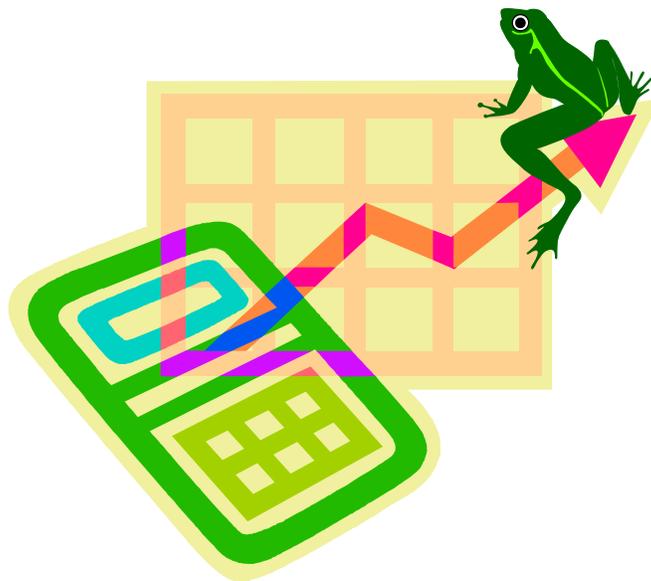


# Wild About Math

A collection of activities for the TI-83 and TI-84 Plus graphing calculator using authentic wildlife research data from the Virginia Department of Game and Inland Fisheries



Funded by:  
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# Special thanks to

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# Introduction

At the turn of the twentieth century, Virginia's wildlife populations were low. Many species plentiful today such as the deer, beaver, and blue heron, had all but disappeared from the Commonwealth because of a lack of understanding about how wildlife populations respond to over hunting and because there were no laws safeguarding animal numbers. In 1916 the Virginia General Assembly established the Department of Game and Inland Fisheries to bring species like these back through legislation and effective wildlife management techniques.

The scientific field of wildlife management was new and experimental in the early 20<sup>th</sup> century. A variety of methods to restore wildlife populations were tried and many failed. Today, we know that habitat management, based on sound research, is the key to long term survival of any species. To be able to manage a habitat for the food, water, shelter and space needs of any given species, we need to know what the species' requirements are. Wildlife biologists at the Department of Game and Inland Fisheries design research projects that identify the habitat requirements as well as assess the health of the population. The statistics provided in this guide are the result of many years of data collection that has been based on a variety of research methods.

The Department also depends upon public support for the collection of additional data that otherwise would be difficult to obtain. Certain wildlife species can be hunted without adversely affecting their population. Citizens who hunt for deer and turkey are asked to provide age and sex of the animals they hunted. This provides a large sample size that could not be collected in other ways. Smaller samples of the population are taken through other methods including the mark and recapture technique, direct observations and actual counts.

For some species the Department uses the latest in technological methods. For example, the data on the swan activity was collected using satellite transmitters placed on just a few swans. Since swans fly in large flocks, only a few birds needed to be followed. What we found is that not all swans that winter in Virginia return to the same nesting grounds but instead scatter across the northern portion of Canada and Alaska. Similar transmitters have been placed on sea turtles, peregrine falcons and pintail ducks over the past 20 years. Radio transmitters followed by plane, boat or on foot have been also placed on bears, fish and even on the endangered canebrake rattlesnake.

Biologists Virginia Department of Game and Inland Fisheries are experts in their field; many have a Masters or Doctorate Degree in Wildlife Resource Management. If students would like additional information on careers in wildlife, visit:

<http://www.dgif.virginia.gov/jobs/careers-pamphlet.html#Wildlife>.

# *A Weighty Issue*

## **Overview:**

In this activity, students graph the growth of bear cubs that were part of a reproductive study done at Virginia Tech.

## **SOL Connections:**

Math 8.12, 7.16, 7.18  
Science 6.1, LS.1, LS.8

## **Background:**

Black bears are found in all but a few eastern counties of Virginia, but the densest populations are in the western mountainous part of the state and in the south east corner, mainly the Great Dismal Swamp and surrounding areas. The population of bears is growing and spreading to practically all counties of the Commonwealth. The total number of bears in Virginia may be about 7,000 animals. Bears are nearly always solitary animals, with the exception of family groups (sow with cubs). The male and female have little or no contact other than during mating. Females spend a lot of effort feeding and fattening up before going into hibernation in order to produce healthy cubs. As part of a study conducted by the VA Department of Game and Inland Fisheries and VA Tech, small numbers of female black bears or sows were placed into captivity before hibernation. The sows were pregnant and gave birth to their cubs during the winter hibernation. The purpose of the study was to obtain growth data on cubs in order to be able to assess the health of cubs in the wild population. Similar data is being collected on sows and their cubs in the wild for comparison.

The cubs are born at about 224 grams or about the size of a guinea pig; they grow rapidly. At one year, cubs will grow from the 224 grams to about 22.50 to 31.50 kg. As part of the research project, every 10 days, the sows were immobilized and the cubs were weighed and other growth data recorded. Afterward, cubs were returned to their mothers who then woke up and continued to care for them. Once spring arrived and food was again plentiful, the sow and her cubs were released back into the wild.

More information on black bears and Virginia's Bear Management Plan can be found at <http://www.dgif.virginia.gov/wildlife/bear/>.

**Problem:** Create a box and whiskers plot and determine the appropriate measure of central tendency. Enter data from the data table. Calculate the average weight of a bear cub at various stages of development.



## Data table

### CUB WEIGHT IN GRAMS

CUB	5 DAYS	45 DAYS	85 DAYS
1	581.7	1939.6	2400
2	520.5	1588.3	2050
3	310.8	988.1	2600
4	387.4	1670.6	2650
5	331.6	1287.8	2700
6	358.7	962.3	1600
7	311.5	1443.5	2400
8	408.7	1108.5	1800
9	369.0	1680.0	2500
10	364.3	1650.0	2450
11	393.9	1135.8	2600
12	364.8	1365.8	3200
13	348.7	1474.9	2700

### Key strokes:

1. Refer to Appendix I. Calculator Set Up
2. Press **STAT** , Select 1:Edit, Press **ENTER**
3. Clear L<sub>1</sub>. Use the arrow keys to place the cursor on L<sub>1</sub>, Press **CLEAR**, **ENTER** to clear the list. Repeat for L<sub>2</sub>, L<sub>3</sub>, and L<sub>4</sub>
4. Enter cub number in L<sub>1</sub>.
5. Enter cub weight at 5 days in L<sub>2</sub>.
6. Enter cub weight at 45 days in L<sub>3</sub>
7. Enter cub weight at 85 days in L<sub>4</sub>
8. Press **2<sup>nd</sup> STAT PLOT**. Select Plot 1, Select **ON** and **Box and Whisker Plot with outliers**.
9. Make selections using arrow keys to match *figure 1*

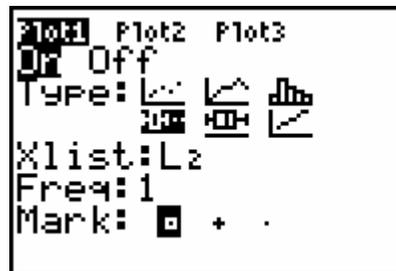


Figure 1

10. Press ZOOM, 9 to create a box and whisker plot with outliers. Press TRACE and use the arrow keys to determine:

Min: \_\_\_\_\_ 3<sup>rd</sup> Quartile: \_\_\_\_\_  
 1<sup>st</sup> Quartile: \_\_\_\_\_ Outliers: \_\_\_\_\_  
 Med: \_\_\_\_\_ Max: \_\_\_\_\_

11. Press 2<sup>nd</sup> STAT PLOT , select 2:Plot 2, turn plot on, make selections using arrow keys to match figure 2

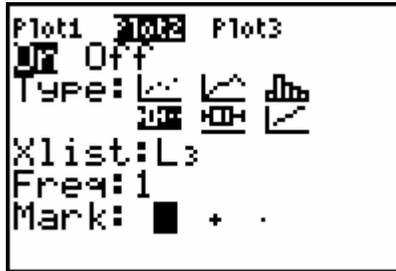


Figure 2

12. Press 2<sup>nd</sup> STAT PLOT , select 3:Plot 3, turn plot on, make selections using arrow keys to match figure 3

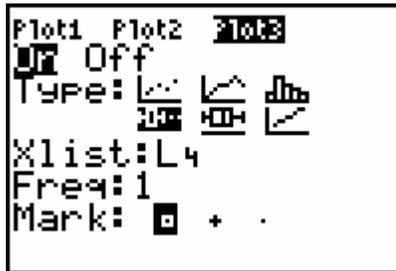


Figure 3

13. Press ZOOM 9 to graph

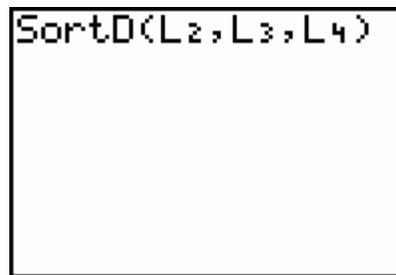
14. Press TRACE and use the arrow keys to show the quartile and median values for each box and whisker plot.

	5 Days	45 Days	85 Days
Min:	_____	_____	_____
Q 1:	_____	_____	_____
Med:	_____	_____	_____
Q 3:	_____	_____	_____
Max:	_____	_____	_____

15. Sketch your plots below. Remember a graph needs a Title and Axes Labels.



16. To determine the modes for Lists 2, 3, and 4. Press **STAT**, Select 3:Sort D and add L<sub>2</sub>, L<sub>3</sub>, L<sub>4</sub>. See *Figure 4* below.



*Figure 4*

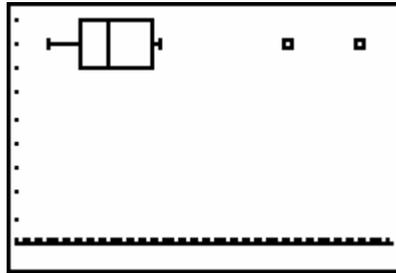
- 17. Press **STAT** select 1:Edit, press **ENTER**
- 18. Review Lists 2,3, and 4 data to identify the modes
- 19. List the modes for each time span:
  - 5 days \_\_\_\_\_
  - 45 days \_\_\_\_\_
  - 85 days \_\_\_\_\_

**Analysis questions:**

- 1. Using the weight data, which measure of central tendency best describes the normal weight of cubs for each age?
- 2. In which quartile do the majority of the weights fall for 5 days, 45 days, and 85 days?
- 3. Are there any outliers, and if so, what are they?
- 4. Is there an age where the bear weight values differ more than the others?

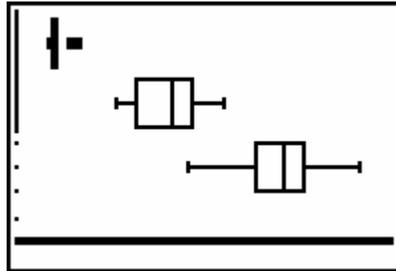
## Teacher Notes – A Weighty Issue:

1. The first 5 days bear cub growth will create a box and whisker plot with outliers. See *figure 1*.



*Figure 1*

2. The second two graphs, 45 days and 85 days do not have outliers. If all three graphs are displayed on the same screen they will show statistical bear cub growth. See *figure 2*.



*Figure 2*

3. You can explore further statistics by pressing **STAT**, arrow right to **CALC** and selecting 1: 1-Var Stats. Then add the list you wish to be analyzed. See *figure 3* and *figure 4*.

```
1-Var Stats L1
```

*Figure 3*

```
1-Var Stats
x̄=7
Σx=91
Σx²=819
Sx=3.894440482
σx=3.741657387
↓n=13
```

*Figure 4*

## Can You Bear the Weight?



### Overview:

Students will graph the weight of male and female bear cubs and determine which grows faster.

### SOL Connections:

Math 7.5, 7.18, 8.12, and 8.14

Science 6.1, LS.1, LS.8

### Background:

Black bears are found in all but a few eastern counties of Virginia, but the densest populations are in the western mountainous part of the state and in the south east corner, mainly the Great Dismal Swamp and surrounding areas. The population of bears is growing and spreading to practically all counties of the Commonwealth. The total number of bears in Virginia may be about 7,000 animals. Bears are nearly always solitary animals, with the exception of family groups (sow with cubs). The male and female have little or no contact other than during mating. Females spend a lot of effort feeding and fattening up before going into hibernation in order to produce healthy cubs. As part of a study conducted by the VA Department of Game and Inland Fisheries and VA Tech, small numbers of female black bears or sows were placed into captivity before hibernation. The sows were pregnant and gave birth to their cubs during the winter hibernation. The purpose of the study was to obtain growth data on cubs in order to be able to assess the health of cubs in the wild population. Similar data is being collected on sows and their cubs in the wild for comparison.

The cubs are born at about 224 grams or about the size of a guinea pig; they grow rapidly. At one year, cubs will grow from the 224 grams to about 22.50 to 31.50 kg. As part of the research project, every 10 days, the sows were immobilized and the cubs were weighed and other growth data recorded. Afterward, cubs were returned to their mothers who then woke up and continued to care for them. Once spring arrived and food was again plentiful, the sow and her cubs were released back into the wild.

More information on black bears and Virginia's Bear Management Plan can be found at <http://www.dgif.virginia.gov/wildlife/bear/>.

**Question:** Which cub will grow faster, the male or female bear cubs?



Data tables:

**WEIGHT DATA FOR 10 MALE CUBS IN GRAMS**

DAYS	CUB1	CUB2	CUB3	CUB4	CUB5	CUB6	AVG
5	311.5	348.7	369	364.3	393.9	364.8	358.7
15	419.9	610.2	605.5	617.7	571.9	625.	575.0
25	668.7	910.1	933.5	904.9	771.7	889.7	846.4
35	987.3	1181.1	1258.1	1165.7	941.4	1149.1	1113.8
45	1443.5	1474.9	1680	1650	1135.8	1365.8	1458.3
55	1583	1775.1	1850	1700	1321	1596.2	1637.6
65	2000	2100	2100	2000	1593.1	1971.2	1960.7
75	2400	2700	2500	2450	1600	2100	2291.7
85					2600	3200	2900
DAY	CUB 7	CUB 8	CUB 9	CUB 10	AVG		
7	599.0	508.1	390.0	435.9	483.3		
17	1037.2	917.9	705.0	672.9	833.3		
27	1508.4	1377.1	1020.0	926.0	1207.9		
37	1999.2	1791.8	1200.0	1116.3	1526.8		
47	2343.	2200	1410.0	1350.9	1826		
57	2800	2600	1680.0	1542.2	2155.6		
67	3000	2750	1750.0	1850.0	2337.5		
77	3000	2800	1800.0	2300.0	2475		

**WEIGHT DATA FOR 10 FEMALE CUBS**

DAYS	CUB 1	CUB 2	CUB 3	CUB 4	CUB 5	AVG
1	366	480	287	402.2	349.2	367.9
11	686	797	450	632.5	580	629.1
21	1095	1297	637	915.8	863.4	961.6
31	1490	1942	1299	1216	1107.6	1410.9
41	1879	2146	1005	1499	1402.2	1586.2
51	2200	2550	900	1716.1	1648.9	1803
61	2700	3000	1005	2100	2050	2171
71	3550	3850		2500	2400	3075
DAYS	CUB 6	CUB 7	CUB 8	CUB 9	CUB 10	AVG
9	634	545.9	511.7	412.4	470.7	514.9
19	1120	1098.5	1076.6	752.3	826.8	974.8
29	1590	1412.3	1373.6	1101.8	1108.3	1317.2
39	2042	1513.5	1373.9	1464.1	1437.4	1566.2
49	2300	1829.5	1812.6	1774.9	1754.6	1894.3
59	2650	2128.7	2384	2040.8	2022.9	2245.3
69	2900	2400	3400	2300	2250.	2650
79	3000	3250	4250	2560		3265

**Keystrokes:**

1. Refer to Appendix I. Calculator Set Up
2. Press **STAT**, 1, **ENTER**
3. Clear L<sub>1</sub>. Use the arrow keys to place the cursor on L<sub>1</sub>. Press **CLEAR**, **ENTER** to clear the list.  
Repeat for L<sub>2</sub>, L<sub>3</sub>
4. Enter male time periods (days) in L<sub>1</sub>.
5. Enter male average weights in L<sub>2</sub>.
6. Enter female time periods (days) in L<sub>3</sub> and female average weights in L<sub>4</sub>. See sample data in *figure 1*.

L1	L2	L3	3
5	358.7	9	
7	483.3	9	
15	575	11	
17	833.3	19	
25	846.4	21	
27	1207.9	29	
35	1113.8	31	

L3(1)=1

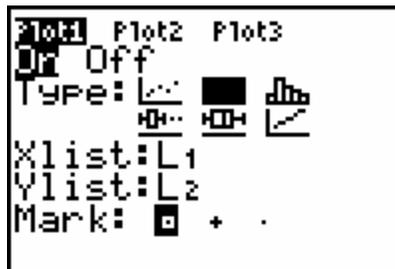
*Figure 1*

7. To be sure that your data is sorted chronologically, press **STAT**, select 2: Sort A (Press L<sub>1</sub>, L<sub>2</sub>)  
*figure 2*
8. Repeat for L<sub>3</sub> and L<sub>4</sub>



*Figure 2*

9. Press 2<sup>nd</sup>, **STAT PLOT**, **ENTER** to choose a line graph)
10. Make selections using arrow keys to match *figure 3*



*Figure 3*

11. Press 2<sup>nd</sup>, STAT PLOT, select 2:Plot 2, turn plot on, make selections using arrow keys to match figure 4

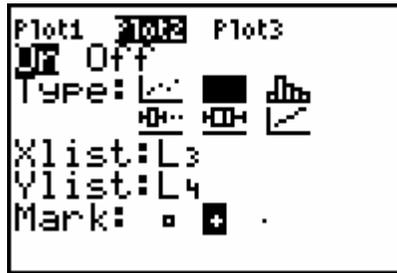


Figure 4

12. Press ZOOM, select 9  
13. GRAPH See sample graph in figure 5.

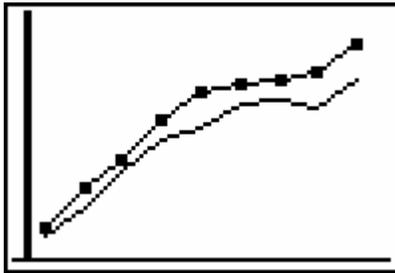
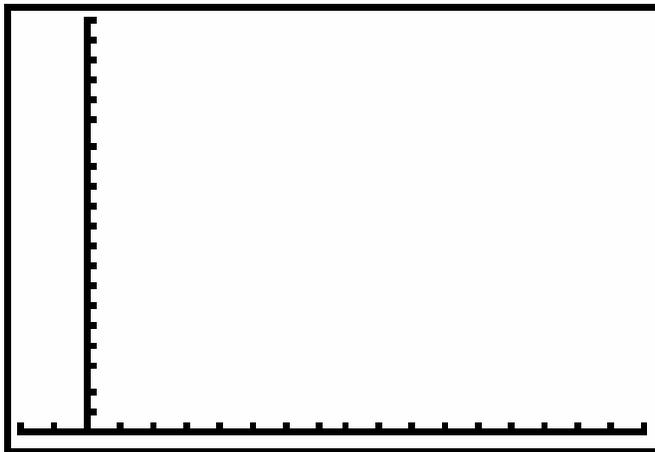


Figure 5

Draw your graph here. Remember to title the graph. Each axis should be labeled.



### Analysis questions:

1. Is there a difference in growth between male and female cubs?
2. Do they grow at the same rate throughout the 85 days? Are there times when the growth slows down? Do they grow faster at the beginning of their life or later? (Hint: look at the slope.)

### Extension:

1. Follow the directions below to create a scatter plot with a line of best fit to look at growth trends of the male and female cubs. Then write a short paragraph to explain the slopes of the male and female cub growth.
  - Press **2<sup>nd</sup> STAT PLOT** and change PLOT 1 and PLOT 2 to scatter plots (the first icon) see *figure 1 and 2* below.

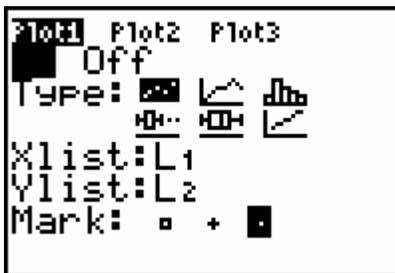


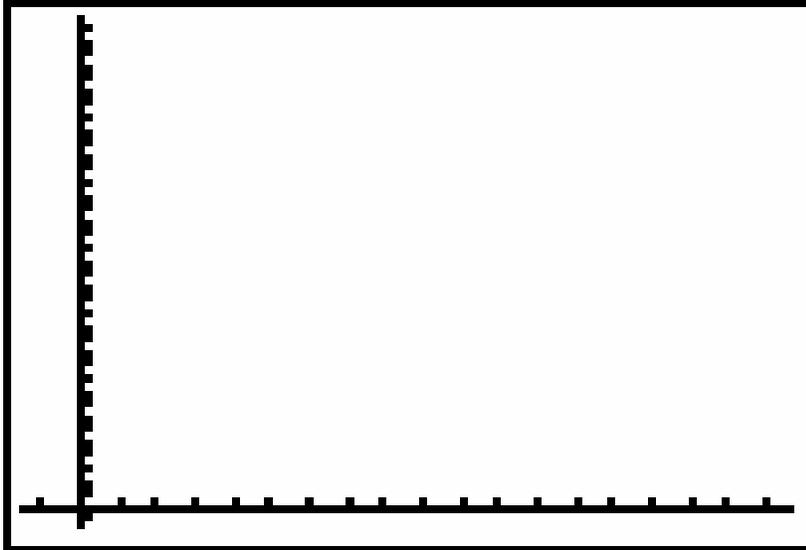
Figure 1



Figure 2

- Press **STAT**, arrow to **CALC** and select 4:LinReg (ax+b)
- Press **2<sup>nd</sup> L1 comma 2<sup>nd</sup> L2 comma VARS**, arrow to **Y-VARS**, select 1:Function, select 1:Y<sub>1</sub>
- Press **ENTER** to complete the line of best fit for the male cub growth.
- Press **STAT**, arrow to **CALC** and select 4:LinReg (ax+b)
- Press **2<sup>nd</sup> L3 comma 2<sup>nd</sup> L4 comma VARS**, arrow to **Y-VARS**, select 1:Function, select 1:Y<sub>2</sub>
- Press **ENTER** to complete the line of best fit for the female cub growth.
- Press **ZOOM** Select 9 to create the graph

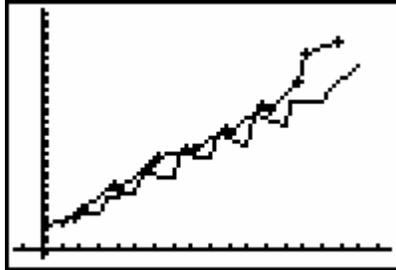
2. Draw your graph below and write your paragraph explaining the graph.



Explanation of graph:

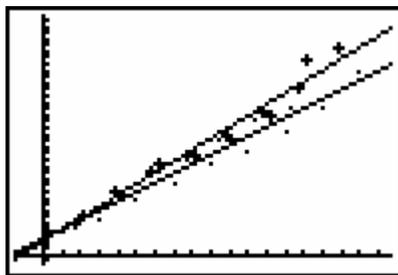
## Teacher Notes – Can You Bear the Weight?

1. The student graph will look like *figure 1* below. Notice that the female growth is faster in the final days.



*Figure 1*

2. Since this is authentic data, the mother bears could not all be sedated in order to remove the cubs on the same day, so the data is from alternating days. There were more bears involved in the study. The ten bears selected for the activity are a representation of the total data.
3. Students could also graph the averages as a scatter plot and then use the linear regression calculation to create a line of best fit. The slope of the line represents the growth rate and the y intercept represents the first weight measurement. If you are examining the equation, press the **Y=** key to see the calculator generated equations. It may be a good idea to have the students set the calculator to 1 decimal place to avoid large insignificant numbers in the equation. To do this press **MODE** and use the arrow keys to select **1** on the **FLOAT** line by pressing **ENTER** before they do the calculations.
4. Line of best fit and scatter plot for cub data *figure 2* below



*Figure 2*

# Deer Population Growth

## Overview:

This activity measures potential growth of a deer population uses data from a hypothetical deer herd as well as data from Virginia's early deer restocking efforts.

## SOL Connections:

Math 7.16, 7.18

Science LS.1, LS.8, LS.11, LS.12

## Background:

Deer had disappeared from western Virginia at the turn of the 20<sup>th</sup> century. Unregulated hunting and the loss of habitat had eliminated a large portion of the herd. The Department of Game and Inland Fisheries began restoration of the deer herd in 1931 by capturing deer in other states and releasing them in Virginia, until 1950. Restocking began again in the late 1960s and early 1970s with deer from established herds within Virginia.

In the southwestern county of Russell there were no resident deer before the department started restocking and transplanting deer. Russell County received a total of 96 deer from 1933 - 1969. The deer season opened in Russell in 1952 with a short "bucks only" (male deer) season. The number of deer taken in Russell County since 1947 can be found at:

[http://www.dgif.virginia.gov/hunting/va\\_game\\_wildlife/deer\\_harvest.asp?temporalFilter=1994&disp=null](http://www.dgif.virginia.gov/hunting/va_game_wildlife/deer_harvest.asp?temporalFilter=1994&disp=null)

Without any controls on the population, a deer herd will quickly fill the available habitat. Once the total number of deer has passed carrying capacity of the habitat, they begin to destroy their habitat. The activity below makes several assumptions: 1) The habitat quality and quantity remain constant, i.e. there has been no further human development in the area since stocking. 2) No deer are hit by vehicles, killed by stray dogs, or die from disease. 3) Hunting is the only possible source of mortality in the herd. These factors that affect the population are called *limiting factors* and normally exert some control over any population. The Department of Game and Inland Fisheries manages the size of Virginia's deer herd by allowing citizens to hunt deer and limit the number each hunter may take.

**Problem:** How does the deer population in Russell County change overtime? Will hunting affect the population?



Data Table:

Deer stocked in Russell County

Year stocked	Number stocked
1933	2
1937	12
1968	46
1969	36

One pair of adult deer, living in a good habitat, can produce two fawns per year. Fawns are born 50-50 males and females (bucks and does). Fawns mature at two years of age.

Sample Deer Population Growth Data Table:

Year	Adult M	Adult F	Fawn M	Fawn F	Yr M	Yr F	Total	Harvest of Adult M
0	1.0	1					2.0	
1	1.0	1	1	1			4.0	0.1
2	0.9	1	1	1	1	1	5.9	0.1
3	1.8	2	1	1	1	1	7.8	0.2
4	2.6	3	2	2	1	1	11.6	0.3
5	3.4	4	3	3	2	2	17.4	0.3
6	5.0	6	4	4	3	3	25.0	0.5
7	7.5	9	6	6	4	4	36.5	0.8
8	10.8	13	9	9	6	6	53.8	1.1
9	15.7	19	13	13	9	9	78.7	1.6
10	23.1	28	19	19	13	13	115.1	2.3
11	33.8	41	28	28	19	19	168.8	3.4
12	49.4	60	41	41	28	28	247.4	4.9
13	72.5	88	60	60	41	41	362.5	7.2
14	106.2	129	88	88	60	60	531.2	10.6
15	155.6	189	129	129	88	88	778.6	15.6
16	228.1	277	189	189	129	129	1141.1	22.8
17	334.2	406	277	277	189	189	1672.2	33.4
18	489.8	595	406	406	277	277	2450.8	49.0
19	717.8	872	595	595	406	406	3591.8	71.8
20	1052.1	1278	872	872	595	595	5264.1	105.2
21	1541.9	1873	1278	1278	872	872	7714.9	154.2
22	2259.7	2745	1873	1873	1278	1278	11306.7	226.0
23	3311.7	4023	2745	2745	1873	1873	16570.7	331.2
24	4853.5	5896	4023	4023	2745	2745	24285.5	485.4
25	7113.2	8641	5896	5896	4023	4023	35592.2	711.3

## Keystrokes

Use the following keystrokes to create a sample graph of deer population growth.

1. Refer to Appendix I. Calculator Set Up
2. Enter data into graphing calculator. Press **STAT**, **ENTER** and clear L<sub>1</sub> and L<sub>2</sub> by placing the cursor on L<sub>1</sub> and pressing **CLEAR** and **ENTER** Repeat for L<sub>2</sub> and L<sub>3</sub>. Enter **Year Number** data into L<sub>1</sub> and **Total Population** into L<sub>2</sub>, and **Harvest** into L<sub>3</sub>.
3. To create a scatter plot of the deer population, Press **2nd**, **Y=**. Choose 1: Plot 1 and On. Use the arrow keys to highlight the choices on *figure1*

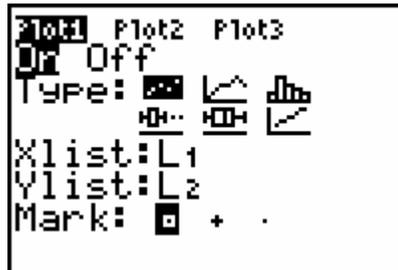
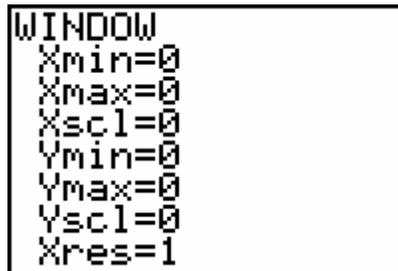
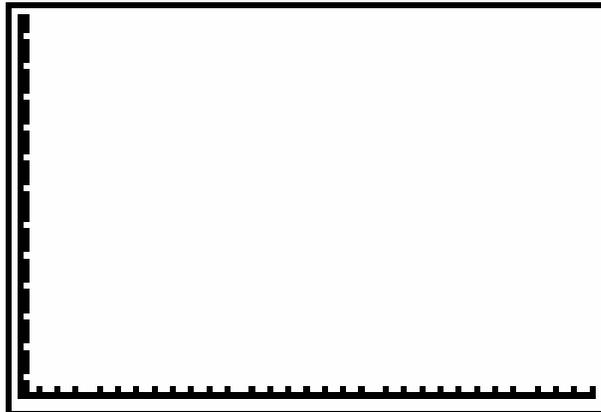


Figure 1

4. Look at your year data to determine:  
X min \_\_\_\_\_, X max \_\_\_\_\_, X scale \_\_\_\_\_  
Y min \_\_\_\_\_, Y max \_\_\_\_\_, Y scale \_\_\_\_\_
5. Press **WINDOW** and replace the 0's with your correct values.



6. Press **GRAPH** and use **TRACE** to draw your plot below. Remember a graph needs a Title, and Axes Labels.



7. The curve of the data suggests that this is an exponential relationship. To create a line of best fit: Press **STAT**, arrow right to **(CALC)**, select **0: ExpReg**.
8. Press **2<sup>nd</sup> 1**, **2<sup>nd</sup> 2**, **VARS** arrow right to **Y-VARS**, select 1: Function, select 1:Y<sub>1</sub>. Your home screen should look like *figure2*.



*Figure 2*

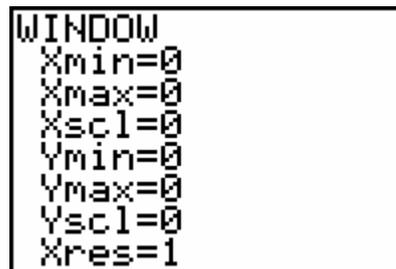
9. Press **ENTER** to complete calculations
10. Press **GRAPH** to view the graph with the line of best fit. Add the line of best fit to your plot above.
11. Press **Y=** to view the equation for the line of best fit.
12. To create a scatter plot of the harvest. Press **2<sup>nd</sup>, Y=**. Choose 2: Plot 2and On. Use the arrow keys to highlight the choices on *figure3*



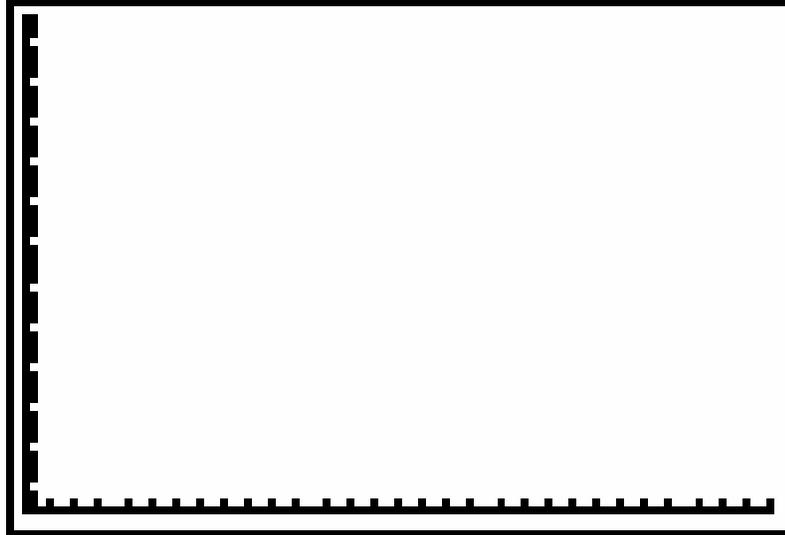
*Figure 3*

13. Look at your year data to determine:  
X min \_\_\_\_\_, X max \_\_\_\_\_, X scale \_\_\_\_\_  
Y min \_\_\_\_\_, Y max \_\_\_\_\_, Y scale \_\_\_\_\_

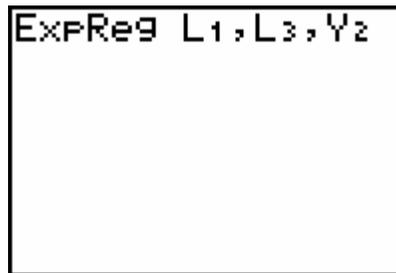
14. Press **WINDOW** and replace the 0's with your correct values.



15. Press **GRAPH** and use **TRACE** to draw your plot below. Remember a graph needs a Title, and Axes Labels.



16. The curve of the data suggests that this is an exponential relationship. To create a line of best fit: Press **STAT**, arrow right to **(CALC)**, select **0:ExpReg**.
17. Press **2<sup>nd</sup> 1**, **2<sup>nd</sup> 3**, **VAR** arrow right to **Y-VARS**, select 1:Function, select 2:Y<sub>2</sub>. Your home screen should look like *figure 4*.

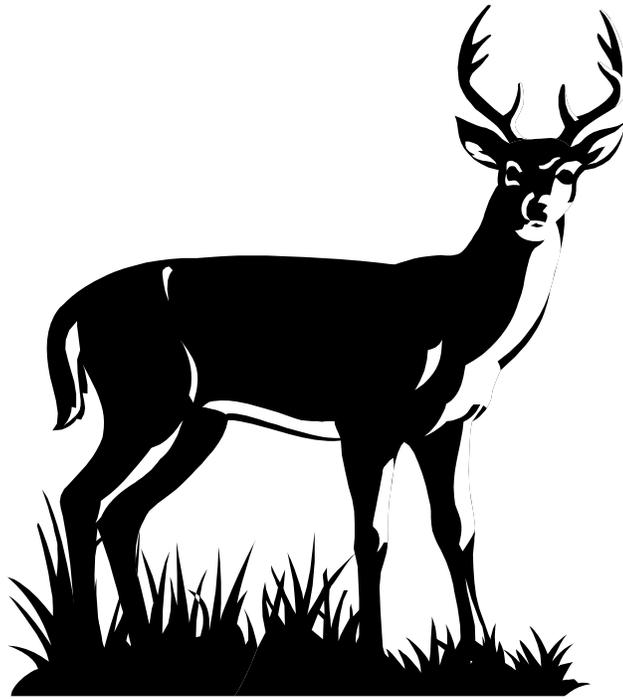


*Figure 4*

18. Press **ENTER** to complete calculations
19. Press **GRAPH** to view the graph with the line of best fit. Add the line of best fit to your plot above.
20. Press **Y=** to view the equation for the line of best fit.
21. Press **2<sup>nd</sup> TABLE** to view a table of the data. Use the arrow keys or press **GRAPH** and **TRACE** and use the arrow keys to determine the answers to the following questions.

## Analysis Questions

1. How many deer would be in this herd at the end of five years? \_\_\_\_\_ Ten years? \_\_\_\_\_
2. What would be the herd size in 25 years? \_\_\_\_\_ In 30 years? \_\_\_\_\_
3. If hunters harvest 10 percent of the mature bucks each year, how many will they harvest the third year? \_\_\_\_\_ The fifth year? \_\_\_\_\_ The tenth year? \_\_\_\_\_
4. Why are your figures not really "true-to-life"?
5. In the real world, what limiting factors can affect the size of a deer herd?





## *Flying High with Fledglings*



### **Overview:**

Students will create a graph of the number of nests and fledglings of bald eagles in Virginia and make inferences on the reasons behind the growth curve.

### **SOL Objectives:**

Math 7.18, 8.3, 8.12, 8.14

Science 6.1, 6.9, LS.1, LS.7, LS.11, LS.12

### **Background:**

The bald eagle became our national symbol in 1782. As our national symbol, it holds a special place in the hearts of our citizens. Even though the bald eagle has been protected from direct harm by people since the Bald Eagle Protection Act of 1940, its habitat was not protected. By the 1960's the eagle population began to seriously decline until 1967, when it was placed on the U.S. Endangered Species List. The eagle was removed from the list on June 28, 2007. The decline was the result of DDT poisoning, a pesticide that caused the shells of the eggs to be thin and the embryos to develop improperly. The use of DDT in the United States was banned in 1972.

The Endangered Species Act provided protection of any eagle's nest site and surrounding habitat. In 1977, the Virginia Department of Game and Inland Fisheries, (DGIF) began tracking the number of nests and the number of young fledged. Eagles lay 1 to 3 eggs each year during their reproductive life. Since eagles begin nesting in late winter, biologists are able to fly over the nests and count the number of young before the leaves appear on the trees. Later in the year, boat trips counted the number of juvenile and adult birds along Virginia's tidal rivers. The data table on page 24, shows the number of nests and the number of young fledged.

The table that follows shows a recovering population of eagles. The population will begin to level off once the carrying capacity is reached. **Carrying capacity** is the number of individuals that a given ecosystem can support during the year. Several limiting factors determine the number of eagles an area can support, including the availability of large trees capable of supporting nests, the distance to a river or other source of food, and the frequency of disturbance by outside factors such as boats or people walking near the nest site. Mated pairs tend to be territorial around their nests and will defend their nest site from other birds. They will continue to use the same nest year after year, adding more sticks each winter until the nest may weigh close to 100 pounds.

Eagles will congregate in feeding areas along the rivers and other areas where there is a plentiful food source. The sudden availability of a food source such as a fish kill or other carrion can be detrimental to the population if that food source is contaminated by pesticides or another poison. Eagles are capable of flying long distances during any given day; or an area may host a large number of birds one week and a small number the following week. The ability to travel long distances to a food source may cause a sudden decrease in the population along a river or in a region.

**Problem:**

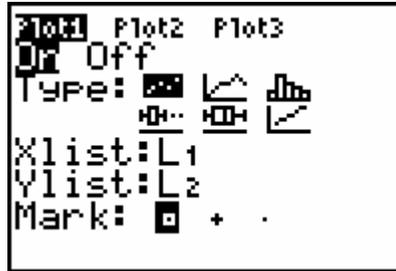
Determine if there is a relationship between the number of eagle fledglings and improved environmental conditions. Did the number of eagles increase with the banning of the pesticide DDT? What other factors may have contributed to the number of eagles nesting in Virginia?

**Data table**  
Eagle Nest's and Fledglings by Year

Date	Year	Active Nests	Young Fledged
1977	1	31	18
1978	2	36	18
1979	3	34	20
1980	4	35	35
1981	5	39	40
1982	6	45	40
1983	7	52	51
1984	8	60	57
1985	9	65	84
1986	10	66	83
1987	11	73	107
1988	12	80	118
1989	13	92	88
1990	14	104	142
1991	15	110	153
1992	16	131	141
1993	17	149	172
1994	18	144	158
1995	19	154	223
1996	20	180	243
1997	21	214	321
1998	22	229	314
1999	23	230	326
2000	24	270	414
2001	25	312	465
2002	26	329	501
2003	27	371	454
2004	28	401	612
2005	29	429	657
2006	30	469	709
2007	31	560	737

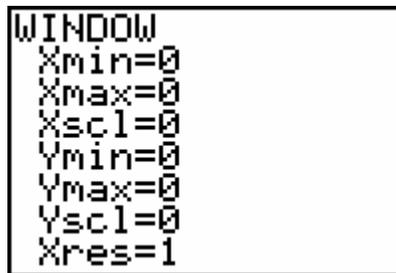
**Key strokes:**

1. Refer to Appendix I. Calculator Set Up
2. Enter data into graphing calculator. Press **STAT**, **ENTER** and clear  $L_1$  and  $L_2$  by placing the cursor on  $L_1$  and pressing **CLEAR** and **ENTER** Repeat for  $L_2$ . Enter **Year Number** data into  $L_1$  and **Number Fledged** into  $L_2$ .
3. Create a scatter plot. Press **2nd**, **Y=**. Choose 1: Plot 1 and On. Use the arrow keys to highlight the choices on *figure 1*

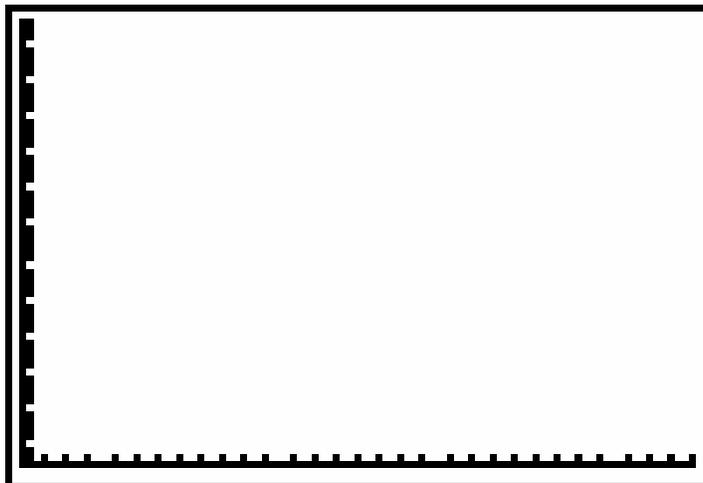


*Figure 1*

4. Look at your year data to determine:
  - i. X min \_\_\_\_\_, X max \_\_\_\_\_, X scale \_\_\_\_\_
  - ii. Y min \_\_\_\_\_, Y max \_\_\_\_\_, Y scale \_\_\_\_\_
5. Press **WINDOW** and replace the 0's with your correct values.



6. Press **GRAPH** and use **TRACE** to draw your plot below. Remember a graph needs a Title, and Axes Labels.



7. The curve of the data suggests that this is an exponential relationship. To create a line of best fit: Press **STAT**, arrow right to (**CALC**), select **0:ExpReg**.
8. Press **2<sup>nd</sup> 1**, comma, **2<sup>nd</sup> 2**, comma, **VARS** arrow right to **Y-VARS**, select **1:Function**, select **1:Y1**. Your home screen should look like *figure 2*.



*Figure 2*

9. Press **ENTER** to complete calculations
10. Press **GRAPH** to view the graph with the line of best fit. Add the line of best fit to your plot above.
11. Press **Y=** to view the equation for the line of best fit.

### Analysis Questions

1. Looking at the graph, what inferences can you make about the relationship between the number of young and environmental conditions?
2. What are factors that would affect the population? (Hint: The goal of banning DDT and protection of nest sites and surrounding habitat was to increase the population, was this successful?)
3. Will the population continue to increase indefinitely? Why or why not?

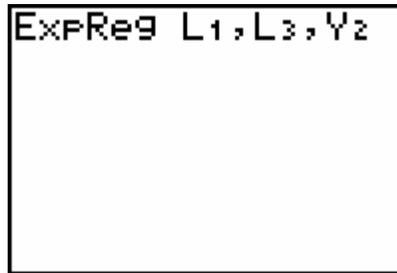
### Extensions

1. Use the following directions to determine if in addition to increasing the number of surviving fledglings each year, there has been an increase in the number of nests.
  - Enter the nest data in **L<sub>3</sub>** by pressing **STAT**, **ENTER** clearing **L<sub>3</sub>** and typing in the number of nests for each year.
  - Use **2<sup>nd</sup>, STAT PLOT**, select **2: Plot 2** and create the screen in *figure1* below.



*Figure 1*

- To create a line of best fit, press **STAT**, arrow right to **CALC** and select **0:Exp.Reg.**
- On the home screen add **2<sup>nd</sup> L1, comma, 2<sup>nd</sup> L3, comma, VARS**, arrow right to **Y-VARS**, select **1: Function**, then **2:Y2**. See *figure 2* below.



*Figure 2*

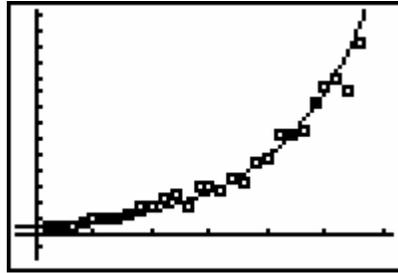
- Press **ENTER** to complete calculations. Set the window with the correct values. Press **GRAPH** to view the graph with the line of best fit.
- Draw your graph below. Remember a graph needs a title and labeled axes.



2. Why is it important to analyze the increase of nests in addition to the increase of fledglings?

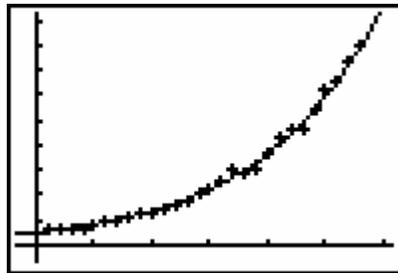
## Teacher Notes – Flying High with Fledglings:

1. The number of fledglings that survive and the number of nests will level off when the population reaches the carrying capacity of the environment. The limiting factors might be available food, nesting sites, number of surviving adults, predation, etc. The population is still expanding exponentially because it has not yet reached carrying capacity.
2. The exponential graph for year and fledglings is below. (*Figure 1*)



*Figure 1*

3. The exponential graph for the year and nests is below. (*Figure 2*)



*Figure 2*

4. If you want to look at the equations for the line of best fit press **Y=** to view them. If you want more manageable numbers, press **MODE** and select 1 or 2 decimal places before doing the line of best fit calculations.
5. If you want to practice sequencing with the students, this can be done in the year list. Use the arrow keys to place the cursor on  $L_1$  and press **2<sup>nd</sup> LIST**, arrow right to **OPS**, select 5:seq( On the list screen add to seq(X,X,1,28,1). The sequence format is: *seq(expression, variable, begin, end, increment)*
6. **IMPORTANT.** The students must use year number not year because the years are beyond the graphing limits of the calculator screen.

## Hey Mister, How Much is That Fish?



### Overview:

Students will use math to determine the cost of raising and releasing one brook trout into a Virginia stream.

### SOL Connections:

Math: 7.18, 8.14,

Science: 6.1, 6.7, LS.1, LS.4, LS.12

### Background:

Many streams in Virginia's mountains can no longer produce breeding populations of native brook trout. The riparian buffers or stream edges were destroyed by timber practices, farming or construction before regulations protecting these fragile ecosystems were put into place. Without trees to shade the stream trout could not survive. The trees prevent silt from entering streams and provide leaf litter for insects to live in. Trout require optimal water temperatures of 50-68 degrees F and a minimum dissolved oxygen content of 6.0 parts per million (ppm). There must also be plenty of aquatic insects available for food. Each year the Department of Game and Inland Fisheries raises or houses trout at six fish cultural stations or fish hatcheries in the western portion of the state.

Fish are grown to catchable size in the hatchery and then placed on trucks to be transported to streams with suitable environmental conditions. A list of where the trout are being stocked on any given week can be found on the web site <http://www.dgif.state.va.us/fishing/stocking/>

In order to fish for trout, anglers must purchase an additional trout stamp or license for \$17.00. This additional charge pays for Virginia's "put and take" trout fishery. The effort to improve stream banks and riparian buffers along Virginia's streams is a constant challenge. With improved water conditions, brook trout, along with the introduced rainbow and brown trout species, will be able to reproduce naturally.

### Problem:

Determine the cost of producing one trout for restocking and graphically represent the breakdown of operational costs for a trout hatchery.

### Data Table:

Coursey Springs Hatchery Data 2004

Data Type	Amount
Total Operating Cost	\$319,835.00
% salaries	65
% wages	1
% feed	23
% utilities	5
% vehicles	5
% maintenance	1
Number of Trout released	348,013
Pounds of Trout released	176,752

## Key Strokes

1. Refer to Appendix I. Calculator Set Up
2. Press the **APPS** key. Select **CellSheet**. Press **ENTER, ENTER**.
3. Press the **Menu** function key to get a new cell sheet. Select **1:File**. Select **3:New**. Type **TROUT**. Press **ENTER, ENTER** to get a blank cell sheet titled Trout. *Figure 1*

TROUT	A	B	C
1			
2			
3			
4			
5			
6			
A1:	[Menu]		

*Figure 1*

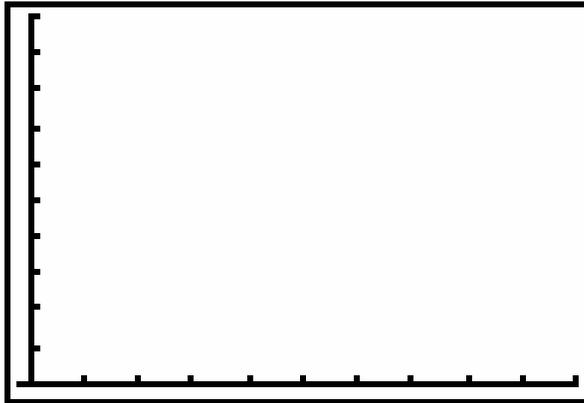
4. Enter data into the cell sheet.
5. Enter categories in column **A** pressing **ALPHA** to use the alphabetic keys (salary, wages, feed, utilities, vehicle, maintenance)
6. Note: You can only choose 8 characters and categories must be in quotes. i.e. "salary"
7. Convert the Hatchery expense percentages to decimals equivalents and enter into column **B**.
8. In cell **C1** enter the equation to determine the amount of dollars spent on each hatchery category. With the cursor in **C1** press **STO ->** (for the = sign), ( Press **ALPHA B1 x Total Operating Cost**). Press **ENTER** to complete the calculation and place the product in **C1**.
9. To copy and paste the equation in cells **C2 – C5**; place the cursor in **C1** press the **F3** function key to copy; place the cursor in **C2** press the **F4** key to paste. Repeat the paste for **C3, C4, C5**.
10. In cell **D1** enter the equation to determine the amount of spent on each released trout. With the cursor in **D1** press **STO ->** (for the = sign), ( **ALPHA C1/Total number of trout released**). Press **ENTER** to complete the calculation and place the product in **D1**.
11. To copy and paste the equation in cells **D2 – D5**; place the cursor in **D1** press the **F3** function key to copy; place the cursor in **C2** press the **F4** key to paste. Repeat the paste for **D3, D4, D5**.
12. In column **E** round the numbers in column **D** to the nearest hundredth to represent dollars and cents.
13. To create a circle graph, press **menu**, select **4:Charts**, select **7. Pie**. Use the alpha and number keys to enter Categories, Series, and Title. Select **Number**; use arrow key to place cursor on **Draw**. See *figure 2* below

```

PIE CHART
Categories:A1:A5
Series:E1:E5
Number Percent
Title:TROUT
Draw
    
```

*Figure 2*

14. Press ENTER and sketch your graph below.



### Analysis Questions

What is the cost to release one hatchery produced trout?

In some streams anglers are allowed to keep only four fish and they must be 12 inches in length. A citizen pays \$17.00 annually for a general Fishing License and another \$17.00 to fish for trout in stocked trout streams.

Assuming that an angler catches his/her limit of fish, how many days must be fished before the angler breaks even?

### Extensions

1. Use the "pounds of trout released" data to create the circle graph of hatchery expenses for one pound of trout.
2. Use the data table for the Montebello Hatchery to create a cell sheet and circle graph for hatchery expenses for one fish and one pound of fish.

### Data Table

Montebello Hatchery Data 2004

Data Type	Amount
Total Operating Cost	\$145,998.00
% salaries	48
% wages	8
% feed	8
% utilities	4
% vehicles	18
% maintenance	14
Number of Trout released	141,921
Pounds of Trout released	61,119

## Teacher Notes – Hey Mister, How Much Is That Fish?

1. See Appendix II for more information on Celsheet Apps
2. Spread sheet screens and graph screens for the **Coursey Springs Hatchery** are below

TROUT	A	B	C
1	SALARY	.65	207893
2	WAGES"	.01	3198.4
3	FEED"	.23	73562
4	UTILIT	.05	15992
5	VEHICL	.05	15992
6	MAINTN	.01	3198.4
C6: =B6*319835.00			Menu

TROUT	C	D	E
1	207893	.59737	.6
2	3198.4	.00919	.01
3	73562	.21138	.21
4	15992	.04595	.05
5	15992	.04595	.05
6	3198.4	.00919	.01
E6: .01			Menu

Figure 1

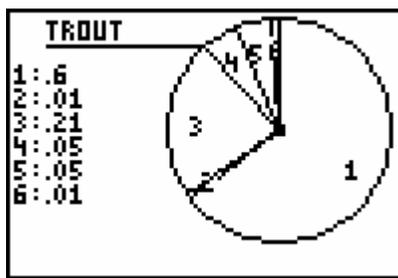


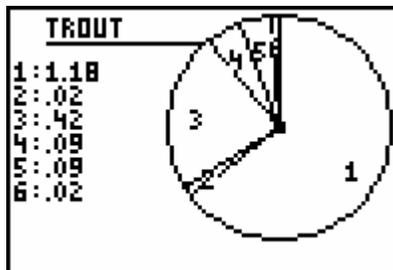
Figure 2

3. The cost to raise one fish at the **Coursey Springs Hatchery** is \$0.39
4. Cell sheet Apps is a free application that can be downloaded from the TI website [www.education.ti.com](http://www.education.ti.com)
5. The activity can also be completed using a standard spreadsheet application.

### Extensions:

1. The pounds of fish cost for **Coursey Springs Hatchery** spreadsheet continuation and graph. The cost per pound is \$1.82

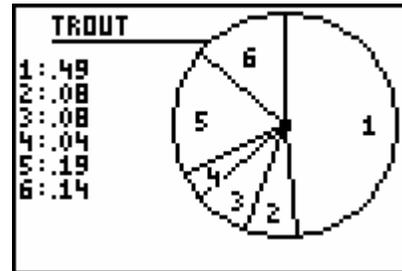
TROUT	E	F	G
1	.6	1.1762	1.18
2	.01	.0181	.02
3	.21	.41619	.42
4	.05	.09048	.09
5	.05	.09048	.09
6	.01	.0181	.02
G6: .02			Menu



2. Montebello Hatchery spreadsheet and graph. The cost per fish, \$1.02

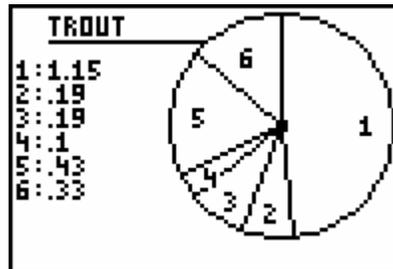
TROUT	A	B	C
1	SALARY	.48	70079
2	WAGES"	.08	11680
3	FEED"	.08	11680
4	UTILIT	.04	5839.9
5	VEHICL	.18	26280
6	MAINTE	.14	20440

TROUT	C	D	E
1	70079	.49379	.49
2	11680	.0823	.08
3	11680	.0823	.08
4	5839.9	.04115	.04
5	26280	.18517	.19
6	20440	.14402	.14



Montebello Hatchery spread sheet and graph. The cost per pound of fish \$2.39

TROUT	F	G	H
1	1.1466	1.15	
2	.1911	.19	
3	.1911	.19	
4	.09555	.1	
5	.42997	.43	
6	.33442	.33	



## How Far is Home?



**Overview:** Tundra swans migrate long distances to their summer and wintering grounds. Students determine how far a swan can travel in one season.

**SOL Connections:**

Math: 7.8, 8.12

Science: 6.1, LS.1, LS.11

**Background:**

The tundra swan is the largest species of waterfowl that travels to Virginia for the winter months. The population of tundra swans dropped to dangerously low levels in the early 1900s, the species has successfully recovered throughout most of their range.

During the winters of 2001 and 2002, the Virginia Department of Game and Inland Fisheries, along with our neighboring states, placed satellite transmitters on tundra swans in order to determine the birds migration route. The transmitters should last for 1.5 to 2 years, although some swans have already lost their transmitters along the way or were not successful in completing the migration. It is critical to know where migratory species such as tundra swans migrate to so that both of their habitats, summer and winter, can best be managed to protect the health of the population.

The tundra swans that winter along the east coast in the Chesapeake Bay region nest in tundra habitats across northern Canada and Alaska. The swans travel a long distance between these two locations. Sometimes the swans take a break along the way, either on the trip north while they wait for the spring thaw, or on the way south when they are with their young and need to stop and rest. Waterfowl, such as geese, ducks and swans have historical staging areas where large numbers of birds gather before making the next portion of the trip. These areas usually have abundant food and water supplies that can sustain a large flock. Swans feed on grasses, aquatic vegetation and small grains such as corn, wheat, and soybeans. The U.S. Fish and Wildlife Service, the state wildlife agencies across the United States have established numerous Wildlife Refuges in some of these important staging areas.

You can see the migration paths, nesting locations and diaries of three tundra swans that were captured and tagged in Virginia on the Department of Game and Inland Fisheries web site at <http://www.dgif.virginia.gov/wildlife/swan/index.html> . There are maps of other swans from previous years in the archived section.

A data table for three of the swans during one migration cycle follows.

**Problem:**

Determine how far and how long it takes for three swans to migrate, then graph and compare their migration journeys.

Data Table:

Swan ID Number	Start Date Record	End Date Record	Total Days	Distance Traveled	Total distance Traveled (mi.)
33888	4/22/03	4/30/03		388.72 mi. N	338.72
33888	5/01/03	5/05/03		496.39 mi. N	885.11
33888	5/06/03	5/13/03		0 mi. - resting	885.11
33888	5/14/03	5/18/03		583 mi. N	1468.10
33888	5/19/03	9/19/03		0 mi. - nesting	1468.10
33888	9/20/03	9/27/03		1379.17 mi. S	2847.30
33888	9/28/03	11/01/03		0 mi. - resting	2847.30
33888	11/02/03	11/05/03		617.81 mi. S	3465.10
<b>Total days in each direction</b> →	27 North 47 South		<b>Total distance each direction</b> →	1468.11 miles North 1996.98 miles South	
33894	3/29/03	4/02/03		621.69 mi. N	621.69
33894	4/03/03	4/27/03		0 mi. - resting	621.69
33894	4/28/03	5/05/03		376.72 mi. N	998.41
33894	5/06/03	5/26/03		0 mi. - resting	998.41
33894	5/27/03	5/30/03		529.33 mi. N	1527.70
33894	5/31/03	9/22/03		0 mi. - nesting	1527.70
33894	9/23/03	9/30/03		1252.78 mi. S	2780.60
33894	10/01/03	12/09/03		0 mi. - resting	2780.60
33894	12/10/03	12/13/03		662.23 mi. S	3442.80
<b>Total days in each direction</b> →			<b>Total distance each direction</b> →		
33893	4/04/03	4/12/03		731.66 mi. N	731.66
33893	4/13/03	4/25/03		0 mi. - resting	731.66
33893	4/26/03	5/03/03		328.69 mi. N	1060.40
33893	5/04/03	5/20/03		0 mi. - resting	1060.40
33893	5/21/03	6/01/03		1115.04 mi. N	2175.40
33893	6/02/03	9/17/03		0 mi. -nesting	2175.40
33893	9/18/03	9/26/03		1224.28 mi. S	3399.70
33893	9/27/03	12/09/03		0 mi. resting	3399.70
33893	12/10/03	12/21/03		903.55 mi. S	4303.30
<b>Total days in each direction</b> →			<b>Total distance each direction</b> →		

**Keystrokes:**

Complete the total days column and the total miles column in the data table.

To graphically represent the migration journeys of the three swans from the data table complete the following:

1. Refer to Appendix I. Calculator Set Up
2. Press **STAT**, Select 1:Edit
3. Clear L<sub>1</sub>. Use the arrow keys to place the cursor on L<sub>1</sub>. Press **CLEAR**, **ENTER** to clear the list. Repeat for L<sub>2</sub>, L<sub>3</sub>, L<sub>4</sub>, L<sub>5</sub>, L<sub>6</sub>.
4. Enter Total Days for swan 33888 in L<sub>1</sub>.
5. Enter Total Distance Traveled for swan 33888 in L<sub>2</sub>.
6. Enter Total Days for swan 33894 in L<sub>3</sub>.
7. Enter Total Distance Traveled for swan 33894 in L<sub>4</sub>.
8. Enter Total Days for swan 33893 in L<sub>5</sub>.
9. Enter Total Distance Traveled for swan 33893 in L<sub>5</sub>
10. Press **2<sup>nd</sup> STAT PLOT** Select 1:Plot 1(to choose a line graph)
11. Make selections using arrow keys to match *figure 1*



Figure 1

12. Press **2<sup>nd</sup> STAT PLOT**, select 2:Plot 2, turn plot on, make selections using arrow keys to match *figure 2*.

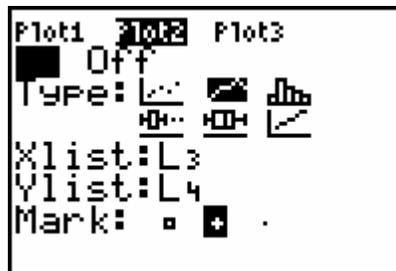


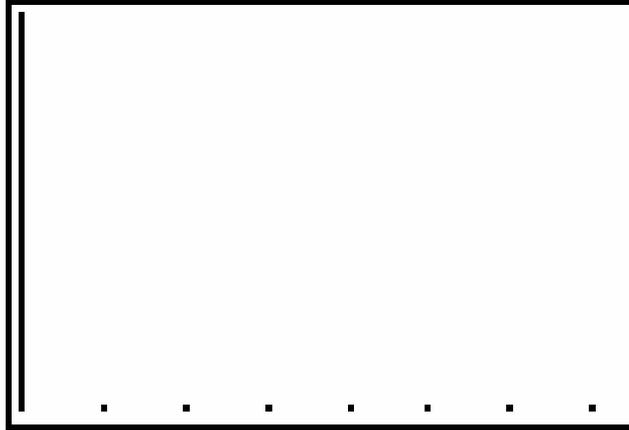
Figure 2

13. Press **2<sup>nd</sup> STAT PLOT**, select 3:Plot 3, turn plot on, make selections using arrow keys to match *figure 3*.



Figure 3

14. Press **ZOOM**, select 9 to create a graph
15. Press **TRACE** and use the arrow keys to sketch your plot below. Remember a graph needs a title and labeled axes.



#### Analysis Questions:

Looking at the table and graph, calculate the answers to the following questions.

1. Which bird flew the greatest distance to their nesting grounds?
2. Which bird made it back to Virginia the quickest in the fall?
3. By looking at the distance traveled where would you expect each one to nest?
4. What was the average distance traveled during the flight North, during the flight South?
5. What is the average distance traveled per day, assuming the birds do not stop to rest?
6. When looking at the actual paths each swan took, one swan decided to head East before continuing south. Which swan took a "side trip"? Where did this swan go before heading South to Virginia?
7. How does the distance of each swan's migration journey differ?

See web page to check answers <http://www.dgif.virginia.gov/wildlife/swan/index.html>

## Teacher Notes – How Far Is Home: Data Table:

Swan ID Number	Start Date Record	End Date Record	Total Days	Distance Traveled	Total distance Traveled (mi.)
33888	4/22/03	4/30/03	9	388.72 mi. N	338.72
33888	5/01/03	5/05/03	14	496.39 mi. N	885.11
33888	5/06/03	5/13/03	22	0 mi. - resting	885.11
33888	5/14/03	5/18/03	27	583 mi. N	1468.10
33888	5/19/03	9/19/03	151	0 mi. - nesting	1468.10
33888	9/20/03	9/27/03	159	1379.17 mi. S	2847.30
33888	9/28/03	11/01/03	194	0 mi. - resting	2847.30
33888	11/02/03	11/05/03	198	617.81 mi. S	3465.10
<b>Total days in each direction</b> →	27 North 47 South		<b>Total distance each direction</b> →	1468.11 miles North 1996.98 miles South	
33894	3/29/03	4/02/03	5	621.69 mi. N	621.69
33894	4/03/03	4/27/03	30	0 mi. - resting	621.69
33894	4/28/03	5/05/03	38	376.72 mi. N	998.41
33894	5/06/03	5/26/03	59	0 mi. - resting	998.41
33894	5/27/03	5/30/03	63	529.33 mi. N	1527.70
33894	5/31/03	9/22/03	178	0 mi. - nesting	1527.70
33894	9/23/03	9/30/03	186	1252.78 mi. S	2780.60
33894	10/01/03	12/09/03	256	0 mi. - resting	2780.60
33894	12/10/03	12/13/03	260	662.23 mi. S	3442.80
<b>Total days in each direction</b> →	63 North 82 South		<b>Total distance each direction</b> →	1527.70 miles North 1915.01 miles South	
33893	4/04/03	4/12/03	9	731.66 mi. N	731.66
33893	4/13/03	4/25/03	22	0 mi. - resting	731.66
33893	4/26/03	5/03/03	30	328.69 mi. N	1060.40
33893	5/04/03	5/20/03	47	0 mi. - resting	1060.40
33893	5/21/03	6/01/03	59	1115.04 mi. N	2175.40
33893	6/02/03	9/17/03	167	0 mi. - nesting	2175.40
33893	9/18/03	9/26/03	176	1224.28 mi. S	3399.70
33893	9/27/03	12/09/03	250	0 mi. resting	3399.70
33893	12/10/03	12/21/03	262	903.55 mi. S	4303.30
<b>Total days in each direction</b> →	59 North 95 South		<b>Total distance each direction</b> →	2175.40 miles North 2127.83 miles South	

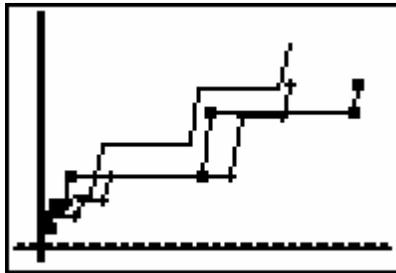
- ❖ Swan 33893 flew farthest to its nesting ground. Tundra swans nest in Canada and Alaska.
- ❖ Swan 33888 flew back to Virginia the fastest
- ❖ For the three swans on the data table, the average distance flown North is 1724 miles; the average distance flown South is 2013 miles.
- ❖ Swan 33888 headed East before heading South on the return migration trip

Maps are available on line at [www.dgif.virginia.gov](http://www.dgif.virginia.gov)

Average Distance Flown per Day

Swan	North (mi./day)	South (mi./day)	Total Trip (mi./day)
33888	54	45	50
33894	75	24	50
33893	37	25	31

1. The line graph of the 3 swan migrations below



## Let's Talk Deer

**Overview:** The quality of habitat has an affect on the overall size and health of individual deer. Students graph antler size and infer the relationship between antler growth and habitat quality of two Virginia counties.

**SOL Objectives:**

Math 7.18, 8.12

Science 6.9, LS.1, LS.9, LS.10, LS.11, LS.12

**Background:**

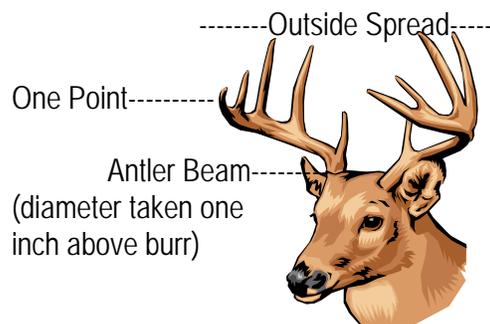
Deer had disappeared from western Virginia at the turn of the 20<sup>th</sup> century. Unregulated hunting and the loss of habitat had eliminated a large portion of the herd. The Department of Game and Inland Fisheries began restoration of the deer herd in 1931 by capturing deer in other states and releasing them in Virginia until 1950. Restocking began again in the late 1960s and early 1970s with deer from established herds within Virginia.

Without any controls on the population, a deer herd will quickly fill the available habitat. Habitat is more than just the piece of land that the deer occupy. Although there must be ample food, water and shelter in the habitat, the quality of those key components will determine the actual number and health of the animals in the area. The habitat quality in Frederick County is better than the habitat in Caroline County. Frederick County has richer soils that are limestone based and will grow better vegetation that deer need. Frederick County also has more farms which means the availability of more crops and orchards, a favorite food source for deer. In contrast the soil in Caroline County is an acidic mix of sand and clay. Such soils do not support optimal deer habitat. Factors like habitat quality which can affect a population are called *limiting factors* and normally exert some control over herd numbers and growth vigor.

Each year, several measurements are recorded from the deer hunted in each county and the numbers are analyzed by the Virginia Department of Game and Inland Fisheries. The antler beam diameter, number of points, and outside spread are measured. We can use the size of the antler beam to infer the size of the deer.

**Problem:**

How does antler growth compare between two different deer herds in Caroline County and Frederick Count? Which county "grows" healthier deer?



**Data table**

Yearling (1.5 yrs) Antler Data for Caroline and Frederick Counties in 2000

Harvest Date	No Points	Beam Diameter in mm	Outside Spread in inches	County Name
17-Nov-00	2	10	6.00	Caroline
24-Nov-00	4	20	16.25	Caroline
17-Nov-00	4	19	7.25	Caroline
22-Nov-00	2	14	4.25	Caroline
20-Nov-00	5	14	8.00	Caroline
10-Nov-00	3	20	6.00	Caroline
06-Nov-00	2	14	7.00	Caroline
17-Nov-00	2	10	6.00	Caroline
20-Nov-00	5	14	8.00	Caroline
20-Nov-00	4	16	6.00	Caroline
20-Nov-00	2	13	9.25	Caroline
22-Nov-00	2	14	4.25	Caroline
20-Nov-00	3	16	9.25	Caroline
24-Nov-00	3	17	9.00	Caroline
24-Nov-00	2	15	6.50	Caroline
24-Nov-00	2	19	9.00	Caroline
24-Nov-00	2	12	15.00	Caroline
11-Nov-00	3	8	9.25	Caroline
22-Nov-00	4	19	9.00	Caroline
24-Nov-00	5	15	6.00	Caroline
25-Nov-00	3	10	8.00	Caroline
25-Nov-00	2	13	6.00	Caroline
06-Nov-00	2	14	6.75	Caroline
17-Nov-00	2	18	6.88	Caroline
20-Nov-00	3	16	8.50	Caroline
15-Nov-00	3	16	15.50	Frederick
20-Nov-00	2	16	7.13	Frederick
20-Nov-00	5	20	10.50	Frederick
25-Nov-00	4	17	20.00	Frederick
25-Nov-00	2	14	5.25	Frederick
17-Nov-00	3	16	6.50	Frederick
13-Nov-00	4	16	7.00	Frederick
20-Nov-00	2	10	6.00	Frederick
16-Nov-00	2	14	7.00	Frederick
14-Nov-00	8	17	9.00	Frederick
25-Nov-00	2	12	7.50	Frederick
20-Nov-00	5	16	7.13	Frederick
20-Nov-00	4	15	9.38	Frederick
20-Nov-00	2	13	4.00	Frederick
20-Nov-00	4	16	9.38	Frederick
20-Nov-00	6	26	11.38	Frederick

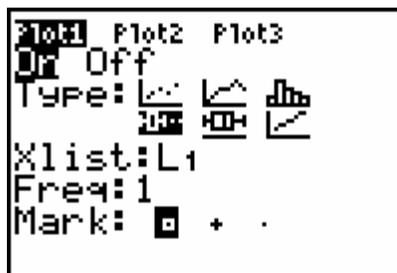
Harvest Date	No Points	Beam Diameter in mm	Outside Spread	County Name
20-Nov-00	4	19	6.50	Frederick
25-Nov-00	7	20	10.63	Frederick
24-Nov-00	2	10	3.50	Frederick
15-Nov-00	7	29	14.25	Frederick
25-Nov-00	7	26	11.50	Frederick
25-Nov-00	6	25	10.38	Frederick
20-Nov-00	4	16	4.00	Frederick
20-Nov-00	4	15	4.00	Frederick

**Question:**

Does habitat affect the size of antlers in deer yearlings?

**Key strokes**

1. Refer to Appendix I. Calculator Set Up
2. Press **STAT** , Select 1:Edit, Press **ENTER**
3. Clear L<sub>1</sub>. Use the arrow keys to place the cursor on L<sub>1</sub>, Press **CLEAR**, **ENTER** to clear the list. Repeat for L<sub>2</sub>.
4. Enter Deer Beam Diameter for Caroline County in L<sub>1</sub>.
5. Enter Deer Beam Diameter for Frederick County in L<sub>2</sub>.
6. Press **2<sup>nd</sup> STAT PLOT**. Select Plot 1, Select ON and Box and Whisker Plot with outliers.
7. Make selections using arrow keys to match *figure 1*



*Figure 1*

8. Press **ZOOM**, 9 to create a box and whisker plot with outliers. Press **TRACE** and use the arrow keys to determine:

Min: \_\_\_\_\_ 3<sup>rd</sup> Quartile: \_\_\_\_\_  
 1<sup>st</sup> Quartile: \_\_\_\_\_ Outliers: \_\_\_\_\_  
 Med: \_\_\_\_\_ Max: \_\_\_\_\_

9. Press **2<sup>nd</sup> STAT PLOT** , select 2:Plot 2, turn plot on, make selections using arrow keys to match *figure 2*

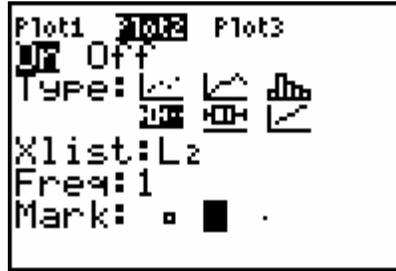


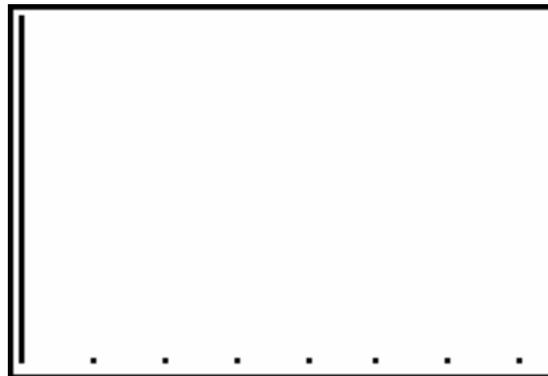
Figure 2

10. Press **ZOOM 9** to graph
11. Press **TRACE** and use the arrow keys to show the quartile and median values for each box and whisker plot.

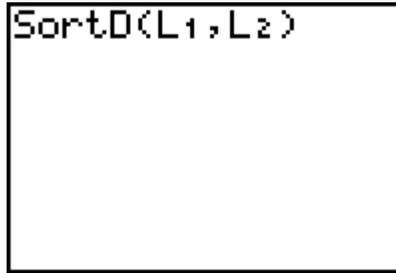
Caroline County  
 Min: \_\_\_\_\_  
 Q 1: \_\_\_\_\_  
 Med: \_\_\_\_\_  
 Q 3: \_\_\_\_\_  
 Max: \_\_\_\_\_

Frederick County  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

12. Sketch your plot below. Remember a graph needs a Title and Axes Labels.



13. To determine the modes for Lists 1 and 2. Press **STAT**, Select 3: Sort D and add L<sub>1</sub>, L<sub>2</sub>,. See *Figure 4* below.



*Figure 4*

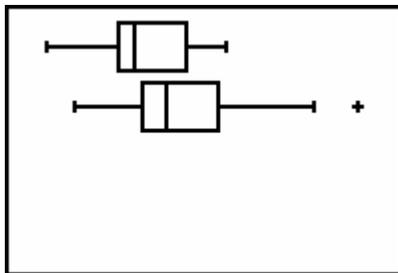
14. Press **STAT** select 1:Edit, press **ENTER**  
15. Review Lists 1 and 2 to identify the modes  
16. List the modes for each time span:  
17. Caroline County Deer Beam Diameter \_\_\_\_\_  
18. Frederick County Deer Beam Diameter \_\_\_\_\_

**Analysis questions:**

1. Using the beam diameter data, which measure of central tendency best describes the average size deer for each county?
2. In which quartile do the majority of the deer fall for each county?
3. Are there any outliers, and if so, what are they?
4. Are the deer in one county statistically larger than the deer in the other county? What might explain this?

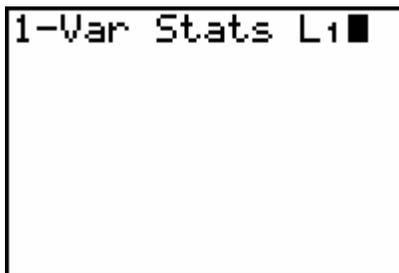
## Teacher Notes – Lets Talk Deer:

1. The size of deer as inferred from its antler beam diameter is statistically larger in Frederick County than in Caroline County. See *figure 1*.

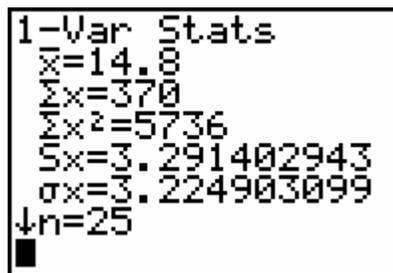


*Figure 1*

2. The deer population in Frederick County has one Outlier. The mode for Caroline County is 14 mm and the mode for Frederick County is 16 mm.
3. You can explore further statistics by pressing **STAT**, arrow right to **CALC** and selecting 1: 1-Var Stats. Then add the list you wish to be analyzed. See *figure 3* and *figure 4*.



*Figure 3*



*Figure 4*

# Let's Talk Turkey



## Overview:

All wildlife species, including turkey, are dependent upon their habitat. The biotic (living) and abiotic (non-living) factors in the ecosystem have an influence on the survival of young and adult turkeys. In years when oak trees do not produce abundant acorns, fall or winter survival may be limited to those birds that can find enough additional food sources to replace the calories obtained from acorns.

## SOL Connections:

Math 7.18, 8.12

Science: LS.1, LS.7, LS.9, LS.11

## Background:

Wild turkeys were abundant in colonial times and were a major source of food for early Virginians. Loss of habitat in the early 1900's caused a large decline in Virginia's turkey population. Turkeys can now be found throughout the state after an extensive recovery plan that began in the early 20<sup>th</sup> century. The population of wild turkeys in Virginia numbers around 180,000 birds.

The Department of Game and Inland Fisheries continuously monitors the ratio of adult to juvenile turkeys and male to female turkeys in order to maintain a stable population. To assist biologists in determining this ratio, fall turkey hunters turn in a breast and wing feather from each bird harvested. This provides the biologists with a random sample of the overall population.

Turkeys feed on a variety of plants and insects during the year. During the fall, acorns make up a large part of their diet. Biologists call the fall fruit, nut and berry production "*mast*". Hard mast is made up of hickory nuts, walnuts and acorns. Soft mast is made up of berries on holly, honeysuckle, blueberries and other soft fruits. By surveying the amount of mast available, biologists have an idea of how many young animals will have enough food to get them through the winter. Each year biologists count the number of acorns on each limb of a sample plot of oak trees to determine the relative abundance of mast. Oak trees tend to produce large number of acorns every two to three years. Spring rains, wind and the amount of summer rainfall can also have an effect on the number of acorns available to turkeys.

An important factor that influences the ratio of juveniles to adults is the amount of rain each spring. Turkeys are ground-nesting birds, and heavy rains will flood out their nests, forcing the hens to begin a new clutch or nest of eggs again. Second or even third clutches are usually smaller than the original clutch. Biologists look at this and many other limiting factors to determine the health of wildlife populations. In this activity we will only look at the mast count.

## Problem:

How does the abundance of an acorn crop influence the population of young wild turkeys that survive each year?

Data table

Wild Turkey Age and Sex Composition from Fall Harvest Feather Collections in Virginia.

Year	Year Number	% Juvenile	% Adult Female	% Adult Male	Sample Size Total of all birds
1984	1	60.9	18.6	20.5	4,483
1985	2	61.3	17.2	21.4	5,270
1986	3	64.6	16.4	19.0	5,447
1987	4	63.6	16.1	20.3	6,599
1988	5	61.9	17.3	20.8	4,877
1989	6	66.3	15.8	17.9	6,289
1990	7	52.0	21.9	26.1	6,986
1991	8	63.0	17.4	19.6	4,474
1992	9	51.1	21.0	27.9	4,421
1993	10	65.1	16.8	18.1	4,329
1994	11	60.4	17.2	22.4	5,011
1995	12	58.9	19.0	22.0	3,638
1996	13	54.9	18.7	26.4	3,650
1997	14	45.4	24.3	30.3	3,235
1998	15	43.3	26.0	27.7	1,924
1999	16	56.4	24.3	30.3	1,899
2000	17	55.3	18.7	26.0	1,870
2001	18	48.3	21.6	30.1	2,815
18 yr. avg.		57.5	19.1	23.3	
5 yr avg.		50.3	22.1	27.5	



## Virginia Oak Mast Survey Ratings Mean Number of Acorns per limb



Year Number	Year	Avg. # per limb
1	1984	16.8
2	1985	36.5
3	1986	15.6
4	1987	2.8
5	1988	24.0
6	1989	26.6
7	1990	10.2
8	1991	22.1
9	1992	8.9
10	1993	17.9
11	1994	18.5
12	1995	21.0
13	1996	20.5
14	1997	7.2
15	1998	17.1
16	1999	18.8
17	2000	18.4
18	2001	26.6
	Total	329.5
	# years	18
	Mean	18.3

The acorn count is collected each year by physically counting the number of acorns on selected limbs on selected trees. Biologists use binoculars to see the acorns and calculate the average number in their area. The number above is a state wide average combining the eastern and western count.

### Key strokes

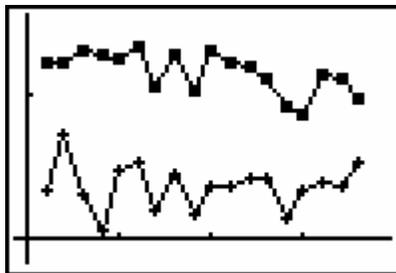
1. Refer to Appendix I. Calculator Set Up
2. Press **STAT**, Select 1:Edit
3. Clear L<sub>1</sub>. Use the arrow keys to place the cursor on L<sub>1</sub>. Press **CLEAR**, **ENTER** to clear the list. Repeat for L<sub>2</sub>, L<sub>3</sub>
4. Enter year number from the first table in L<sub>1</sub>.
5. Enter percent of juveniles in L<sub>2</sub>.
6. Enter state acorn average data from the second table in L<sub>3</sub>
7. Press 2<sup>nd</sup> **STAT PLOT** Select 1:Plot 1(to choose a line graph)





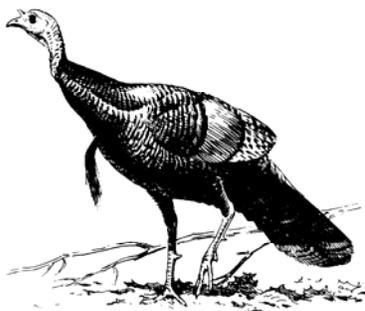
## Teacher Notes – Talk Turkey:

1. There is a correlation between acorn mast and juvenile turkey populations for years 6 through 14. See *figure 1*.



*Figure 1*

2. There is no correlation between acorn mast and the juvenile turkey population for year 3, 15, and 18. This could be due to climate, other food sources or predation.
3. If you want to practice sequencing with the students, this can be done in the year list. Use the arrow keys to place the cursor on L<sub>1</sub> and press 2<sup>nd</sup> LIST, arrow right to OPS, select 5:seq( On the list screen add to seq(X,X,1,18,1). The sequence format is: *seq(expression, variable, begin, end, increment)*





## Turkey Families

### Overview:

Wild turkeys can be aged and sexed by their feathers. Using feather information collected by hunters, students will determine the ratio of adult to juvenile birds harvested.

### SOL Connections:

Math: 7.18, 8.12

Science: 6.1, LS.1, LS.4, LS.7

### Background:

Wild turkeys were abundant in colonial times and were a major source of food for early Virginians. Loss of habitat in the early 1900's caused a large decline in Virginia's turkey population. Turkeys can now be found throughout the state after an extensive recovery plan that began in the early 20<sup>th</sup> century. The population of wild turkeys in Virginia numbers around 180,000 birds.

The Department of Game and Inland Fisheries continuously monitors the ratio of adult to juvenile turkeys and male to female turkeys in order to maintain a stable population. To assist biologists in determining this ratio, fall turkey hunters turn in a breast and wing feather from each bird harvested. This provides the biologists with a random sample of the overall population.

Breast feathers from female turkeys are brown on the tip and the edge is ragged. Male breast feathers have a black tip with a smooth edge. To determine the age of the turkey, biologists look at a primary or wing feather. Pointed primaries without white barring or stripes on the tip come from juvenile birds. Rounded primaries with barring to the end of the feather are adults. A color graphic of the methods used to age turkeys can be viewed at [http://www.dgif.virginia.gov/hunting/va\\_game\\_wildlife/index.html](http://www.dgif.virginia.gov/hunting/va_game_wildlife/index.html).

### Problem:

What is the correlation between the numbers of juveniles and the numbers of adult birds over several years? Does the ratio of adult to juvenile turkeys remain stable over a period of years?

**Data table:** Wild turkey age and sex composition from fall harvest feather collections in Virginia.

Year	Year Number	% Juvenile	% Adult Female	% Adult Male	Total of birds sampled
1984	1	60.9	18.6	20.5	4,483
1988	5	61.9	17.3	20.8	4,877
1992	9	51.1	21.0	27.9	4,421
1997	14	45.4	24.3	30.3	3,235
2001	18	48.3	21.6	30.1	2,815
18 yr. ave.		57.5	19.1	23.3	

## Key Strokes

1. Refer to Appendix I. Calculator Set Up
2. Press the **APPS** key. Select **CellSheet**. Press **ENTER, ENTER**.
3. Press the **Menu** function key to get a new cell sheet. Select **1: File**. Select **3: New**. Type **TURKEY**. Press **ENTER, ENTER** to get a blank cell sheet titled Turkey. See *fig. 1*

TURK	A	B	C
1			
2			
3			
4			
5			
6			

A1: [Menu]

Figure 1

4. Enter data into the cell sheet.
5. Enter categories in Row 1 pressing **ALPHA** to use the alphabetic keys (year, male, female, young)
6. Note: You can only choose 8 characters and categories must be in quotes. i.e. "year" See *figure 2*

TURK	A	B	C
1	"YEAR"	"MALE"	"FEMAL"
2			
3			
4			
5			
6			

A2: [Menu]

Figure 2

7. Enter the years for the turkey data in Column A
8. Enter the percentages of males in Column B
9. Enter the percentages of females in Column C
10. Enter the percentages of young in Column D
11. To create a bar graph, press **menu**, select **4:Charts**, select **5. Bar** Use the alpha and number keys to enter Categories, Series, and Title. Select **Number**; use arrow key to place cursor on **Draw**. See *figures 3 & 4* below

```

BAR CHART
Categories:A2:A7
Series1:B2:B7
Ser1Name:MALE
Series2:C2:C7
Ser2Name:FEMALE
↓
  
```

```

↑
Series3:D2:D7
Ser3Name:YOUNG
Title:TURKEY
Vertical Horiz
DrawFit Draw
  
```

Figures 3 & 4

12. Press **ENTER** and sketch your graph below. (Remember a graph needs a title and labeled axes) Press **TRACE** and use the arrow keys to analyze the graph.



### Analysis Questions

1. How do the numbers of males, females, and young compare within the populations of turkeys graphed?
2. Is there any variation in the population make up of males, females, and young in the turkey populations among the years graphed?

### Extensions

3. Use the percentages and the sample size to determine and graph the number of males, females, and young for the populations of turkeys.

## Teacher Notes – Turkey Families:

1. See Appendix II for more information on Celsheet Apps
2. Spread sheet screens and graph screens for the Turkey Populations are below

TURK	A	E	C
1	YR"	MALE"	FEMAL
2	1984	20.5	18.6
3	1988	20	17.3
4	1992	27.9	21
5	1997	30.6	24.3
6	2001	30.1	24.3
A1: "YR"			[Menu]

TURK	D	E	F
1	YOUNG"		
2	60.9		
3	61.9		
4	51.1		
5	45.4		
6	48.3		
F6:			[Menu]

Figure 1

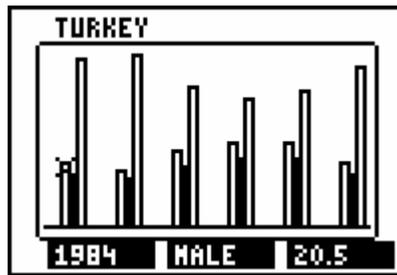
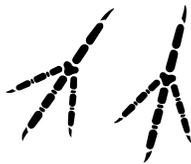


Figure 2

3. Pressing the **TRACE** key and using the arrow keys will indicate that adult males always outnumber the adult females but are close to being equal percentages in the population. The greatest variation is in the young: some years there are more young than adults; some years the percentages of young and adults are about equal; and some years the adults outnumber the young.
4. Celsheet Apps is a free application that can be downloaded from the TI website [www.education.ti.com](http://www.education.ti.com)
5. Activity can also be completed using a standard spreadsheet application.



## Who Just Swam By?



### Overview:

Students will analyze the data collected from observations of fish that swim past the viewing window at the Boshers's Dam Fishway.

### SOL Connections:

Math 7.18, 8.14, A.7, A.8

Science 6.1, 6.7, LS.1, LS.11, LS.12

### Background:

Two hundred years ago the need for hydropower resulted in the construction of dams on the James River. The water running over the dams produced the power needed to run the mills that supported the Richmond economy. The dams also blocked anadromous, or migratory, fish from reaching their historic spawning or breeding grounds upriver. Anadromous fish hatch in freshwater, and then swim out to the ocean where they grow and mature. When it is time to spawn, or reproduce, they return to the rivers and streams where they hatched years before.

Because the construction of dams reduced the number of uninterrupted linear miles between the ocean and the freshwater spawning grounds, the populations of *American Shad* and other species of migratory fish eventually declined. In an effort to recover these species the dams had to be altered. Since most were no longer in use, they were either removed or had small notches cut into them that the fish could swim through. The largest dam in Richmond and the last to be altered on the James River was Boshers's Dam. Because this dam was still in use, it could not be completely removed. Instead, a fishway was placed in the dam. A fishway is a ladder-like system that directs water flow from one side of the dam to the other. To check on the effectiveness of the fish way, an observation window was constructed in order for biologists to watch the fish swim by.

During the migratory season, a video camera records all fish that swim past the viewing window. You can view the fish by visiting [www.dgif.virginia.gov/shadcam/](http://www.dgif.virginia.gov/shadcam/). The "Shad Cam" is live only during those spring months when fish are migrating. Photos of the fishway and additional information about the shad and other migratory species are also available on this site.

American Shad is the target species for recovery since it is a valuable species in the Chesapeake Bay ecosystem. Other species of anadromous fish also use the fish way on their migration routes. In addition, freshwater species also use the fishway on their daily travels, including sunfish, large mouth bass and carp. Occasionally, a river otter will swim through in search of a dinner.

### Problem:

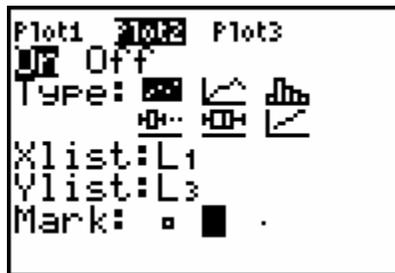
Do any trends exist in numbers of fish swimming up the James River in a four year period?  
In which species do you see a trend in the numbers?



11. Sketch your graph on the axis below using **TRACE** and the arrow keys to find the coordinates of your data points. Remember a graph needs a Title and Axes Labels.



12. Record any trends in the shad data
13. Press **2<sup>nd</sup>**, **Y=**, select 2:Plot 2, turn plot on, make selections using arrow keys to match *figure 3*



*Figure 3*

14. Press **ZOOM**, select **9**
15. Press **2<sup>nd</sup>**, **Y=**, select 3:Plot 3, turn plot on, make selections using arrow keys to match *figure 4*



*Figure 4*

16. Press **ZOOM**, select **9**
17. Record trend if any for each species

**Analysis questions:**

1. Based on the definition of anadromous fish, which species is most likely to be anadromous and why?

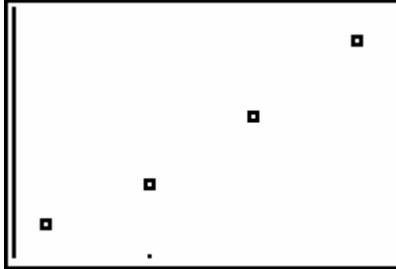
**Extensions:** Graph species from the table below and determine if any trends exist.

MORE BOSHER OBSERVATION WINDOW DATA

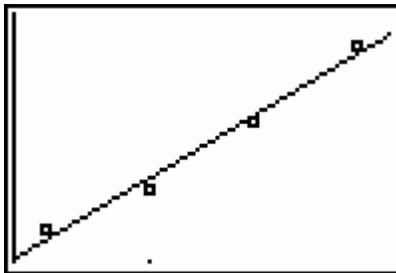
FISH SPECIES	1999	2000	2001	2002
Longnose gar	70	93	241	127
Channel catfish	671	835	1,100	201
Quillback	3,974	6,333	4,848	4,848
Flathead catfish	0	23	73	11

## Teacher Notes – Who Just Swam By?

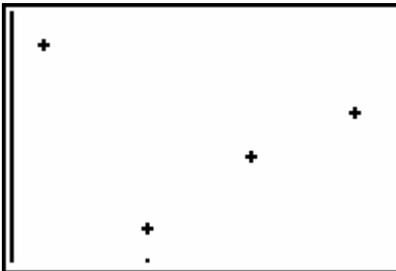
- The scatter plot shows a trend of increase for the *American Shad*, indicating that the population may be increasing. The Department's efforts are successful as the American Shad is recovering.



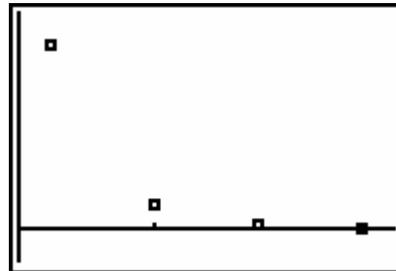
Students can check for the linear regression line by:  
 Press **STAT**, arrow right to **CALC**, select 4:LinReg(ax+b)  
 Press **2<sup>nd</sup> L<sub>1</sub>**, **2<sup>nd</sup> L<sub>2</sub>**, **VARS**, **Y-VARS**, and select 1:Function, 1:Y1  
 Press **ENTER**  
 Press **ZOOM**, select **9** to show the linear trend



- The scatter plots for the Sunfish and Hogsucker do not show any trends

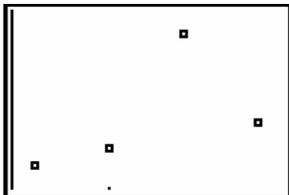


Sunfish

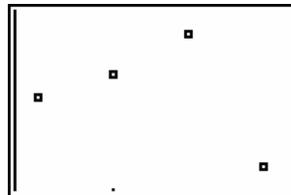


Hogsucker

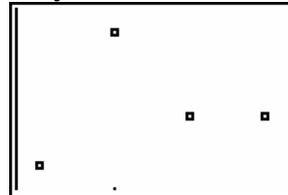
- The fish on the extension also do not show any trends.



Longnose Gar



Channel Catfish



Quillback



Flathead Catfish

## APPENDIX 1

### Calculator Set Up

Before using the calculator to record and analyze data and create a graph of that data, it is recommended these steps be followed. It is wise to complete the following steps.

1. Press **2<sup>nd</sup> QUIT** and **CLEAR** to clear the home screen
2. Press **Y=**. Place the cursor on any equations and press **CLEAR** to remove them.
3. Press **2<sup>nd</sup> STAT PLOT**. Select 4: Plots Off. Press **ENTER** to get the message DONE on the home screen that all plots have been turned off.
4. Press **MODE**. Usually all options to the left should be highlighted. Be sure the mode is set correctly for the activity.
5. Press **2<sup>nd</sup> FORMAT**. Usually all options to the left should be highlighted. Be sure the mode is set correctly for the activity.

## APPENDIX 2

### TI-83 Plus Cell Sheet.Application

#### How To...

Enter data Edit data

Create charts Import and export data

#### Examples

Scatter chart Bar chart

Pie chart Linear regression

-You can download a free copy of the latest operating system software from

[www.education.ti.com/softwareupdates](http://www.education.ti.com/softwareupdates).

Follow the link to Operating Systems.

#### Quick Reference Guide

- **Starting the Application**
  1. Press **APPS**, and then select **CellSheet**. The information screen is displayed.
  2. Press any key to continue. The CellSheet™ help screen is displayed.
  3. Press any key to continue.
- **Quitting the Application**
  1. From the main spreadsheet screen, press **GRAPH (Menu)** or **2<sup>nd</sup> QUIT**.
  2. From the **CELLSHEET MENU**, select **Quit CellSheet**.
- **Deleting the Application from Your Calculator**
  1. Press **2<sup>nd</sup> MEM** to display the **MEMORY** menu.
  2. Select **Mem Mgmt/Del**.
  3. Select **Apps**.
  4. Move the cursor to **CellSheet**.
  5. Press **DEL**. A confirmation message is displayed.
  6. Select **Yes** to delete the application.

#### Completing Tasks

- |  | Task Instructions   |
|--|---|
| • Enter a value in a cell                  | 1. Enter the value, and then press <b>ENTER</b> .   |
| • Enter text or a numeric string in a cell | 1. Press <b>ALPHA</b> then press <b>"</b> .<br>2. Enter the text.<br>3. Press <b>"</b> then press <b>ENTER</b>  |
| • Create a formula                         | 1. Press <b>STO-&gt;</b><br>2. Enter a formula.<br>3. Press <b>ENTER</b> .  |
| • Use a variable in a Spreadsheet          | 1. From the TI_83 Plus home screen, store a value to a variable (for example, 5 <b>STO-&gt; X</b> ).<br>2. Start the CellSheet™ application, and open the spreadsheet file. |

- 3. Move the cursor to a cell and type the variable (such as **X**). Do not surround the variable with quotation marks.
  - 4. Press **ENTER** The variable's value appears in the cell.
- Switch between the spreadsheet and a chart or graph
  - 1. Select **Menu**, select **Charts**, and then select the chart you want to display.
  - 2. To return to the spreadsheet, press **2<sup>nd</sup> QUIT**
- Delete a row or column
  - 1. Move the cursor to the row header or column header to select the row or column.
  - 2. Press **DEL** The columns to the right of the deleted column shift left. The rows below a deleted row shift up.
- Clear data from a cell, cell range, row, or column
  - 1. Select one or more cells, a row, or a column.
  - 2. Press **CLEAR**.
- Cut, copy, and paste
  - To cut or copy a cell:**
    - 1. Move the cursor to the cell.
    - 2. Press **WINDOW** cut the cell.—or—Press **FORMAT** copy the cell.
  - To paste:**
    - 1. Cut or copy one or more cells.
    - 2. Move the cursor to the new cell (or the first cell of a new cell range).
    - 3. Select Paste press **TRACE**

### CellSheet Main Menu

1. To display the CELLSHEET MENU, select **Menu** (press GRAPH).
2. To display a help screen for common tasks, select **Help** from the CELLSHEET MENU.
3. To exit the application, select **Quit CellSheet** from the CELLSHEET MENU.
4. Press **2<sup>nd</sup> QUIT**-Return to the main menu from a submenu  
 -Return to the spreadsheet from the main menu

### File Menu

#### Menu Item Description

- 1: Open Opens an existing spreadsheet file.
- 2: Save As Saves the current spreadsheet with a different name.
- 3: New Creates a new spreadsheet and lets you enter a unique name.
- 4: Delete Deletes a spreadsheet. You cannot delete the currently open spreadsheet.
- 5: Format Lets you set up formatting options such as automatic recalculation, cursor movement, help screen display, and edit line display.
- 6: Recalc Recalculates the spreadsheet (only needed when the auto calculation feature in the Format menu is turned off)

### Edit Menu

#### Menu Item Description

- 1: Go To Cell Moves the cursor to a specific cell.
- 2: Undelete Cell Retrieves the contents of the cell that you just deleted or cleared.
- 3: Clear Sheet Deletes all data from the current spreadsheet.

- 4: Select Range Selects a range of cells.
- 5: Cut Cuts the contents and formulas from the currently selected cell or range of cells and places them on the clipboard.
- 6: Copy Copies the contents and formulas from the currently selected cell or range of cells and places them on the clipboard.
- 7: Paste Pastes the contents and formulas that were just cut or copied to the clipboard into the current cell.

### Options Menu

#### Menu Item Description

- 1: Statistics Calculates 1-variable statistics, 2-variable statistics, or linear regression for the currently selected cell range.
- 2: Fill Range Fills a range of cells with a formula, number, or text.
- 3: Sequence Fills a range of cells with a sequence of numbers.
- 4: Import/Export Imports lists or matrices, or variables; exports lists, matrices, or variables.
- 5: Sort Sorts a range of cells in ascending or descending order.
- 6: Col Decimal Sets the decimal mode display for a column. not affect the CellSheet™ application.

### Charts Menu

#### Menu Item Description

- 1: Scatter Displays a scatter chart for a range of cells.
- 2: Scatter Window Displays the parameters for the viewing window for the scatter chart so that you can change the values.
- 3: Line Displays a line chart for a range of cells.
- 4: Line Window Displays the parameters for the viewing window for the line chart so that you can change the values.
- 5: Bar Displays a bar chart for a range of cells.
- 6: Bar Window Displays the parameters for the viewing window for the bar chart so that you can change the values.
- 7: Pie Displays a pie chart for a range of cells.

### Creating, Saving, and Opening Files

#### Creating a File

To create a new, blank spreadsheet:

1. Select **Menu** (press APPS) to display the CELLSHEET MENU.
2. Select **File 3. New**.
3. Enter a name for the new spreadsheet, and then press ENTER two times. A new, blank spreadsheet is displayed.

**Tip** The spreadsheet name

- can contain numbers and letters, but must begin with a letter
- can contain up to 8 characters
- TICSFILE is a reserved name used by the CellSheet™ application.

#### Saving a File

The spreadsheet is automatically saved in RAM as you work.

You do not have to manually save your work. However, you can save the current spreadsheet with a new file name.

To save a file with a new name:

1. Select **Menu** (press GRAPH).
2. Select **File > Save As**.

3. Enter a name for the new spreadsheet, and then press ENTER two times. The spreadsheet is displayed, and the first four characters of the new name are displayed in the top left cell.

#### Opening a File

1. Select **Menu** (press GRAPH).
2. Select **File**, and then select **Open**. A list of spreadsheet file names is displayed.
3. Move the cursor to the spreadsheet name that you want to open, and then press ENTER.

**Tip** : Only one spreadsheet can be open at a time.

Names of archived spreadsheets do not appear in the list. You must unarchive a spreadsheet before you can open it.

#### Managing Files

##### Copying a File

To copy a spreadsheet file, [save the file with a new name](#).

##### Deleting a File

1. Select **Menu** (press GRAPH).
2. Select **File** > **Delete**.
3. Move the cursor to the spreadsheet file name that you want to delete, and then press ENTER.

**Note** You cannot delete the spreadsheet that is currently open.

4. Select **Yes**. The spreadsheet file is deleted.

##### Renaming a File

To rename a file, [save the file with a new name](#), and then [delete the old spreadsheet](#).

#### Using CellSheet Commands

The CellSheet™ application displays commands at the bottom of the screen at various times to help you complete specific tasks.

To select a command, press the graphing key directly below the command.

#### Entering Spreadsheet Data

1. A numeric value, text string, or formula that is entered into a single cell can contain a maximum of 40 characters.
2. Numeric values are right-justified in the cell; text is left justified.
3. The number of characters that are displayed is limited by the [column decimal format](#) for numeric values, and by the contents of the adjacent cell(s) for text. The edit line displays the entire contents of the cell.
4. The displayed value of the cell is rounded to the number of decimal places specified by the [column decimal format](#). However, the actual value of the cell is used in calculations.
5. Cells that contain text are treated as if they contained the value 0 when they are referenced in math operations, statistics, or charts.
6. Cells that contain text are ignored when they are referenced in cell ranges that are used in formulas.

#### Entering a Formula

A formula is an equation that performs operations on spreadsheet data. Formulas can:

7. Perform mathematical operations, such as addition and multiplication
8. Compare worksheet values
9. Refer to other cells in the same spreadsheet

When you use a formula, the formula and the evaluation of the formula are both saved in the cell.

The following example adds 15 to the value in cell C4 and then divides the result by the sum of the values in cells B4, B5, and B6.

**=(C4+15)/sum(B4:B6)**

To enter a formula, press  $\text{=}$  to place an equal sign on the edit line, and then enter the formula.

### Entering a Function

A function is a predefined formula that performs calculations by using specific values in a particular order. The values are called arguments. The arguments can be numbers, lists, cell names, cell ranges, etc., depending on what the function requires. The arguments are enclosed in parentheses, and a comma separates each argument.

**=sum(A3:A25)** **Note** The ending parenthesis is required!

1. When a function uses a cell name or range as arguments, it must be preceded by an equal sign; otherwise, no equal sign is necessary.
2. When the function is not preceded by an equal sign, only the resulting value of the function is saved in the cell; the entire function and its arguments are not saved.
3. If a function's argument is a list, a cell range is also a valid argument.
4. If a function's argument is a value, a cell name is also a valid argument.

To enter a function:

1. Press STO-> to place the equal sign on the edit line, if necessary.
2. Press GRAPH display a list of commonly used functions, move the cursor to a function, and then press ENTER to select it.

—or—

Select a function from the calculator catalog or other menus, such as Math, List, or Test.

3. Enter the argument(s) for the function, and then press ENTER.

dit).

### Editing Spreadsheet Data

#### • Editing Cell Contents

You can change a cell's contents by entering a new text string, value, or formula in place of the existing one. If you want to edit the existing contents, move the cursor to the cell that you want to edit, and then press ENTER. The cursor moves to the edit line at the bottom of the screen. You can use the arrow keys to move the cursor to the part of the entry that needs to be changed.

### Using the Tools on the Options Menu

#### Analyzing Data

**Note** - When you perform statistics or a linear regression on a range of cells, empty cells in the range are treated as if they contained the value 0.

You can select a range on which to perform statistics before you select the statistics type. The range is automatically entered at the appropriate prompts.

#### Performing 1-Var Statistics

1. Select **Menu**, and then select **Options > Statistics > 1-Var Stats**.
2. Enter the range for the calculation at the Range prompt.
3. Press ENTER two times to perform the calculation.

#### Performing 2-Var Statistics

1. Select **Menu**, and then select **Options > Statistics > 2-Var Stats**.
2. Enter the first range for the calculation at the 1st Range prompt, and then press ENTER.
3. Enter the second range for the calculation at the 2nd Range prompt.
4. Press ENTER two times to perform the calculation.

#### Performing a Linear Regression

1. Select **Menu**, and then select **Options > Statistics > LinReg(ax+b)**.
2. Enter the range for the x-variable at the XRange prompt.

**Tip** Press ENTER to move the cursor to each subsequent prompt.

3. Enter the range for the y-variable at the YRange prompt.
4. If necessary, enter the range for the frequency of the variables at the FrqRange prompt.
5. Enter a y-variable to store the equation at the Sto Eqn To prompt. To do this, press VARS >, select **Function**, select a y-variable from the list displayed.
6. Press ENTER two times to perform the calculation.

### Filling a Range

You can fill a range with text, a number, or with a formula. The range is filled beginning with the top left cell in the range. If you fill a range with a formula, relative cell references or range references are adjusted as the range is filled.

1. Select **Menu**, and then select **Options > Fill Range**.
2. Enter the spreadsheet range that you want to fill (for example A1:A10), and then press ENTER.
3. Enter the text, number, or formula at the Formula prompt. **Note** If you enter a formula, it must begin with an = or +.
4. Press ENTER two times to fill the range.

### Entering a Sequence

1. Select **Menu**, and then select **Options > Sequence**.
2. Enter the beginning cell address at the 1st Cell prompt (for example, D5), and then press ENTER.
3. Enter the arguments for the sequence function at the seq( prompt, and then press  $\square$ . (Example: **seq(x,x,3,10,2)** for the sequence **3, 5, 7, 9**.)
4. Select either **Down** or **Right** (to enter the number sequence down the spreadsheet or across the spreadsheet), by moving the cursor to the option and pressing ENTER.
5. Press ENTER to return to the spreadsheet and enter the sequence.

### Importing and Exporting Data

**Note** When you export data from a range of cells, empty cells in the range are treated as if they contained the value 0.

#### Importing Data from a List

1. Select **Menu**, and then select **Options > Import/Export > Import List**.
2. Enter the list name at the List Name prompt, and then press ENTER.  
**Tip** You can enter the list name, or select it from the LIST NAMES menu (GRAPH).
3. Enter the cell address for the first cell where you want the list imported at the 1st Cell prompt, and then press ENTER.
4. Select **Down** to import the list into a column, and then press ENTER.—or—  
Select **Right** to import the list into a row.
5. Press ENTER two times to import the list.

#### Exporting Data to a List

**Note** Exporting data from a row takes much longer than exporting data from a column.

1. Select **Menu**, and then select **Options > Import/Export > Export List**.
2. Enter the range to export at the Range prompt, and then press ENTER
3. Enter the list name at the List Name prompt. **Tip** You can enter the list name, or select it from the LIST NAMES menu (GRAPH).
4. Press ENTER two times to export the list.

## Working with Charts

### Creating a Scatter Chart

1. Select **Menu**, and then select **Charts > Scatter**.

2. Enter the range for the X-coordinates at the XRange prompt.

**Tip** - You can select a range that you want to chart before you select the chart type. The range is automatically entered at the appropriate prompts.

Press ENTER to move the cursor to the each subsequent prompt.

3. Enter the range for the Y-coordinates at the YRange1 prompt.

4. If necessary, enter YRange2, and YRange3.

5. Enter a title for the chart at the Title prompt.

**Tip** - Alpha-lock mode is on when you move the cursor to this prompt.

Entering a title for the chart is optional.

6. Select either **AxesOn**, or **AxesOff** (to turn the X and Y axes on or off) by moving the cursor to the selection and pressing ENTER.

7. Select either **DrawFit** or **Draw** by moving the cursor to the selection and pressing ENTER. The chart is displayed.

**Note** The DrawFit option changes the window settings so that the chart is displayed on the screen. If you select Draw, the chart might be displayed outside of the viewing window.

8. To see the X and Y coordinates for each point, press TRACE, and then use the arrow keys to move from point to point.

9. Press 2<sup>nd</sup> QUIT two times to exit trace mode and return to the spreadsheet.

**Note** If necessary, you can change the window settings for the chart.

1. From the CHARTS menu, select **Scatter Window**.

2. Change the values as necessary, and then either select **Draw** to display the chart or select

### Creating a Line Chart

1. Select **Menu**, and then select **Charts > Line**.

2. Enter the range for the X-coordinates at the XRange prompt (for example A2:A11), and then press ENTER.

**Tip** - You can select a range that you want to chart before you select the chart type. The range is automatically entered at the appropriate prompts.

Press ENTER to move the cursor to each subsequent prompt.

3. Enter the range for the Y-coordinates at the YRange1 prompt (for example B2:B11).

4. If necessary, enter YRange2, and YRange3.

5. Enter a title for the chart at the **Title** prompt.

**Tip** Alpha-lock mode is on when you move the cursor to this prompt.

6. Select either **AxesOn**, or **AxesOff** (to turn the X and Y axes on or off) by moving the cursor to the selection and pressing ENTER.

7. Select either **DrawFit** or **Draw** (to select the window settings for the drawing) by moving the cursor to the selection and pressing ENTER. The chart is displayed.

**Tip** The Draw Fit option changes the window settings so that the chart is displayed on the screen. If you select Draw, the chart might be displayed outside of the viewing window.

8. Press TRACE and use the arrow keys to view the data elements.

9. Press 2<sup>nd</sup> QUIT twice to return to the spreadsheet.

**Note** If necessary, you can change the window settings for the chart.

1. From the CHARTS menu, select **Scatter Window**.

2. Change the values as necessary, and then either select **Draw** to display the chart or select **Save** to save the window settings and return to the spreadsheet.

### Creating a Bar Chart

1. Select **Menu**, and then select **Charts > Bar**.
2. Enter the range for the category labels at the Categories prompt, and then press ENTER.
3. Enter the range for the first category at the Series1 prompt, and then press ENTER.  
**Tip** - You can select a range that you want to chart before you select the chart type. The range is automatically entered at the appropriate prompts.  
Press ENTER to move the cursor to each subsequent prompt.
4. Enter a name for the first category at the Ser1Name prompt.  
**Tip** - Alpha-lock mode is on when you move the cursor to this prompt.
5. Enter the range for the second category at the Series2 prompt.
6. Enter a name for the second category at the Ser2Name prompt.
7. If necessary, enter the range for the third category at the Series3 prompt.
8. If necessary, enter a name for the third category at the Ser3Name prompt.
9. Enter a title for the chart at the Title prompt.  
**Tip**- Alpha-lock mode is on when you move the cursor to this prompt.
10. Select either **Vertical**, or **Horiz** (to display the chart either vertically or horizontally) by moving the cursor to the selection and pressing ENTER.  
**Tip** - You can return to the BAR CHART screen later and change the display without having to enter the other parameters again.
11. Select either **DrawFit** or **Draw** (to select the window settings for the drawing) by moving the cursor to the selection and pressing ENTER. The chart is displayed.  
**Tip** - The DrawFit option changes the window settings so that the chart is displayed on the screen. If you select Draw, the chart might be displayed outside of the viewing window.  
If the entire chart will not fit on one screen; arrows are displayed on the left side of the screen. Press the arrow keys to view the part of the chart that is not currently displayed.
12. Press TRACE and use the arrow keys to view the data elements.
13. Press 2<sup>nd</sup> QUIT twice to return to the spreadsheet.  
**Note** If necessary, you can change the window settings for the chart.
  1. From the CHARTS menu, select **Scatter Window**.
  2. Change the values as necessary, and then either select **Draw** to display the chart or select **Save** to save the window settings and return to the spreadsheet.

### Creating a Pie Chart

1. Select **Menu**, and then select **Charts > Pie**.
2. Enter the range for the category labels at the Categories prompt.  
**Tip** - Press ENTER to move the cursor to each subsequent prompt.
3. Enter the range for the chart at the Series prompt.  
**Tip** - You can select a range that you want to chart before you select the chart type. The range is automatically entered at the appropriate prompts.
4. Select **Number** or **Percent** by moving the cursor to the option and pressing ENTER.  
**Tip** - If you select Number, the data from the spreadsheet is displayed in the pie chart.  
If you select Percent, the percentage of the whole that each data element makes up is displayed in the pie chart.
5. Enter a title for the chart at the **Title** prompt.  
**Tip** - Alpha-lock mode is on when you move the cursor to this prompt.
6. Select **Draw** to display the chart.

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# Glossary

Terms used in the field of wildlife management

**Anadromous:** species of fish that live their lives in the ocean and return to the freshwater rivers where they hatched to spawn. In Virginia, the striped bass, shad, sturgeon and herring are all anadromous fish.

**Carrying Capacity:** the maximum number of individuals that a given environment can support without detrimental effects to the ecosystem.

**Ecosystem:** a natural unit that includes living and nonliving parts interacting to produce a stable system in which the exchange of materials between the living and nonliving parts follows closed paths.

**Fledgling:** a young bird who has the feathers necessary to begin to fly or to leave the nest.

**Hatchery:** where fish are hatched or raised until released, also called a fish cultural station.

**Hibernation:** the act of passing the winter, or a portion of it, in a state of sleep; a torpid or resting state.

**Limiting factors:** influences in the life history of any animal, population of animals, or species (e.g. food, water, shelters, space, disease, predation, climate conditions, etc)

**Mast:** The fruits or nuts of wild plants and trees.

**Riparian buffer:** the area of land along a stream, river, lake or other body of water. The plants along this edge hold soil and filter runoff before it reaches the waterway.

**Waterfowl:** water birds, usually refers to ducks, geese and swans.

Some definitions are from the Project WILD activity guide glossary.  
Additional information about Project WILD in Virginia is below.

Thank you for using this guide with your students. In addition to building math skills, the activities will increase understanding of Virginia's wildlife resource and how local scientists use math to answer biological questions.

For more information about Virginia's wildlife resources visit us on the web at [www.dgif.virginia.gov](http://www.dgif.virginia.gov). The Department provides a *Virginia Wildlife* magazine subscription to all public schools in the Commonwealth. The magazine will provide your class with additional information on wildlife research projects as results are published.

The Virginia Department of Game and Inland Fisheries is the state sponsor of **Project WILD**, a K-12 wildlife education program available through free workshops. If you are interested in attending a Project WILD workshop contact:

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### Virginia Department of Game and Inland Fisheries

The Department of Game and Inland Fisheries shall afford to all persons and equal access to Department programs and facilities without regard to race, color, religion, national origin, disability, sex or age. If you believe that you have been discriminated against in any program, activity or facility, please write to: Virginia Department of Game and Inland fisheries, Attn. Compliance Officer, 4010 West Broad Street, P.O. Box 11104, Richmond, VA 23230-1104