Sweetart	43.5	127	137	1.65
1	Rollo	51.5	144	153	2.2
1	Mr. Goodbar	36.5	121	138	1.42
1	Twix	48.5	137	144	2.21
1	Snickers	47.5	134	144	2.09
1	Smartie	41	121	136	2.07
1	Skittles	43	130	136	2.59
3	Caramello	65	136	153	2.95
3	Charleston Chew	66	139	150	2.75
3	KitKat	66	141	159	2.69
3	Sweetart	64.5	139	155	2.53
3	Rollo	87	147	169	3.04
3	Mr. Goodbar	5	134	154	2.4
3	Twix	83.5	144	159	2.8
3	Snickers	85	151	169	2.95
3	Smartie	79	136	152	2.57
3	Skittles	81	141	152	3.38
5	Caramello	85.5	142	163	2.72
5	Charleston Chew	96.5	148	167	3.18
5	KitKat	82.5	150	165	3.5
5	Sweetart	74.5	141	158	2.75
5	Rollo	120.5	162	180	3.83
5	Mr. Goodbar	88	147	159	3.15
5	Twix	109.5	155	173	4.03
5	Smartie	103	145	165	3.77
5	Skittles	100.5	152	161	4.38
7	Caramello	83	153	158	3.01
7	Charleston Chew	101.5	150	169	3.79
7	KitKat	85	156	167	3.59
7	Sweetart	90	147	169	3.01
7	Rollo	121.5	170	184	4.35
7	Mr. Goodbar	102.5	152	168	3.5
7	Twix	100	143	164	4.25
7	Smartie	107.5	155	165	3.4
7	Skittles	103.5	153	168	4.67

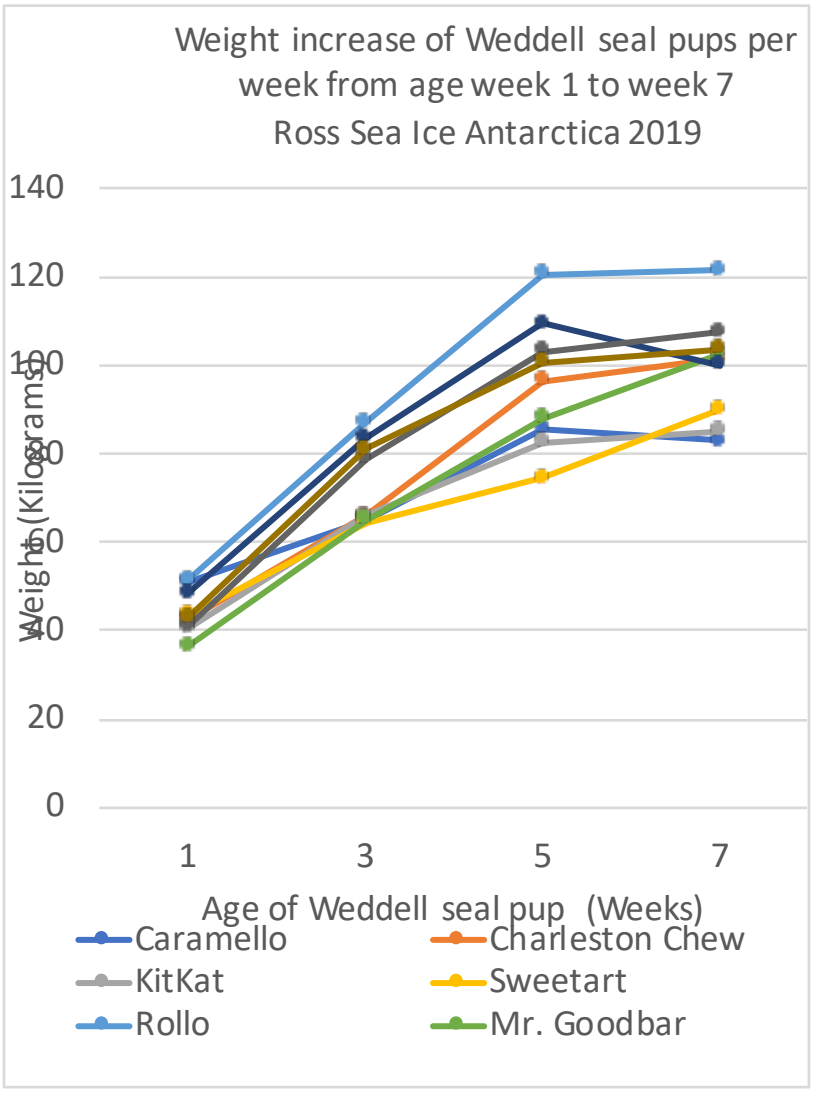
body of the seal when measured


Length growth of Weddell seal pups from nose to tail.
Measured every 2 weeks, age week 1 to week 7
Ross Sea Ice Antarctica 2019
180
160
140
120
100
80
60
40
20
0
Length (cm)
1
3
5
7
Age of Weddell seal pup (Weeks
Caramello
Charleston Chew
KitKat
Sweetart
Rollo
Mr. Goodbar
Twix
Smartie
Skittles

	Week 1	Week 3	Week 5	Week 7	
	1	3	5	7	Trendline
Caramello	127	136	142	153	y = 8.4x + 118.5
Charleston Chew	126	139	148	150	y = 8.1x + 120.5
KitKat	134	141	150	156	y = 7.5x + 126.5
Sweetart	127	139	141	147	y = 6.2x + 123
Rollo	144	147	162	170	y = 9.3x + 132.5
Mr. Goodbar	121	134	147	152	y = 10.6x + 112
Twix	137	144	155	143	y = 2.9x + 137.5
Smartie	121	136	145	155	y = 11.1x + 111.5
Skittles	130	141	152	153	y = 8x + 124

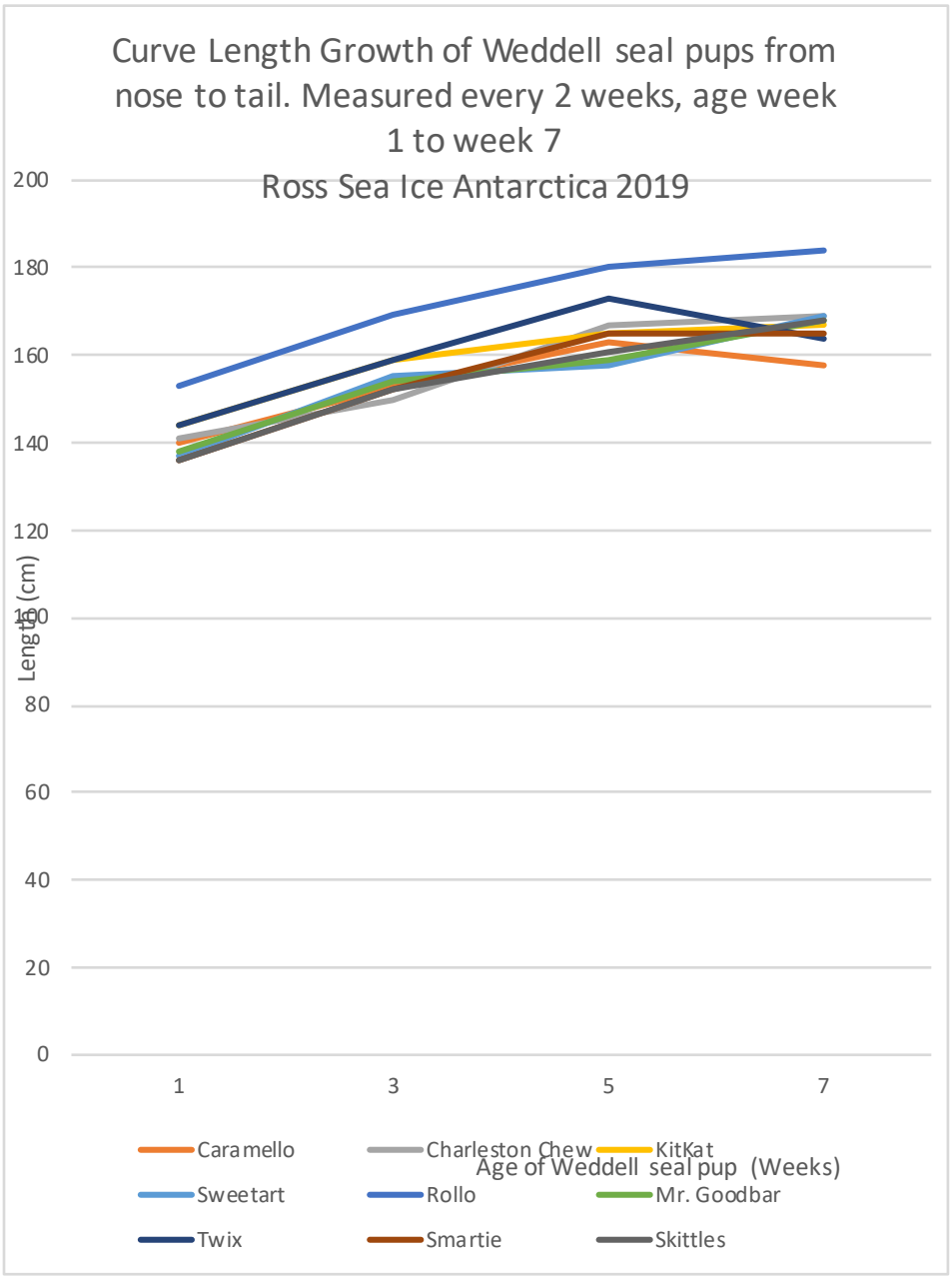
R^2

0.9882
0.9144
0.9947
0.9109
0.9468
0.967
0.2492
0.9861
0.9143

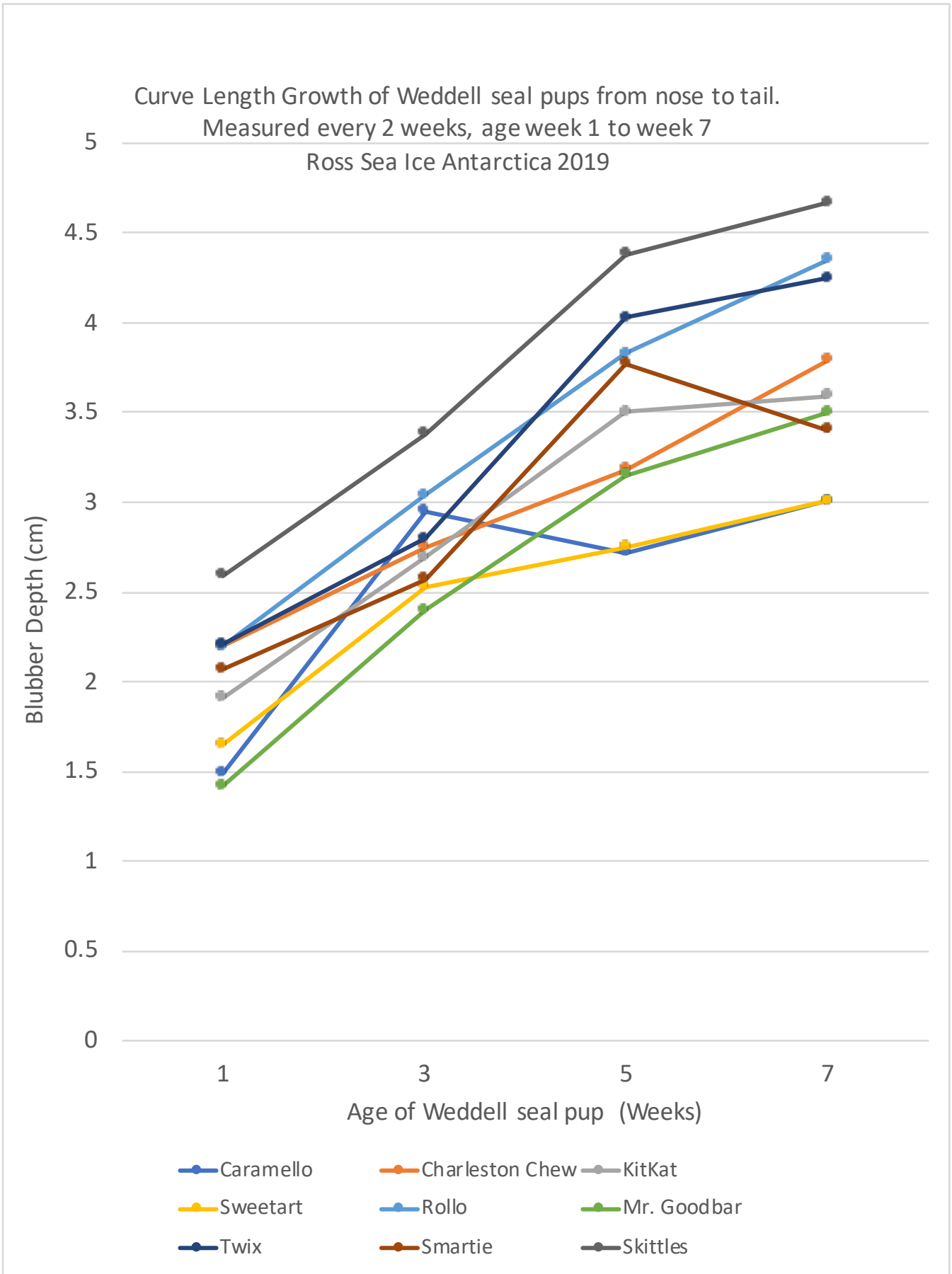

Weight increase of Weddell seal pups per week from age week 1 to week 7
Ross Sea Ice Antarctica 2019
140
120
100
80
60
40
20
0
Weight (Kilograms)
1
3
5
7
Age of Weddell seal pup (Weeks)
Caramello
Charleston Chew
KitKat
Sweetart
Rollo
Mr. Goodbar

	Week 1	Week 3	Week 5
Name	**1**	**3**	**5**
Caramello	51	65	85.5
Charleston Chew	42.5	66	96.5
KitKat	40.5	66	82.5
Sweetart	43.5	64.5	74.5
Rollo	51.5	87	120.5
Mr. Goodbar	36.5	65	88
Twix	48.5	83.5	109.5
Smartie	41	79	103
Skittles	43	81	100.5

Week 7		
7	Trendline	R^2
83	y = 11.65x + 42	0.8588
101.5	y = 20.75x + 24.75	0.9396
85	y = 15x + 31	0.8939
90	y = 14.95x + 30.75	0.9814
121.5	y = 24.35x + 34.25	0.896
102.5	y = 22.1x + 17.75	0.9802
100	y = 18.05x + 40.25	0.7545
107.5	y = 22.35x + 26.75	0.8985
103.5	y = 20.1x + 31.75	0.8683


Curve Length Growth of Weddell seal pups from nose to tail. Measured every 2 weeks, age week 1 to week 7
Ross Sea Ice Antarctica 2019
200
180
160
140
120
100
80
60
40
20
0
Length (cm)
1
3
5
7
Age of Weddell seal pup (Weeks)
Caramello
Charleston Chew
KitKat
Sweetart
Rollo
Mr. Goodbar
Twix
Smartie
Skittles

	Week 1	Week 3	Week 5	Week 7		
Name	**1**	**3**	**5**	**7**	Trendline	R^2
Caramello	140	153	163	158	y = 6.4x + 137.5	0.699
Charleston Chew	141	150	167	169	y = 10.1x + 131.5	0.9295
KitKat	144	159	165	167	y = 7.5x + 140	0.8661
Sweetart	137	155	158	169	y = 10x + 129.5	0.8787
Rollo	153	169	180	184	y = 10.4x + 145.5	0.9373
Mr. Goodbar	138	154	159	168	y = 9.5x + 131	0.9505
Twix	144	159	173	164	y = 7.4x + 141.5	0.6195
Smartie	136	152	165	165	y = 10x + 129.5	0.8787
Skittles	136	152	161	168	y = 10.5x + 128	0.9625


Curve Length Growth of Weddell seal pups from nose to tail.
Measured every 2 weeks, age week 1 to week 7
Ross Sea Ice Antarctica 2019
Blubber Depth (cm)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1
3
5
7
Age of Weddell seal pup (Weeks)
Caramello
Charleston Chew
KitKat
Sweetart
Rollo
Mr. Goodbar
Twix
Smartie
Skittles

	Week 1	Week 3	Week 5	Week 7		
Name	**1**	**3**	**5**	**7**	Trendline	R^2
Caramello	1.49	2.95	2.72	3.01	y = 0.433x + 1.46	0.6152
Charleston Chew	2.2	2.75	3.18	3.79	y = 0.52x + 1.68	0.996
KitKat	1.91	2.69	3.5	3.59	y = 0.585x + 1.46	0.9208
Sweetart	1.65	2.53	2.75	3.01	y = 0.43x + 1.41	0.8846
Rollo	2.2	3.04	3.83	4.35	y = 0.724x + 1.545	0.9894
Mr. Goodbar	1.42	2.4	3.15	3.5	y = 0.699x + 0.87	0.9604
Twix	2.21	2.8	4.03	4.25	y = 0.735x + 1.485	0.9407
Smartie	2.07	2.57	3.77	3.4	y = 0.519x + 1.655	0.7509
Skittles	2.59	3.38	4.38	4.67	y = 0.724x + 1.945	0.9615