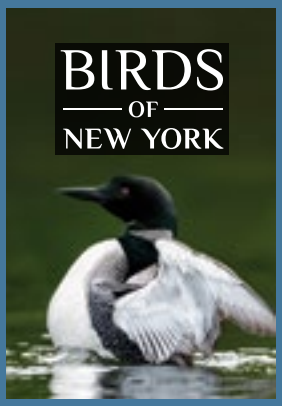

LESSON FOR EDUCATORS

GRADES 6–12

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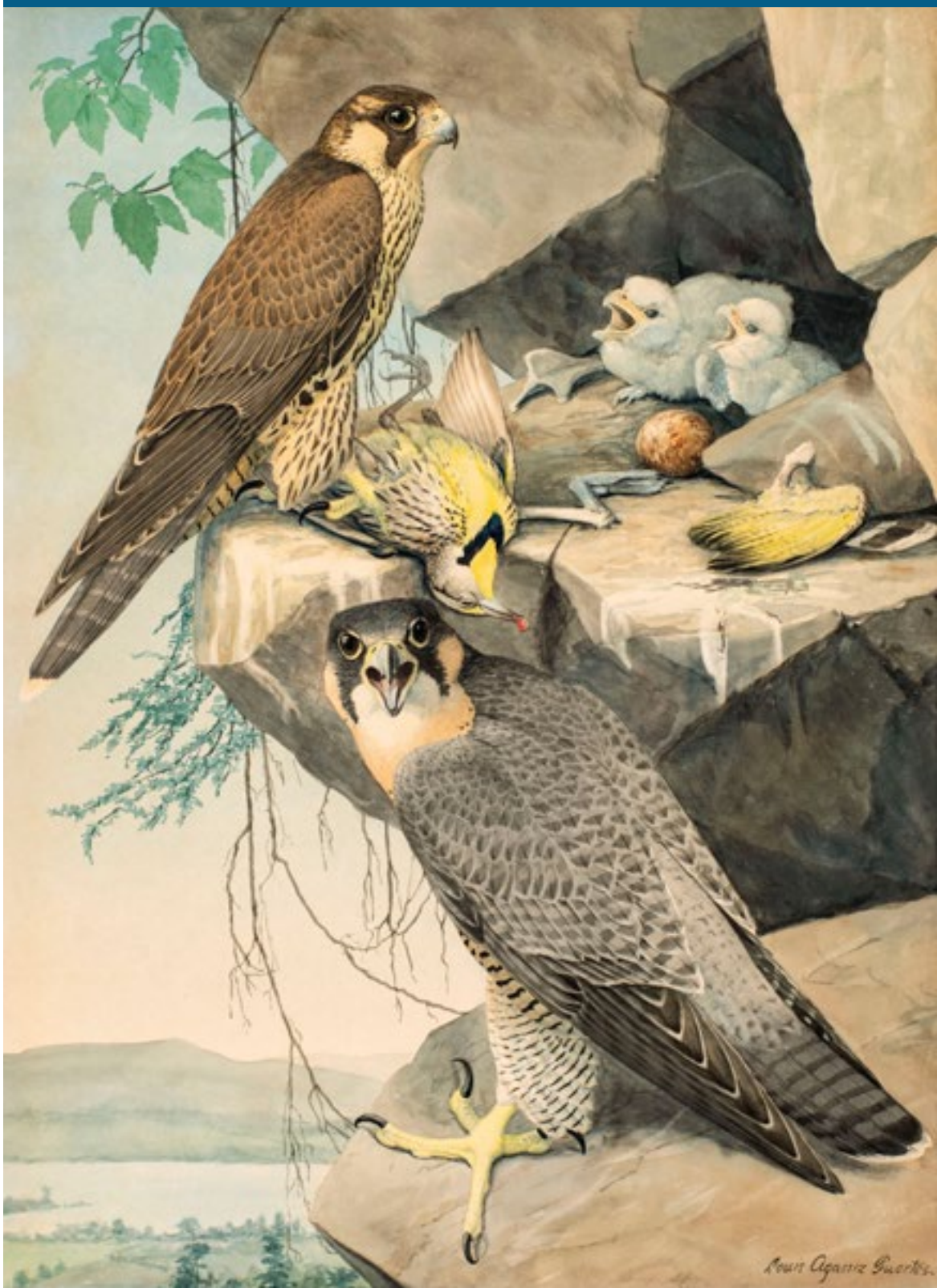
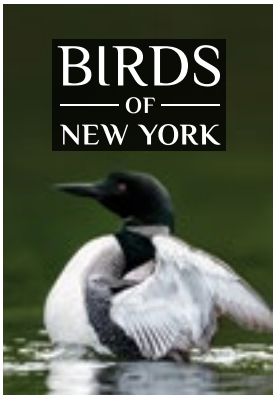
SCIENCE LAB

EXPLORING DDT'S EFFECT ON RAPTOR POPULATIONS





LESSON FOR EDUCATORS

GRADES 6–12

OBJECTIVES

1. Students will compare the findings of Dr. Ratcliff to data obtained from NYS Museum specimens to determine accuracy of his findings.
2. Students will implement techniques used to determine eggshell thinning.
3. Students will evaluate the techniques used to measure chicken eggs and propose an alternate methodology.

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SCIENCE LAB

EXPLORING DDT'S EFFECT ON RAPTOR POPULATIONS

INTRODUCTION

The renovated *Birds of New York* exhibition at the NYS Museum features an exhibit focusing on the extinction and recovery of specific birds in New York State. Museum specimens help tell the story of how birds, such as the Passenger Pigeon, have disappeared and how other species, such as the Peregrine Falcon, nearly went extinct due to the agricultural use of pesticides.

ABOUT THIS LESSON

While exploring this lab, students will build an understanding of how the agricultural pesticide DDT caused populations of many bird species to crash by causing eggshell thinning. Additionally, students will learn about museum specimen collections and how egg specimens were used to establish the links between population declines, eggshell thinning, and DDT exposure.

Below you will find instructions for leading this science lab with your students. On our Education Resources webpage, you will find the Student Handout part of the lab to print and distribute to your students.

In addition to this lab activity, find other classroom activities related to bird research and conservation on our website at www.nysm.nysed.gov/education.

The New York State Learning Standards met in this lesson are included at the end of this guide. For more information on the standards, visit www.nysed.gov/next-generation-learning-standards.

TIME:

- This lab will take two 45-minute lab periods.

MATERIALS NEEDED:

- One raw chicken egg for each pair or group of students
- Electronic balances with the capability to measure weight as small as 0.1 g
- Petri dishes or low, small containers to keep the eggs from rolling off the scale
- Graduated cylinder or graduated beaker large enough to measure volume displacement with units in milliliters if possible (Tip: Unused urinalysis cups work well for this.)
- Rulers or calipers (enough for each pair of students)
- Copies of the Student Handout for each student
- *Optional:* Computer access to create data sets and graphs

SCIENCE LAB

EXPLORING DDT'S EFFECT ON RAPTOR POPULATIONS

LESSON FOR EDUCATORS

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LAB DESCRIPTION AND PROCEDURE

Students conducting this lab measure and weigh chicken eggs before and after blowing out the contents. The measurements enable them to calculate eggshell thickness, using the mathematical equations provided. This activity requires multiple class periods to complete because the eggshells must dry overnight prior to the final weighing.

On day one of the lab, demonstrate how to derive an eggshell's surface area from measurements of either the volume or the mass of a whole egg and demonstrate how to blow out the contents so you can measure the mass of just the shell after it is clean and dry. After your students' eggshells are rinsed, leave them to dry overnight. On day two, measure the mass of the empty eggshell, and use Equation 2, along with your previously measured surface area, to obtain the thickness of the eggshell in centimeters. Then gather the data from the groups for plotting and discussion.

- **STEP 1 –** Have students read the background material about studies of eggshell thicknesses and DDT provided in the Student Handout.
- **STEP 2 –** Have your students analyze data provided from Peregrine Falcon egg specimens from the NYS Museum. Then have students plot the data from these eggs directly on the D. A. Ratcliff graph on their own handouts.
- **STEP 3 –** Have students measure the volume and mass of a raw egg, and use the mathematical equations provided to determine surface area.
- **STEP 4 –** Have students prepare eggshells by blowing out the contents, rinsing them with squirt-bottles or at the sink, and leaving them overnight to dry.
- **STEP 5 –** On day 2, have students weigh the empty, dry eggshells and determine their thicknesses using a second provided equation and provided density of chicken eggshells.
- **STEP 6 –** Collect the final thickness estimates from each group and post them in the classroom (whiteboard, etc.) so you can discuss the variation among groups. Ask groups to provide answers to the provided questions, either in class or as homework.

NOTES AND TIPS

- Have students place a unique number in pencil on each (e.g., Kanesha and Eli - #1, Malcolm and Amaya - #2, and so on). This makes it easier to create a summary of all the data later, should you choose to do so, and makes it possible to re-measure if there are any calculation issues.
- If you have limited equipment (set up stations with the scale, overflow can, calipers, etc.) pairs of students can take turns at each station. They can also compare their results if they measure with both rulers and calipers and decide which version is more accurate. We enjoyed brainstorming ideas for how to achieve the best results since there are many possible solutions to the problem of how to accurately measure an egg. Historically, many different scientists have produced many different solutions; we encourage teachers to enjoy this aspect of the scientific process with their own students.
- We recommend experiment with an egg prior to students engaging in this learning activity. You can choose either the one hole or two-hole method to remove the contents of an egg based on the equipment you have and student skills.
- Extensions could include comparing commercial eggs to farm market eggs, or different varieties of hens or duck or grouse eggs to chicken eggs if these can be obtained. Brown v. white? Small v. jumbo?

NYS Museum
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LESSON FOR EDUCATORS

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RECOMMENDED READING

David B. Peakall, "DDE-induced eggshell thinning: An environmental detective story," *Environmental Reviews* 1, no. 1 (1993): 13-20, www.jstor.org/stwable/envirevi.1.1.13. (Retrieved November 6, 2020.)

SAMPLE LAB REPORT ANSWERS

1. **How much variation is there in the eggshell thickness calculated by different groups?**

   They vary by 0.3 mm. That's a lot, considering they are only about 0.4 mm thick.

2. **Do chicken eggshells really vary this much, or is the variation due to methodological differences?**

   They probably are not that variable. It is surely due to measurement error. It was very hard to get the surface area using the volume method.

3 **Explain how you might change the lab procedure to determine the source of variation among groups, and the true variation in eggshell thickness among eggs.**

   Number the eggs at the start of the lab and have each group make measurements on more than one, so we can see how much the estimate of thickness depends on who measures the egg.

4. **Why do you think it took years of research to convince the public that DDT was responsible for the decline of raptor populations?**

   It takes many repeated studies before skeptical people believe in surprising scientific discoveries. Also, manufacturers of DDT and other pesticides actively opposed environmental regulations that would cut into profits. They sowed doubt in the DDT eggshell studies the same way that fossil fuel companies have sowed doubt in the reality of global warming, and how cigarette companies sowed doubt in the health hazards of smoking.

New York State Museum

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NYS Science Learning Standards:
MS-LS2-4; HS-LS4-5; HS-LS2-2

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WINTER 2021

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Museum Educators
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Cover Photo
Peregrine Falcon first-year male (holding prey), adult female, chicks and egg

Reproduction of original watercolor by
Louis Agassiz Fuertes (NYSM H-1977.74.45)

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