

Lesson 3 and 4 Components

- I. Presentation 3: Data introduction and Osprey Example
- II. Bald Eagle Activity 1
- III. Bald Eagle Activity 2
- IV. Bald Eagle Activity 3

I. Presentation 3: Data introduction and Osprey Example
slideshow

Description

- Introduces students to CEETV, the Contaminants Exposure and Effects-Terrestrial Vertebrates database, as a source of data that can be used to investigate the effectiveness of the DDT ban.
- Reviews how to formulate a hypothesis and determine the type of data needed in order to reduce potential bias.
- Uses osprey data from CEETV to explore the effectiveness of DDT ban.

Goals

- Students learn about data sources available to the public.
- Students practice formulating a hypothesis and selecting data in a manner that minimizes bias.
- Students gain an appreciation for graphing as a way to visualize data.

Materials

Download Files from Lesson 3 4, folder *Lesson3 4 sectionI* :

- “Lesson3_dataintro_presentation”
- “Lesson3_WB” and “Lesson3_WB_KEY”
- “osprey”

Other:

- Copies of presentation workbook for each student
- Equipment to show slideshow or transparencies

II. Bald Eagle Activity 1

group/individual activity, computer preferred

Description

- Students are given a dataset from CEETV containing data on DDE concentrations in bald eagle eggs in the U.S.
- Students are introduced to Microsoft Excel and some of its functions.
- Students sort their data and eliminate records that would introduce bias.
- Students divide records into groups by year and calculate DDE averages for each group.

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- Students graph their results and discuss the meaning of their graphs.

Goals

- Students practice formulating a hypothesis and sorting a dataset in order to remove records that would introduce bias into the investigation.
- Students learn how to manipulate data and graph using Excel.
- Students discuss the meaning of their graph and explore possible explanations for the pattern they observe.

Materials

Download Files from Lesson 3 4, folder *Lesson3 4 sectionII* :

- “baldeagle”
- “baldeagle presentation”
- “BaldEagleActivity1_WB” and “BaldEagleActivity1_WB_KEY”
- “BaldEagleActivity1_Excel”
- “EagleExAct1”

Other:

- Copies of student workbook, discussion questions, and Excel instructions for every student
- Excel dataset, “baldeagle”, copied for every student on student discs or available on computer workstations
- *Optional*: Equipment to show slideshow or transparencies

III. Bald Eagle Activity 2 homework or group/individual activity, computer preferred

Description

- Students look at the records they used to create the graph in Bald Eagle Activity 1 and propose a possible hypothesis to explain their results. In particular, they are encouraged to question whether the trend they observe is a trend across the US or limited to specific location(s).
- Students reexamine their data by dividing data into groups by state, discuss the results and formulate a new hypothesis.

Goals

- Students gain further comfort and expertise with manipulating data and graphing in Excel.
- Students explore how different ways of dividing and visualizing data can lead to different results and hence conclusions.

Materials

Download Files from Lesson 3 4, folder *Lesson3 4 sectionIII* :

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- “BaldEagleActivity2_WB” and “BaldEagleActivity2_WB_KEY”
- “EagleExAct2_KEY”
- “BaldEagleActivity2_Excel”
- “Baldeagle2 presentation”

Other:

- Copies of student workbook and Excel instructions for every student
- *Optional:* Equipment to show slideshow or transparencies if done in class

IV. Bald Eagle Activity 3

group activity

Description

- The results of Bald Eagle Activity 2 are discussed with emphasis on how bias was introduced to the first investigation.
- Students are asked to share their results and new hypotheses. Santa Catalina is identified as a potential hotspot.
- Students investigate their new hypothesis by looking at the bald eagle data one last time. This time they contemplate a graph in which the bald eagle data has been divided into 2 large datasets, one containing all US data with the exception of data from Santa Catalina and the other dataset containing data only from Santa Catalina.
- Students discuss the meaning of their graphs and formulate ideas about what might have caused the patterns they observe.
- Students discuss how combining the data records in different ways led to a different result thereby reviewing ideas about bias presented earlier in the unit.

Goals

- Students develop critical thinking skills with regard to science, in particular by identifying sources of bias.

Materials

Download Files from Lesson 3 4, folder *Lesson3 4 sectionIV*:

- “BaldEagleActivity3_WB” and “BaldEagleActivity3_WB_KEY”
- “Baldeagle3 presentation”
- “BE3graph”, “BaldEagleActivity3_datasheets” and “EagleExAct3”

Other:

- Copies of student workbook, graph3, and datasheets from “EagleExAct3” for every student
- Equipment to show slideshow or transparencies

Introduction to Lesson 3 and 4

USGS Data Exploration Unit: Lesson 3 and 4 Teacher's Manual

Lesson 3 and 4: Using data to investigate the effectiveness of the DDT ban

The manner in which each of the Lesson 3 and 4 sections are covered is flexible. In the table below, schedules are suggested based on particular classroom characteristics (skill level of students, length of class period, and access to computers at school and at home).

Lesson 3 and 4 consists of 4 main sections:

- I. Presentation 3: Data Introduction and Osprey Example – no computer required, optional computer enrichment
- II. Bald Eagle Activity 1 – computer preferred (II2 = no computer alternative)
- III. Bald Eagle Activity 2 – computer preferred (III2 = no computer alternative)
- IV. Bald Eagle Activity 3 – no computer required, optional computer enrichment

| Suggested Teaching Schedules for Sections I-IV of Lesson 3 and 4 | | | | |
|--|-----------------------|--------------------------|-----------------------|--------------------------|
| Class characteristics | Lesson 3 Class | Lesson 3 Homework | Lesson 4 Class | Lesson 4 Homework |
| Long periods, school and home access to computers, advanced students | I, II | III | IV | none |
| Long periods, school but no home access to computers, advanced students | I, II | none | III | IV |
| Shorter periods, school and home access to computers | I, II prep | II finish | III | IV |
| Shorter periods, school but no home access to computers | I, II prep | none | II finish | III2, IV |
| Shorter periods, no school or home access to computers | I, II2 prep | II2 finish | III2 | IV |

If a computer laboratory is available and/or students have access to computers at home, we recommend doing Bald Eagle Activity 1 and 2 using Excel. Students will have time to explore the data thoroughly and utilize critical thinking the most by using Excel. In addition, they will build valuable computer skills. Students can work in groups depending on the availability of computers but ideally students should work alone or in pairs. If this is not possible, we have provided alternative ways to do each activity. However, because of the time involved in sorting and organizing data by hand, some of the critical thinking and data sorting components are left out in the non-Excel versions of the exercises.

I. Presentation 3: Data Introduction and Osprey Example

Throughout the PowerPoint presentation material on slides if not immediately apparent can be brought up by mouse clicks. In the notes below, a ♣ indicates that students are asked to answer a question about this slide in their presentation workbook. Answers are given to these questions in these notes when it is advisable to discuss the answers with the class. Otherwise, answers are provided on the answer key for the student workbook. The slideshow notes in this outline can also be found in the notes section of each slide. To view the slides these notes refer to see the slide presentation, “Lesson3_dataintro_osprey”.

Teacher Preparation

1. Download the files, “Lesson3_dataintro_osprey”, “osprey”, “Lesson3_WB” and “Lesson3_WB_KEY”.
 - “Lesson3_dataintro_osprey” contains the Powerpoint presentation/ presentation 3 that is used to introduce this unit.
 - “osprey” contains the dataset and graph used in the Osprey example. This can be used as reference or for the optional computer enrichment.
 - “Lesson3_WB” and “Lesson3_WB_KEY” contain the student workbook and key for presentation 3. Students will answer questions and take notes about the presentation in their workbooks.
2. Print and copy enough handouts of the student workbook to give one to every student.
3. Prepare equipment for slideshow or transparencies. Make transparencies if needed.

Slide 1

The Opening Questions for the lesson are presented. Students can come in a quietly mark down their answers to these questions at the beginning of class. When a suitable amount of time has passed, review the questions as a class.

- ♣1. *Why is DDT harmful? What effect of DDT (DDE) is linked to the slow decline of birds of prey in the United States during the late 1960s and early 1970s?*

DDT breaks down in the body of animals to become DDE. DDE tends to stay in the body and at high concentrations can result in nervous system damage, immune system problems, thyroid problems, eggshell thinning and death. The slow decline of birds of prey in the US mostly reflects the effect of eggshell thinning caused by DDE bioaccumulation in female birds. Thin eggshells tend to break before embryos can fully develop and hatch.

- ♣2. *Does DDE accumulate in all species equally? Why not? What type of species is most likely to accumulate large amounts of DDE due to biomagnification?*

No, DDE does not accumulate in all species evenly. Consumers that are high in the food chain such as tertiary consumers are likely to accumulate a lot of DDE due to biomagnification. In order to meet their caloric requirements, tertiary consumers eat a lot of organisms that have small concentrations of DDE in their bodies. These small doses add up to high concentrations of DDE in the bodies of tertiary consumers. In addition, since DDT gets washed off into streams, rivers and the ocean, animals that feed on water-dwelling creatures tend to accumulate more DDE than animals that feed on terrestrial animals. (Unless the terrestrial animals they feed on are consumers that largely feed on aquatic animals.)

- ♣3. *When was DDT banned?*

DDT was banned in 1972.

Slide 2

We can use data to determine if DDE concentrations in wildlife decreased after the DDT ban was passed. Through the years scientists have collected a great deal of data on contaminants in wildlife. Much of this data is easily accessible to the public through databases on the internet.

Slide 3

For example, Contaminants and Vertebrates Online provides different types of information about contaminants in animals. One of the components of Contaminants and Vertebrates Online is CEETV, a Contaminants Exposure and Effects-Terrestrial Vertebrates database that people can search on through the Internet to get data concerning contaminants and/or species they are interested in.

Slide 4

The Contaminants Exposure and Effects Database-Terrestrial Vertebrates or CEE-TV (<http://www.pwrc.usgs.gov/contaminants-online/>) stores data about contaminants in mammals, birds, amphibians and reptiles that live near coastline or estuaries in the US. The CEE-TV database was created by scientists working for the Biological Resources Division of the U.S. Geological Survey (USGS). USGS is a part of the Department of the Interior of the federal government. The mission of the Biological Resources Division is “to work with others to provide the scientific understanding and technologies needed to support the sound management and conservation of our Nation's biological resources”. CEE-TV contains data gathered by hundreds of different scientists throughout the 20th and 21st centuries that has been published in peer-reviewed journals, government reports and on government websites. We are going to use data from CEE-TV to investigate whether the DDT ban has been effective in reducing the concentrations of DDE in wildlife.

- ♣ 1. *From where will we get data to investigate whether the DDT ban was effective in reducing DDE concentrations in wildlife?*
- ♣ 2. *Who created this database? Why might they be interested in contaminants?*

- ♣ 3. *Where did the data in the database come from? Do you trust this source of data to be fairly non-biased? Why or why not?*

Slide 5

- ♣ 4. *What type of species should we investigate? Why?*

A TERTIARY CONSUMER. Due to biomagnification, tertiary consumers will accumulate the most DDE in their bodies. DDE concentrations that are not harmful in organisms lower in the food web might still accumulate to dangerous concentrations in a tertiary consumer. In order for the ban to be considered effective, the biomagnification of DDE needs to decrease significantly. That is, DDE concentrations in tertiary consumers need to decrease below harmful concentrations.

Ask students to give some examples of tertiary consumers such as bears, mountain lions, eagles, hawks, etc.

Slide 6

How do we choose? Discuss the following questions with the class:

- ♣ 5. *Do all tertiary consumers have the same likelihood of accumulating high concentrations of DDE?*

No, as noted in lesson 2 and in today's opening questions, DDT runs off into the water and consumers that eat mostly water-dwelling organisms tend to accumulate higher concentrations of DDE. Thus in order to focus on the most sensitive species, we should pick a tertiary consumer that feeds mostly on water-dwelling animals.

- ♣ 6. *Can we combine species or do we need to pick one? Why?*

Species do not necessarily accumulate DDE in the same way due to differences in the type of animals they eat and physiological differences that cause DDE to be processed differently. Some species will accumulate more or less DDE than other species even if fed the exact same food. Thus an 8 ug/g ww DDE concentration in one species may not be comparable to an 8 ug/g ww concentration in another species. In order to insure we are comparing data in a non-biased manner we should pick only one species.

* You may want to follow this question up with "What kind of bias would we be introducing if we combine data for different species?" Sample selection bias

- ♣ 7. *What other factor effects our choice of species since we are getting our data from an existing database?*

We are not collecting data ourselves but relying on data that has been collected by others. Thus, we not only need to pick a tertiary consumer that feeds mostly on water-dwelling

animals but also one for which a lot of DDE data has been collected so we can have a large sample size to minimize bias. Some species are more difficult to study than other species either because they are protected or difficult to capture or only found in very remote locations.

One of the species that meets these requirements is the bald eagle. Tell students that they will be given subset of the CEE-TV database in order to investigate the effectiveness of the DDT ban. Their dataset will only contain data for DDE concentrations in bald eagles in the U.S. First, in order to prepare, the class will review an example using ospreys.

Slide 7

♣ 8. *We have data on DDE concentrations in osprey eggs collected from various locations in the U.S. between 1968 and 1991. What question do we want to ask? What is our hypothesis?*

Recall from Lesson 1, science attempts to disprove things. A hypothesis is always formulated as a null hypothesis. In this case our null hypothesis is “DDE concentrations in osprey eggs in the United States did not consistently decrease below harmful concentrations (< 3 ug/g ww) in the two decades following the DDT ban in 1972.”

♣ 9. *With this hypothesis, how have we specifically defined our investigation?*

With this hypothesis we have clearly defined our investigation in the following ways:

Species: Osprey

Matrix (body part): Egg contents

Location: United States

Harmful DDE concentration: ≥ 3 ug/g ww

Time frame: DDE concentrations < 3 ug/g ww by 1992

Slide 8

We are going to investigate our hypothesis by graphing DDE concentrations in osprey eggs collected in the U.S. by year.

♣ 10. *What do we expect a graph of DDE concentrations in osprey eggs collected in the U.S. by year to look like if the hypothesis is supported?*

*Click with mouse and graph examples will appear one at a time, 1 graph per click.

No consistent pattern, no decrease, or an increase.

*Click with mouse and next question will appear.

♣ 11. *What do we expect a graph to look like if the hypothesis is rejected?*

*Click with mouse and graph will appear.

Consistent decrease with time with DDE < 3 ug/g ww by 1992

Slide 9

This is a slide of raw data. This is what the bald eagle data that students will be working with will look like when they first get it.

Slide 10

The computer program, Excel, is used to sort the individual data records into groups by year. We then use Excel to calculate an average DDE egg content concentration for each group.

♣ 12. *What steps need to be taken to transform the individual records into DDE averages that can be graphed?*

Slide 11

The average DDE egg content concentration for each group is calculated by dividing the sum of DDE concentrations for **all** individuals by the total number of individuals. Stress the need to account for every individual since this is a question that will come up during Bald Eagle Activity 1.

♣ 13. *How is the average DDE concentration for a group calculated?*

Slide 12

We end up with a table of DDE average egg concentration by year group. We can then use Excel to make a graph of these averages.

Slide 13

Note: There are different ways to review the osprey graph with your class depending on the equipment available in your classroom. If you have a classroom display connected to a computer, you can review the example and demonstrate how to make the graph in excel. You can also do this by taking your students to the computer lab after introducing the osprey example and having them follow along with you to make the osprey graph in excel. Instructions for reviewing the osprey graph using a computer and excel are provided following the notes for this slide. Alternatively, you can review the osprey example without demonstrating steps in excel. This may be a better choice for your class due to time, computer lab space, or classroom equipment constraints. To review the osprey graph without using a computer or excel just continue with the slide show.

And here it is, our graph.

♣ 14. *What did the graph of the osprey data look like? What was the highest average concentration of DDE found in osprey eggs and during what time period was this high found?*

With the graph displayed, discuss the following questions:

- ♣ 15. *Do we reject our hypothesis? What is our conclusion?*

YES. Our conclusion is that DDE concentrations in osprey eggs in the United States consistently decreased below harmful concentrations (< 3 ug/g ww) in the two decades following the DDT ban in 1972.

- ♣ 16. *How long did it take for DDE to decrease below harmful concentrations (< 3 ug/g ww)?*

Around 9 years

- ♣ 17. *Was the DDT ban effective in decreasing DDE concentrations in wildlife in the United States?*

We cannot answer this question. Our results are limited to our hypothesis that concerns DDE concentrations in osprey eggs. Moreover, if we wanted to be truly accurate we would not say in the U.S. but along coast and estuaries in the U.S. since the data contained in CEE-TV are limited to these regions. Now lets explore the effectiveness of the DDT ban further by looking at another data set, DDE in bald eagle eggs.

Slide 14

This slide leads the students into the bald eagle activities

Osprey Example with computer and excel

1. Download excel file, "Osprey" from website (Lesson 3). Open file in excel. You will find a copy of the table of averages (Sheet1) and an example graph (Chart1).
2. With Sheet1 open and visible, choose the graph option on the excel toolbar, ie. the icon that looks like a bar graph. This will open the Chart Wizard.
3. Select "Line" for chart type. For chart sub-type select the second picture in the first column, "Line with markers displayed at each data value." Click on "Next".
4. Click in the "Data range" box and then click on Sheet1. With your mouse select the cells that contain the year groups and the DDE averages (A4-A8 and B4-B8). This should show in the "Data range" box as "={Sheet1!\$A\$4:\$B\$8". Make sure "columns" is selected for "Series in:". Click on "Next".
5. Create a title for your graph such as "DDE concentrations in osprey eggs collected in the U.S. from 1968 to 1991." Create a title for the X-axis: "Year" and the Y-axis: "DDE in ug/g ww". Be sure to indicate the units for the Y-axis. Click on "Next".
6. Place chart "As new sheet", Chart2 (or choose a title of your liking). You can now format the chart to your liking by clicking on different parts of the chart and choosing color, range, symbol and text preferences. You may want to delete the "series 1" box, since there is only one series there is no need to label it. Be sure to click on the line and under "data labels" select "show value". Your graph should look similar to the sample graph, Chart1.

II. Bald Eagle Activity 1

As in the section above, ♣ indicates a question in the student workbook. Detailed instructions on how to complete each step of this exercise in Excel is not provided in the teacher's manual since these instructions are provided in in "BaldEagleActivity1_Excel".

Ideally, this activity should be completed in a computer lab where every student or each pair of students have access to their own computer. If computers are not available, an alternative way to teach this activity is offered in Section II2.

Teacher Preparation

1. Download the files, "EagleExAct1", "Baldeagle1", "BaldEagle", "BaldEagleActivity1_Excel", "BaldEagleActivity1_discussionQs", "BaldEagleActivity1_studentWB" and "BaldEagleActivity1_studentWB_KEY".
 - "EagleExAct1" contains a completed example of the datasheets and graph that should be created as a result of following all of the steps correctly in this activity.
 - "Baldeagle1" contains slides that can be used to review this activity as a class.
 - "BaldEagle" contains the raw dataset that will be used for this activity.
 - "BaldEagleActivity1_Excel" contains detailed instructions on how to complete each step of this exercise in Excel.
 - "BaldEagleActivity1_studentWB" and "BaldEagleActivity1_studentWB_KEY" contain the student workbook and key. Students will answer questions in their workbooks as they complete the activity.
 - "BaldEagleActivity1_discussionQs" contains a list of questions that should be discussed at the conclusion of the activity.
2. Put a copy of the file "BaldEagle" on every computer that will be used by students. Alternatively (especially if students will be completing their homework using excel), tell students to bring in blank discs labeled with their name the day or week before you plan to do this activity. Download/copy the file "BaldEagle" to every disk.
3. Print and copy enough handouts of the Excel directions, student workbook and discussion questions to give one of each to every student.

Student Preparation

1. Prepare students to analyze the bald eagle data by having them write down their null hypothesis in their workbooks. Tell students they have data for DDE concentrations in bald eagle eggs from 1969 to 2000. Their null hypothesis should be as specific as the hypothesis in the Osprey example.
 - ♣ *You will be given a dataset containing data for DDE concentrations in bald eagle eggs collected in the US from 1969 to 2000. What is the hypothesis you will investigate?*
 - ♣ *How does your hypothesis specifically define your investigation?*

2. Have students make a copy of the file “BaldEagle”. Call it “BaldEagle1”. As a rule of thumb when working with data students should keep a copy that is error free in case something gets deleted or changed when they are working with the data. If a student's excel file does get messed up at any time during the bald eagle activities, they should copy the source file again and use this new copy. **Always keep a spare error-free version.**
3. Open “BaldEagle2”. This file should consist of one sheet, “baldeagle” that contains 146 records (147 rows with headings).
4. Review what each of the headings average.
 - RECORD_ID = identification number unique to that particular record
 - COMMON_NAME = common name of species
 - YEAR_FROM = record contains data for eggs/tissues collected during or after this year
 - YEAR_TO = record contains data for eggs/tissues collected before or during this year
 - LOCATION = name of location at which eggs/tissues were collected
 - STATE = name of state from which eggs/tissues were collected
 - MATRIX = body part used for analysis, ex. liver, kidney, egg content
 - N = number of individual eggs/animals represented by this particular record. If N=5, the DDE concentration given in the record represents the average DDE concentration calculated for DDE concentrations of 5 different eggs/animals.
 - DDE = concentration of DDE found in the eggs/tissues
 - UNITS = units for the DDE concentration reported

Section A. Sorting data

Students will practice sorting data using excel while checking data for suitability for their investigation. Students will remove data points that do not fit and would introduce bias.

WARNING!!!!!! Follow instructions for sorting very carefully. If you sort a column using the A to Z button on the tool bar your data will get all mixed up. The entries for each row need to be kept together and sorted together. If you sort using the toolbar, the column you selected will be sorted in alphabetical order independently of the information contained in other columns. The DDE concentrations will no longer match the year they were collected or the units or the species. The final results and graph will make no sense.

♣ 1. *What records did you remove when you sorted your data by species? Why did you remove these records? What type of bias would you have introduced if you kept the records?*

This question was answered earlier in presentation 3, slide 6, question 6:

Species do not necessarily accumulate DDE in the same way due to differences in the type of animals they eat and physiological differences that cause DDE to be processed differently. Some species will accumulate more or less DDE than other species even if fed the exact same food. Thus an 8 ug/g ww DDE concentration in one species may not be comparable to an 8 ug/g ww concentration in another species. In order to insure we are comparing data in a non-biased manner we should pick only one species. We would have introduced sample selection bias.

♣ 2. *What records did you remove when you sorted your data by units? Why did you remove these records? What type of bias would you have introduced if you kept the records?*

We cannot compare DDE concentrations taken in different units for such a comparison is meaningless. It would be like treating 2 inches and 2 cm as the same length. We would have introduced measurement bias.

♣ 3. *What records did you remove when you sorted your data by matrix? Why did you remove these records? What type of bias would you have introduced if you kept the records?*

The rate at which contaminants accumulate in the body differs by body organ. DDE concentrations may be low in the brain but high in eggs. As with units, we must only compare DDE concentrations in the same matrix in order for the comparison to mean anything. A 2 ug/g ww DDE concentration in the brain is fairly high while a 2 ug/g ww DDE concentration in egg content is fairly insignificant. We would have introduced measurement bias.

Section B. Organizing data

Students sort records in ascending order by year and then divide records into groups by year.

Section C. Calculating DDE averages

Students calculate average DDE for each year group. In step 4c of Section C, students are asked to come up with an Excel formula to calculate group DDE averages. This formula should be =“=K11/H11” (can be any number K??/H?? as long as ??=??).

♣ 1. *What does the number under the column, “DDE” represent?*

It represents an average value for the DDE concentration present in “N” eggs.

♣ 2. *Why must you multiply “N” by “DDE” in order to calculate an average for each year*

group?

For the average we calculate for each year group, we want each individual egg to count equally in determining the average value. In order for this to be true, we first need to multiply “N” by “DDE” for each record.

♣ When they have completed Section C, students should print out their completed datasheet. They will use this for Section D and later activities. They should hand it in with their workbooks.

Section D. Graphing results

♣ Students are asked to fill in a table of the DDE averages they calculated for each year group in their notebooks. When they have complete their graph, Students should print it and hand it in with their workbooks. They will need to refer to their graphs to answer the discussion questions for this activity.

* Students should save their Excel direction sheet since they may need to refer to them in the next activity.

Section E. Discussion Questions

Handout the discussion questions for Bald Eagle Activity 1 from file “BaldEagleActivity1_discussionQs”. As time allows have students answer the questions on their own. Students can take these questions home to complete before undertaking Bald Eagle Activity 2. Alternatively, you can review the questions as a class.

II.2. Bald Eagle Activity 1 with no computer

Teacher Preparation

1. Download the excel file, “EagleExAct1”. This file contains a completed example of the datasheets and graph that should be created as a result of following all of the steps in this activity.
2. Download the powerpoint file, “Baldeagle1”. This contains slides that may be of use in reviewing the unit as a class.
3. Print out a copy of the datasheet, “baldeagle”, and make copies of this data sheet for all of your students.
4. Review the directions for Bald Eagle Activity 1 with a computer. As you see fit, you may want to incorporate some of the discussion questions that are covered as students sort their data and calculate averages.

Revised activity

1. Hand out datasheet, “baldeagle” to students.
2. Review the meanings for each of the column headings. (*See section II.B4*).
3. Have students fill in DDE averages for each year group in the table in their workbooks for Bald Eagle Activity 1.
4. On graph paper, have students construct a graph for the data in the table.

III. Bald Eagle Activity 2

In this exercise students take a second look at their data by dividing the data into groups by state and then further dividing the data for each state into 2 year groups: 1969-1979 and 1980-2000. They then make a graph and discuss their results.

We recommend completing this activity using computers. However, if computers are unavailable an alternative way to complete the activity is presented in Section III.2.

Teacher Preparation

1. Download the files, “EagleExAct2”, “Baldeagle2”, “BaldEagleActivity2_Excel”, “BaldEagleActivity2_studentWB” and “BaldEagleActivity2_studentWB_KEY”.
 - “EagleExAct2” contains a completed example of the datasheets and graph that should be created as a result of following all of the steps correctly in this activity.
 - “Baldeagle2” contains slides that can be used to review this activity as a class.
 - “BaldEagleActivity2_Excel” contains detailed instructions on how to complete each step of this exercise in Excel.
 - “BaldEagleActivity2_studentWB” and “BaldEagleActivity2_studentWB_KEY” contain the student workbook and key. Students will answer questions in their workbooks as they complete the activity.
2. Print and copy enough handouts of the Excel directions and student workbook to give one of each to every student.

Bald Eagle Activity 2

♣ Students generate average DDE concentrations for the new data groups. Students record these averages in a table in their workbooks and then graph their results. Students should print out their graph to hand in with their workbook and to refer to while answering workbook questions.

We recommend students work on the discussion questions in their workbooks by themselves or in pairs.

III.2. Bald Eagle Activity 2 with no computer

Teacher’s Preparation

Follow directions given in III except do not download or copy the Excel directions.

Revised Activity

1. Similar to Bald Activity 1 without a computer, provide students with copies of the datasheet “baldeagle2” from “EagleExAct2”.
2. Have students fill in a table of the DDE averages divided by state and by year in their workbooks.

3. Students can make the graph by hand or you can hand out copies of the graph and students can use the handouts to answer the discussion questions in their notebooks.

IV. Bald Eagle Activity 3

In the activity students explore the hypothesis generated in Bald Eagle Activity 2 by taking a look at the bald eagle data one last time.

We recommend dividing the class into groups of 4 to conduct this activity.

Teacher Preparation

1. Download the files, “EagleExAct3”, “Baldeagle3”, “BE3graph”, “BaldEagleActivity3_datasheets”, “BaldEagleActivity3_studentWB” and “BaldEagleActivity3_studentWB_KEY”.
 - “EagleExAct3” contains the datasheets and graph that will be used in this activity and can be used for reference.
 - “Baldeagle3” contains slides that can be used to review this activity as a class.
 - “BE3graph” and “BaldEagleActivity3_datasheets” contain print ready copies of the graph and datasheets that will be used in this activity.
 - “BaldEagleActivity3_studentWB” and “BaldEagleActivity3_studentWB_KEY” contain the student workbook and key. Students will answer questions in their workbooks as they complete the activity.
2. Print and copy enough handouts of the student workbook, Begraph, and BaldEagleActivity3_datasheets to give one of each to every student.

Opening Questions

- ♣ 1. *What state had the highest DDE concentrations post-1980? From what location within the state were these records collected?*

California, all from Santa Catalina Island

- ♣ 2. *What could explain such high DDE concentrations in one location?*

Encourage students to share the explanations and hypothesis they developed when answering the discussion questions for Bald Eagle Activity 2.

Activity

1. Divide the class into groups of four. Give each student or each group a copy of the datasheets from “BaldEagleActivity3_datasheets” and the graph from “BE3graph”.
2. If possible display the graph from “EagleExAct3” on the screen of the classroom.

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3. Have students work as a group to answer the discussion questions in their workbooks and develop a final hypothesis. Remind students to refer to the datasheets as well as the graph when answering the questions.
4. Review the discussion questions as a class.
5. If time permits, have each group present their hypothesis and the experiment they developed to test their hypothesis.

IV2. Bald Eagle Activity 3 – computer enrichments

Option 1:

Provide students with the datasheets “baldeagle5” and “baldeagleCA” but not the graph. Have students create the graph in Excel.

Option 2:

Do not provide any handouts. Give students their assignment in terms of what kind of graph they need to create and have students organize the data, calculate averages, and make the graph themselves.