Name ____________________________Class _________________ Date _________________

That's Amazing! Worksheet

Vegetarian Alligators

with Dr. Michael Heithaus

Problem

Are alligators kings of the Everglades? Science can't answer what it means to be the king, but it can provide answers to some related questions. In our investigation, we'll look at where alligators fit in the Everglades food web and what *trophic level* they occupy.

INVESTIGATION

We'll start our investigation by figuring out what the alligators in Shark River are eating. During the study, Mike, Adam, and the team flushed the stomachs of 20 alligators that ranged in size from 140 cm to 270 cm long. They identified everything that came out and counted the number of each item in each stomach.

Table 1. Stomach contents of 20 alligators captured in the Shark River Estuary. Numbers in parentheses are total number of each prey type found in the stomach.

Alligator number	Total length (cm)	Stomach contents	Total items
1	150	crab (2); small fish (8)	10
2	240	empty	0
3	260	crab (1); pond apple (2)	3
4	230	crab (2); raccoon hair (from one raccoon)	3
5	180	crab (4); pond apple (1)	5
6	220	small fish (7); snail (2), crab (3)	12
7	175	turtle (1); pond apples (3)	4
8	155	crab (4); mangrove seed (1)	5
9	200	empty	0
10	265	small fish (2); big fish (1); crab (1); bird feathers (from one bird)	5
11	235	pond apples (5); crab (1)	6

Table 1 *(continued)*

Alligator number	**Total length (cm)**	**Stomach contents**	**Total food items**
12	190	pond apples (1); bird feathers (from one bird)	2
13	165	empty	0
14	240	empty	0
15	195	crab (1)	1
16	255	crab (4)	4
17	185	small fish (3); balloon (3)	6
18	205	big fish (1); pond apple (1)	2
19	215	empty	0
20	230	crab (1); snail (1)	2

1. **Data Analysis** How many alligators had food in their stomachs? __________
2. **Data Analysis** How many food items, in total, were found in alligators?_____
3. Use the information in Table 1 to fill out Table 2.

Table 2. The amount of different food types in alligator stomachs

Food type	**Number of stomachs**	**Number of food items**
Crabs		
Small fishes		
Big fishes		
Snails		
Birds		
Mammals		
Reptiles		
Plants		
Human objects		

One way that biologists measure diet is by determining the proportion of individuals that have a particular type of food in their stomachs (Frequency %). Another method is to calculate the proportion of total food items that a particular type of food makes up (Number %).

4. **Data Analysis** Use the following formulas to fill out Table 3.

$$Frequency\ \% = \frac{Number\ of\ stomachs\ with\ a\ particular\ food\ type}{Total\ number\ of\ stomachs\ with\ any\ food\ present}$$

$$Number\ \% = \frac{Total\ number\ of\ a\ particular\ food\ item\ in\ stomachs\ of\ all\ alligators}{Total\ number\ of\ food\ items\ from\ all\ alligator\ stomachs\ combined}$$

Table 3. Two measures of the relative importance of different food types to the diets of alligators in the Shark River Estuary

Food type	**Frequency (%)**	**Number (%)**
Crabs		
Small fishes		
Big fishes		
Snails		
Birds		
Mammals		
Reptiles		
Plants		
Human objects		

5. **Data Analysis** Draw a bar graph of the Frequency (%) for each food type in the diets of alligators.

6. **Data Analysis** Draw a bar graph of the Number (%) for each food type in the diets of alligators.

7. **Data Analysis** Describe the diets of alligators. What foods do they eat most frequently?

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8. Do the measures of Frequency (%) and Number (%) in alligator diets give you different information about what these alligators eat? Explain your answer.

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When we look at the stomach contents of alligators, we can only see what they ate at their most recent meal. In order to quantify their trophic level more accurately, we need to analyze what the alligators have been eating over the past several months. It turns out that the tissue samples that Mike and Adam took can help us find out!

One way to determine trophic level is to analyze the nitrogen isotopes present in an organism's tissues. Two isotopes of nitrogen present in organisms are used to build proteins—^{14}N and ^{15}N. The amount of ^{15}N is given by the value *delta*^{15}N. When predators eat prey, they accumulate more ^{15}N than ^{14}N. So, you can infer an organism's level in a food chain by its relative level of ^{15}N—the higher the *delta*^{15}N, the higher the trophic level of an organism. In fact, based on many studies in the laboratory and in the field, we know that *delta*^{15}N increases by an average of 3 parts per thousand (‰) at each trophic level.

For example, if the *delta*^{15}N of a certain plant is 2.0 ‰, then an herbivore that eats that plant will have a *delta*^{15}N of 5.0 ‰, and if a predator eats just that herbivore it will have a *delta*^{15}N of 8.0 ‰. However, it isn't always that simple. Usually ecosystems are better represented by food webs than by food chains, because most organisms eat more than one type of food. That means that the actual *delta*^{15}N values of organisms in the wild are usually not whole numbers. Table 4 shows the *delta*^{15}N values of 10 alligators and the mean *delta*^{15}N for other organisms in the Shark River.

9. **Data Analysis** Calculate the trophic level of the following organisms to complete the table, using the following formula:

$$Trophic\ level = 1 + \frac{\delta^{15}N\ for\ organism - \delta^{15}N\ for\ primary\ producer}{3}$$

Table 4. *delta*^{15}N values and trophic levels of organisms in the Shark River estuary. The lengths of individuals sampled are given in parentheses.

Organism	***delta*^{15}N**	**Trophic level**
Mangrove	2.0	1
Phytoplankton	2.0	1
Herbivorous snail	5.0	2
Florida gar (fish 35-50 cm long fish)	11.0	
Snook (fish 50-70 cm long)	12.0	
Juvenile bull shark (70-120 cm long)	12.5	
American crocodile (320 cm)	14.0	
Alligator (150 cm)	8	
Alligator (235 cm)	9	
Alligator (265 cm)	8.5	
Alligator (185 cm)	9.5	
Alligator (270 cm)	9	
Alligator (220 cm)	8	
Alligator (195 cm)	8.5	
Alligator (240 cm)	9	
Alligator (160 cm)	9.5	
Alligator (250 cm)	8	
Alligator average	8.7	

CONCLUSION

10. Based on the ^{15}N isotope data, are alligators the top predators in the Florida Everglades? Explain your answer.

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11. How did the results of the diet studies compare to what you expected to find?

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12. So, are alligators the kings of the Everglades? Use what you have learned and the data you analyzed to support your position.

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13. **Extension** What further studies you would propose to do to help answer this question?

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