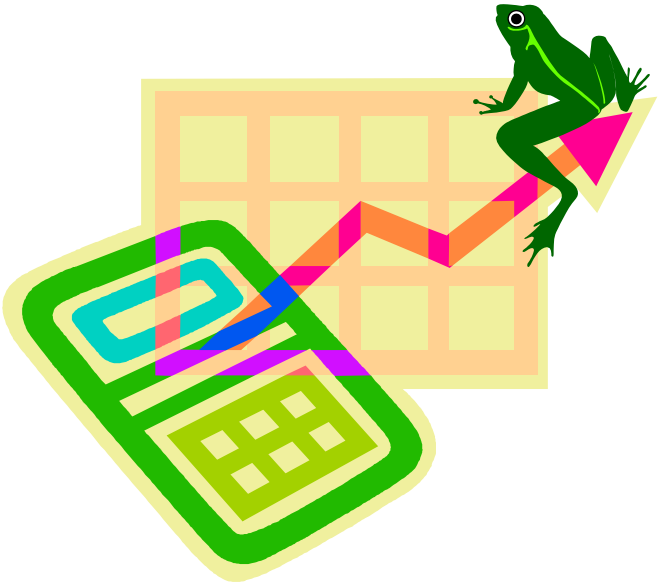
Wild About Math



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

Special thanks to

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Introduction

At the turn of the twentieth century, Virginia's wildlife population numbers were at record lows. Many species plentiful today such as the deer, beaver, and blue heron, had all but disappeared from the Commonwealth. There was a lack of understanding of how wildlife populations respond to over hunting and there were few laws regulating the number of animals that could be harvested. In 1916 the Virginia General Assembly established the Department of Game and Inland Fisheries to bring these and other species back using scientific wildlife management techniques and legislation. The scientific field of wildlife management was new and experimental in the early 20th 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. You can find more data on the Department's web site at www.dgif.virginia.gov . Many species have a management plan developed using research and public Look under hunting, fishing or wildlife and then the species you are interested in.

The Department also depends upon public support for the collection of additional data that otherwise would be difficult to obtain. Wildlife species whose populations can be hunted for their meat or hides are carefully regulated to maintain stable numbers. 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.

The Association of Fish and Wildlife Agencies has developed a Toolkit to help educators use technology to conduct field investigations. The Toolkit contains several useful guides on developing investigations and collecting data.

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.

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. 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/.

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

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.

Graph Analysis:

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?

Can You Bear the Weight?

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

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. 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.

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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?

Graph Analysis:

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.)

Note: 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.

Data tables:

WEIGHT DATA FOR 10 MALE CUBS IN GRAMS

DAYS	CUB 1	CUB 2	CUB 3	CUB 4	CUB 5	CUB 6	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

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.

Background:

Deer had disappeared from western Virginia at the turn of the 20th 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 in1931 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: https://www.dgif.virginia.gov/wildlife/deer/harvest/

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 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

Graph Analysis:

1. How many deer would be in this herd at the end of five years? _____Ten years? _____

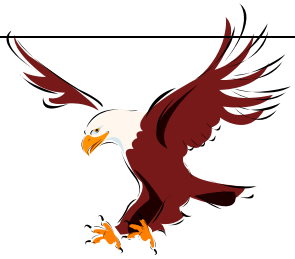
2. What would be the herd size in 25 years?_____ In 30 years?_____

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?

Adapted from Multidisciplinary Wildlife Teaching Activities by Wm. R. Hernbrode, Arizona Game and Fish



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.

Background:

The bald eagle became our national symbol in 1782. As our national symbol, it holds a special place in the hearts of 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

Graph Analysis:

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?

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.

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 https://www.dgif.virginia.gov/fishing/fish-stocking/

In order to fish for trout, anglers must purchase an additional trout stamp or license for $23.00. 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.

Graph Analysis:

1. What is the cost to release one hatchery produced trout?
2. 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 1:

Coursey Springs Hatchery Data 2004

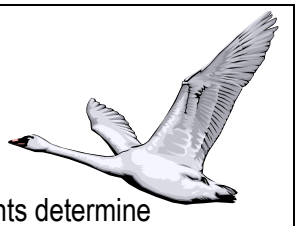
Data Type	Amount
Total Operating Cost	$319,835.00
% salaries	65
% wages	1
% feed	23
% utilities	5
% vehicles	5
% maintenance	1
Number of Trout released	348,013
Pounds of Trout released	176,752

Data Table 2:

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

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.

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.

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

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 distanced 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. How does the distance of each swan's migration journey differ?

Data tables for three of the swans during one migration cycle

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
Total days in each direction →	27 North 47 South		**Total distance each direction** →	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
Total days in each direction →			**Total distance each direction** →		
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
Total days in each direction →			**Total distance each direction** →		

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
Total days in each direction →	27 North 47 South		**Total distance each direction** →	1468.11 miles North 1996.98 miles South	

Swan ID Number	Start Date Record	End Date Record	Total Days	Distance Traveled	Total distance Traveled (mi.)
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
Total days in each direction →	63 North 82 South		**Total distance each direction** →	1527.70 miles North 1915.01 miles South	

Swan ID Number	Start Date Record	End Date Record	Total Days	Distance Traveled	Total distance Traveled (mi.)
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
Total days in each direction →	59 North 95 South		**Total distance each direction** →	2175.40 miles North 2127.83 miles South	

Let's Talk Deer

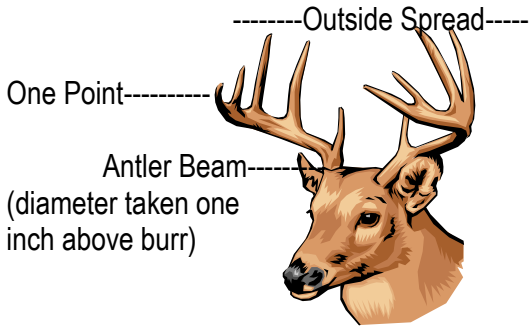
Overview: The quality of habitat has an affect on the overall size and health of individual deer. Students graph antler size and infer the relationship between antler growth and habitat quality of two Virginia counties.

Background:
Deer had disappeared from western Virginia at the turn of the 20th 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

Discussion Question:
Does habitat affect the size of antlers in deer yearlings?

Graph Analysis:

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?

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.

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 20th 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 then 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?

Graph Analysis:

1. Is there a correlation between decreases in juvenile turkey populations and acorn mast for the year? Use examples from your graph to support your answer.

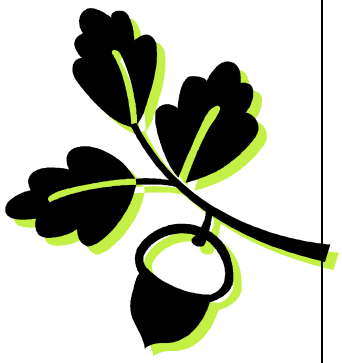
2. Are there years when acorn mast and juvenile turkey populations are not correlated? What might be other factors that would affect juvenile turkey populations?

Data Table

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

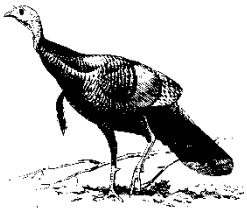
Year	Year Number	% Juvenile	% Adult Female	% Adult Male	Sample Size Total of all birds
1984	1	60.9	18.6	20.5	4,483
1985	2	61.3	17.2	21.4	5,270
1986	3	64.6	16.4	19.0	5,447
1987	4	63.6	16.1	20.3	6,599
1988	5	61.9	17.3	20.8	4,877
1989	6	66.3	15.8	17.9	6,289
1990	7	52.0	21.9	26.1	6,986
1991	8	63.0	17.4	19.6	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

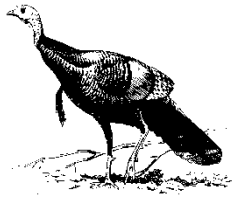


Year Number	Year	Avg. # per limb
1	1984	16.8
2	1985	36.5
3	1986	15.6
4	1987	2.8
5	1988	24.0
6	1989	26.6
7	1990	10.2
8	1991	22.1
9	1992	8.9
10	1993	17.9
11	1994	18.5
12	1995	21.0
13	1996	20.5
14	1997	7.2
15	1998	17.1
16	1999	18.8
17	2000	18.4
18	2001	26.6
	Total	329.5
	# years	18
	Mean	18.3

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.



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.

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 20th 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 https://www.dgif.virginia.gov/wp-content/uploads/agingturkey.pdf

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.

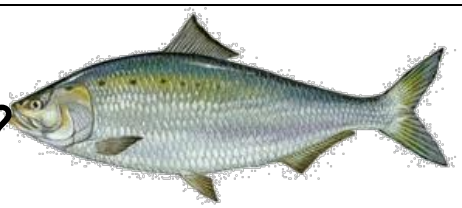
Year	Year Number	% Juvenile	% Adult Female	% Adult Male	Total of birds sampled
1984	1	60.9	18.6	20.5	4,483
1988	5	61.9	17.3	20.8	4,877
1992	9	51.1	21.0	27.9	4,421
1997	14	45.4	24.3	30.3	3,235
2001	18	48.3	21.6	30.1	2,815
18 yr. ave.		**57.5**	**19.1**	**23.3**	

Graph Analysis:
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?

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

Who Just Swam By?



Overview:

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

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 Bosher'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/fishing/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?

Graph Analysis:

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

Data table:

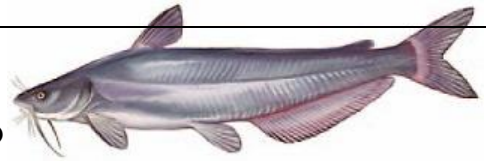
BOSHER OBSERVATION WINDOW DATA

Fish Species	**1999**	**2000**	**2001**	**2002**
American Shad	185	375	697	1066
Sunfish	1498	646	987	1184
Hogsucker	152	20	4	0

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



How Big Will They Get?

Objectives: Students will graph the weight and length of state record blue catfish and predict the size of the next state record fish will be caught based on historical data.

Background:
The blue catfish (***Ictalurus furcatus***) was introduced into Virginia's rivers in the mid 1970's in order to provide additional opportunities for citizens to catch a large fish. The blue catfish is originally native to the Mississippi drainage. The blue catfish were placed in the James River as fingerlings about 2-3 inches in length. This fish is an omnivore and feeds on fish, crayfish, and mollusks. It is also a scavenger, eating dead or dying aquatic and terrestrial animal matter. Like all catfish, the blue catfish is adapted to feed on the dark river bottom, its sense of smell and the very sensitive whiskers help it find food.

Virginia's state record blue cat fish weighed in at exactly 143 pounds and measured 57 inches in length with a girth of 43.5 inches. The huge cat was caught in John H. Kerr Reservoir (Buggs Island Lake) on Saturday, June 18, 2011. This is the largest freshwater fish caught in Virginia waters and is the current **World Record Blue Catfish.**

Historical records for blue catfish indicate that they can grow much larger then the current record but how big no one knows for sure.

Additional information and a description of this species and others may be found on the Department of Game and Inland Fisheries website; https://www.dgif.virginia.gov/fishing/trophy-fish/

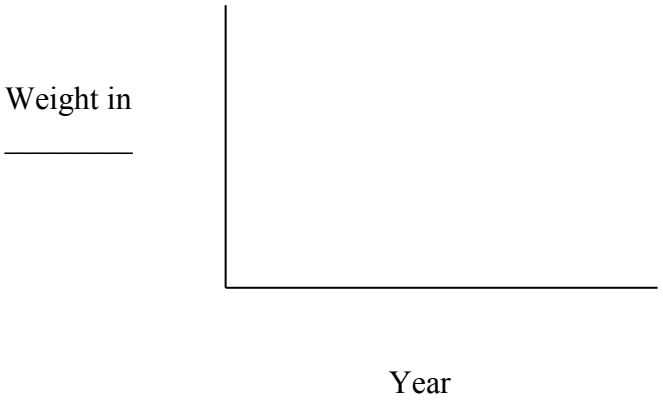
The dates and the weights of each of Virginia's record blue catfish are in Table 1.
Estimate when Virginia's blue catfish record will reach 160 + pounds. You can convert the pounds to kilograms before graphing. To convert pounds to kilograms multiply the number of pounds by 0.45.
before graphing. To convert pounds to kilograms multiply the number of pounds by 0.45.

Table 1.

Date	Weight (lbs)	Weight (kg)	Length (in)	Body of water
4/5/1986	33.75 lbs		38.0 in.	Rappahannock River
4/5/1986	38.50 lbs		39.0 in.	Rappahannock River
3/13/1987	42.25 lbs		40.0 in.	Rappahannock River
3/28/1989	45.50 lbs		41.0 in.	Rappahannock River
3/17/1990	45.50 lbs		46.0 in.	Rappahannock River
11/21/1991	56.75 lbs		48.0in.	James River
3/30/1993	57.00 lbs		44.0 in.	Rappahannock River
4/11/1993	57.50 lbs		47.0 in.	Rappahannock River
6/24/1994	66.50 lbs		50.0 in.	Appomattox River
4/11/1999	67.50 lbs		48.25 in.	James River
11/19/1999	71.75 lbs		48.25 in.	James River
4/30/2004	75.25 lbs		51.75 in.	James River
6/29/2004	92.25 lbs		51.75 in.	Buggs Island Lake
6/15/2006	95.68 lbs		54.50 in.	James River
5/20/2009	102.25 lbs		52.75 in.	James River
3/17/2011	109.00 lbs		53.0 in.	Buggs Island Lake
6/18/2011	143.00 lbs		57.0 in.	Buggs Island Lake

Graphing:

1. Graph the year and weight of each blue catfish below.



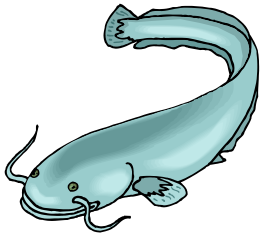
When and where would you go fishing if you wanted to catch the next state record or the next world record blue catfish?

2. Graph the weight and length of each record fish.

Is there a relationship between the weight of the fish and its length?

If you know the length can you estimate the weight of the fish?

Additional blue catfish graphing activity:
If you catch a blue catfish over 30 pounds and 38 inches long you may request a citation or certificate from the Virginia Department of Game and Inland Fisheries. A random sample of the 659 citation size Blue catfish caught in the James River during 2006 can be found in **Table 2**. Most of the fish were released back into the river to be caught again, a few were kept to be eaten or mounted by the fisherman.



Based on this sample; what time of year are most of the citation size fish caught?

Is there a relationship between the weight of the fish and its length?

Table 2: Sample 2006 James River Blue Catfish Citations

Catch Date	Weight	Length
2/8/2006	30.00	38.75
3/1/2006	30.00	39.75
4/10/2006	30.00	28.75
1/31/2006	31.00	38.75
7/29/2006	31.00	41.75
2/19/2006	31.50	39.75
11/24/2006	32.00	39.75
1/24/2006	33.00	38.75
7/22/2006	33.00	37.75
4/10/2006	34.00	41.75
9/7/2006	35.00	38.75
10/21/2006	35.00	41.50
4/8/2006	35.50	39.50
6/11/2006	36.00	43.75
4/8/2006	37.00	39.25
8/5/2006	37.00	40.50
6/4/2006	37.50	39.75
4/6/2006	38.00	40.50
10/8/2006	38.63	42.25
3/4/2006	39.00	43.75
3/11/2006	40.00	43.75
12/17/2006	40.00	45.50
4/8/2006	41.00	44.75
1/1/2006	42.00	42.75
1/15/2006	42.00	44.75
11/17/2006	43.00	44.75
12/17/2006	44.00	45.75
12/5/2006	45.00	51.75

Catch Date	Weight	Length
4/18/2006	46.00	46.25
11/22/2006	47.00	41.75
11/24/2006	48.00	44.75
11/20/2006	49.00	44.50
8/11/2006	50.00	48.75
3/11/2006	51.00	43.75
11/24/2006	52.00	45.75
4/9/2006	53.00	42.75
1/30/2006	54.00	43.50
4/9/2006	55.00	45.75
4/3/2006	57.00	45.75
5/1/2006	57.00	48.75
10/20/2006	60.00	48.75
7/20/2006	61.13	48.50
2/24/2006	63.00	49.75
4/27/2006	68.38	50.75
2/2/2006	69.00	50.75
1/4/2006	70.00	50.75
4/7/2006	70.00	50.50
7/15/2006	72.00	50.75
12/3/2006	72.00	50.75
12/20/2006	72.25	52.75
7/20/2006	73.00	52.75
8/21/2006	74.00	64.75
8/20/2006	77.00	64.75
3/18/2006	78.00	64.75
10/28/2006	85.44	54.50
8/1/2006	86.00	50.75
7/15/2006	95.69	54.50

Piping Plovers Along The Coast

Objectives:
Students will graphically compare the nesting success of the threatened piping plover on the northern and southern barriers islands off the Eastern Shore of Virginia.

Background:
The piping plover (*Charadrius melodus),* a small sand-colored shorebird, was listed as a federally threatened wildlife species in 1986. Since then nesting surveys have been conducted on Virginia's Eastern Shore and on barrier islands in order to keep track of its reproduction success. In Virginia, plovers nest on sandy beaches interspersed with shell fragments that help conceal the 4 eggs laid in a shallow scrape on the sand. Unfortunately, not all of the eggs will hatch or young will survive but if the average fledge rate (i.e., the number of young that achieve sustained flight divided by the number of nesting pairs) equals or exceeds 1.24, the population will remain be stable or increase.

Several factors contribute to the success or failure of the nest and young. If the breeding pair chooses a spot too close to the high tide mark or if there are unusually heavy summer rains the nest may be washed away. Predators, such as foxes, raccoons and gulls will feed on the eggs and the young. Even humans, who walk unknowingly, too close to the nesting pairs, may cause the parents to leave the nest exposing the eggs to avian predators and to the hot sun.

The nesting survey is done each year in early June. Most of the count is done on foot using 2 biologists, when they spot an adult bird they kneel down and watch. Birds exhibiting any type of breeding behavior or if a mate appears, the birds are counted as a breeding pair. Occasionally, a lone adult is spotted and it too is included in the count as a single individual. This allows us to obtain an overall estimate of the number of potential breeding adults in the population. For purposes of this exercise only breeding pairs will be considered.

The northern barrier islands include Assateague, Wallops, Assawoman, Metompkin and Cedar and the southern islands include Parramore, Hog, Cobb, Little Cobb, Wreck, Ship Shoal, Myrtle, Smith and Fisherman. Barrier islands are constantly moving and what was a sandy beach may be washed away in a single hurricane season. Plovers and other beach nesting shorebirds tend to return to the same beach to nest each year.

Additional information about the piping plover may be found at
https://www.dgif.virginia.gov/wildlife/birds/piping-plovers/
To discover ways you can help Virginia's wildlife visit http://www.bewildvirginia.org/

Questions:

Which group of islands has the highest average of breeding pairs?

On what group of islands is the population growing at a greater rate?

Table 1:

Year	Nesting pairs on northern barrier islands	Nesting pairs on southern barrier islands
1986	68	28
1987	75	21
1988	70	29
1989	95	21
1990	96	20
1991	98	27
1992	73	22
1993	80	21
1994	79	16
1995	89	25
1996	71	13
1997	79	8
1998	87	8
1999	84	5
2000	92	4
2001	117	2
2002	113	7
2003	107	7
2004	141	11
2005	169	23
2006	165	37

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 wildlife 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 . 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 in-service workshops across the Commonwealth. If you are interested in attending a Project WILD workshop contact:

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Virginia Department of Game and Inland Fisheries

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