Teacher Considerations for Successful Investigations

Excerpted and adapted from Investigating Evidence, Bird Sleuth K-12.
A complete pdf is available as a free download at http://www.birdsleuth.org/investigation/

TEACHERS: Scampers figured out what was going on with the owl in the garden by following Scientific Practices (asking a question, carrying out investigations, constructing an explanation, and communicating information to others.) You can help your students carry out their own investigations by considering the following questions.

How will you focus student investigations and inspire questions?

To help students focus, choose a particular topic or theme. For example:

- While on a nature walk, instruct students to focus their observations and questions on a particular type of animal, such as birds, insects, frogs, squirrels, etc.
- Have students address a problem or issue they see in your schoolyard.
- Focus on an aspect in the school garden such as the effect of soil, water, or compost on plant growth.
- Instruct students to focus on an animal species that can be observed in your schoolyard or local area.
- Investigate a body of water such as a nearby stream, pond, or vernal pool.

How will students conduct investigations?

- How long do you have for the unit? (Some questions will be difficult to answer in the span of a 2-week unit. Consider reviewing questions to make sure they can be addressed in the time you have.)
- Will they need to do an experiment? Conduct an observational study? Consult online or print resources? Examine citizen-science data? Some combination? Or is the format flexible?
- Will they work in teams, as a class, or individually? Can they choose whether they work with a partner or group? Will you assign group members? What do you need to do to prepare them for collaborative work?

How will students present their work?

- Will they complete a written report? What length and/or format will be required?
- Will they use illustrations, graphs, or other visuals?
- Will the reports be compiled into a class science journal? Might they publish a school newsletter?
- Will they prepare a display? Will they take part in a science fair? Will they share what they have learned with the school or with parents at a festival or open house.
- How will you assess their work?

Section Three: *No Child Left Inside*

Richard Louv, author of *Last Child in the Woods*, has coined the expression "nature deficit disorder" to describe the nature-child disconnect he sees in our culture. He says, "Today, kids are aware of the global threats to the environment, but their physical contact, their intimacy with nature, is fading." Louv cites research that "links our mental, physical, and spiritual health directly to our association with nature."

An ideal way to get students outside and into nature is through citizen science projects, many of which are described in *How We Know What We Know About Our Changing Climate*.

Citizen science refers to any scientific project or program that uses a network of volunteers to conduct research. Research tasks usually focus on collecting phenological data by making observations and recording measurements. (Phenology is the study of life cycle events, such as the first leaf on a tree, the first frog spawn laid, or the first swallow seen.) Citizen scientists are crucial to research because the large network of volunteers helps scientists gather vast amounts of data that would otherwise be impossible to collect. This data helps scientists better understand what is happening to a particular species or habitat. The data is often incorporated into management and conservation plans and used to guide local, state, and federal policy development.

Benefits of Citizen Science

In addition to helping scientists, citizen science projects provide students with meaningful and effective ways to learn. Participation in citizen science has the following benefits:

- **Engages students in learning.** Citizen science is fun and interesting for students! When students are interested in what they are doing, they learn more easily, achieve at a higher level, and remember what they've learned.
- **Makes real-world connections to the classroom.** Students get a first-hand experience of what it means to be a scientist and often gain access to experts in the field. Citizen science projects extend learning beyond the school building. As students realize that learning isn't limited to the classroom, they are encouraged to become life-long learners.
- **Supports academic skill development.** Citizen science is truly an interdisciplinary experience with many opportunities for students to use and practice skills in reading, writing, and math. Research shows a correlation between environmental education and higher test scores.
- **Accommodates students with varying learning styles and differences.** Citizen science is experiential and hands-on, making it one of the most effective ways for students to learn. Students who are unsuccessful with traditional classroom assignments often excel in project-based leaning.
- **Strengthens connections to community.** Citizen science projects help students develop greater social awareness and responsibility. As a result they often take greater pride in their community. In citizen science projects that involve community members, students learn to connect with other adults.
- **Fosters a sense of stewardship of the environment.** As students' awareness of their environment increases, they learn to value nature; and when they value the natural world, they are inspired to take care of it. Brian Day of the North American Association for Environmental Education states, "Once children enjoy the outdoors and understand how the environment works, teaching them about environmental issues can empower them."
- **Increases a sense of personal worth and competence.** Citizen science gives students the opportunity to make a valuable contribution. Their self-confidence increases as they feel that they are making a difference in the world and positively impacting the environment.
- **Improves school performance.** Citizen science is a form of "project-based learning," and educational research has found that, "Schools where project-based learning is practiced find a decline in absenteeism, an increase in cooperative learning skills, and improvement in student achievement." [Source: www.edutopia.org].

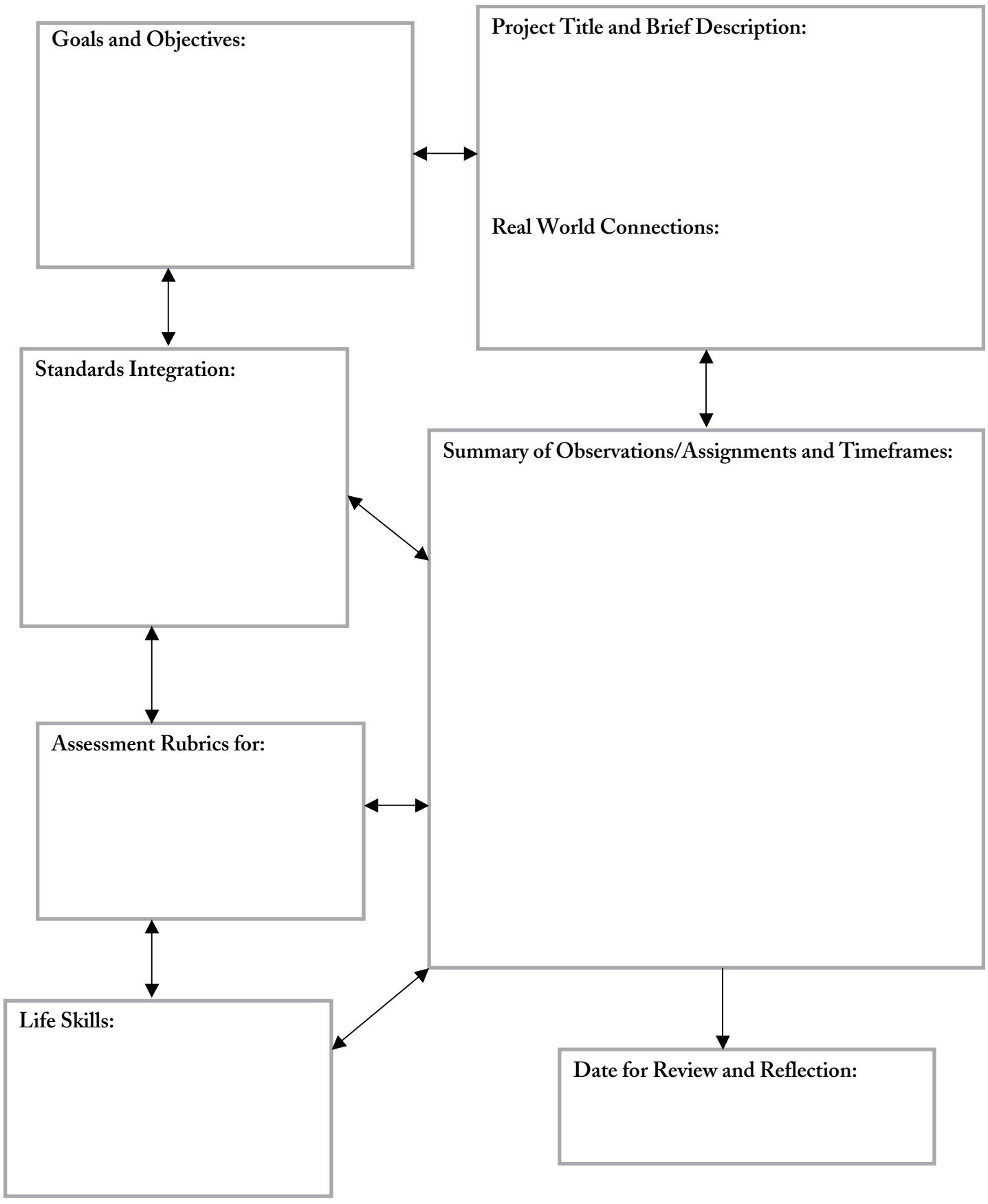
Suggestions for Implementing a Citizen Science Project

Planning and managing a citizen science project requires consideration about a wide range of issues. Use the tips below for a successful start to using citizen science in your classroom.

- **Choose projects that appeal to your students.** Projects are most effective when they are student-centered; therefore, the first step in planning is to determine your students' needs, interests, and motivations. *How We Know What We Know About Our Changing Climate* mentions a variety of citizen science projects that are available for classroom participation, including Classroom FeederWatch, Project BudBurst, and Monarch Watch. (These and other projects are explained in more detail on the pages that follow.)
- **Start small.** Don't feel as though you have to commit to a year-long project the first time you use citizen science in your classroom. Shorter projects with specific beginning and end dates are easier to manage and give you and your students time to adjust to a new way of learning. Stay within your comfort zone and branch out as you gain experience and success.
- **Adjust your role.** In project-based learning, your focus shifts away from delivering information and moves toward organizing learning experiences. A lot of your work will be done before the project begins. Once students are in the field, you become the "guide on the side" monitoring and facilitating their success.
- **Integrate goals and objectives with curriculum standards.** Make sure that the project fits into your science, social studies, and/or language arts curriculum. Many citizen science projects have supplemental teacher information that identifies the national and state standards that correlate with the project. In addition to academic goals, projects are also an excellent avenue for teaching life skills, such as collaboration, cooperation, perseverance, and self-discipline.
- **Establish clear guidelines and expectations for behavior outside.** Discuss your expectations for acceptable behavior with students before the project begins. Working outside has its own unique management challenges, so have a specific goal for each outdoor session. Providing each student or group with a clipboard for recording data helps students stay focused.
- **Use rubrics to assess student performance.** Identify specific criteria for evaluation of each outdoor session or classroom assignment, and give students feedback throughout the project, not just at the end. Rubrics help students stay motivated and do their best work.
- **Tap into all available resources.** Many projects provide free training and materials, and your school district may have grants available specifically for science-related education. Local zoos, museums, clubs, and environmental groups or businesses are also excellent sources of support and may provide supplies or materials for your project.
- **Communicate your plans with administrators and parents.** Use the "Project Summary Sheet" on the following page to succinctly share your project with parents and administrators. Get their support upfront and then share your progress and success with them. Taking photos of your students at work in the field is an excellent way to keep everyone informed. The "Project Summary Sheet" helps you plan each aspect of your project and it also gives students an at-a-glance overview of the project.
- **Take time to review and reflect.** Debriefing may include class discussions, journal entries, and/or written assignments. Address the goals that students accomplished, information and skills that they learned and practiced, and the ways that they contributed to science. Also evaluate what went well and what they would do differently next time.
- **Renew and revitalize yourself.** There's no denying that implementing a citizen science project can be a lot of work. To stay motivated, get support and inspiration from others by attending conferences, networking with other teachers, and involving parents and community members.

Special thanks to Fran Bosi and Lori Painter for contributing their ideas and suggestions to this list.

Citizen Science Project Summary Sheet



Outstanding Citizen Science Projects for the Classroom

Journey North www.learner.org/jnorth Journey North is an online global study of wildlife migration and seasonal change. Students K-12 report their own field observations. The process is simple. Once each month, students go outside as a class and record the changes they see. They use Phenology Checklists to record their findings. Journey North has excellent teacher and student materials available online. The web site has migration maps, pictures, standards-based lesson plans, activities and information to help students make local observations and fit them into a global context. Widely considered a best-practices model for education, Journey North is a premiere citizen science project for students.

Year-at-a-Glance Timeline
Tulip Gardens: September–May
Monarch butterflies: September–October and February–June
Symbolic Migration: September–October and March–May
Whooping Cranes: September–December and February–May
Bald Eagles: February–May
Gray Whales: February–May
Hummingbirds: February–May
Mystery Class: February–May
Robins: February–June
Weather and Migration: February–June
Other Signs of Spring: February–June

Cornell Laboratory of Ornithology www.birds.cornell.edu The lab sponsors a variety of citizen science projects.

Citizen Science Project	Web site	Season
Project FeederWatch Count birds at feeders	www.birds.cornell.edu/pfw	November–March
BirdSleuth Observe birds and record data ($79 fee includes curriculum)	www.birdsleuth.org	Year-round
Urban Bird Studies Study doves, crows, gulls, pigeons, and other city birds	www.urbanbirds.org	Year-round
eBird Report bird sightings	www.ebird.org	Year-round
NestWatch Monitor nests and breeding	www.nestwatch.org	Spring/Summer
Birds in Forested Landscapes Study habitat requirements	www.birds.cornell.edu/bfl	Spring/Summer
House Finch Eye Disease Track the spread of the disease	www.birds.cornell.edu/hofi	Year-round
Great Backyard Bird Count A continent-wide snapshot of winter birds	www.birdcount.org	President's Day weekend in February

GLOBE www.globe.gov

Around the world, K-12 students are making scientific observations and reporting their data to GLOBE for use in research. For a school to participate in GLOBE, at least one teacher must be trained in the GLOBE science measurement protocols and education activities by attending a GLOBE Teacher Workshop. Training in the protocols is free. Additionally, NSF and NASA have funded GLOBE projects, collectively called the Earth System Science Projects (ESSPs). They include: Seasons and Biomes Project, Carbon Cycle Project, Watershed Dynamics Project, and From Local to Extreme Environments (FLEXE) — a deep ocean project.

Project BudBurst www.windows.ucar.edu/citizen_science/budburst

Project BudBurst is a national citizen science field campaign that targets native tree and flower species across the country. By recording the timing of the leafing and flowering of native species each year, scientists can learn about the prevailing climatic characteristics in a region over time. They will use student data to compile valuable environmental information that can be compared to historical records to illustrate the effects of climate change. An Activity Guide details the six steps for completing a Project BudBurst phenological investigation. Additional student and teachers resources are available online.

Monarch Watch www.monarchwatch.org

Monarch Watch is a citizen science project that involves volunteers across the United States and Canada who tag individual butterflies to assist scientists in studying and monitoring monarch populations and the fall migration. There are a number of ways that teachers can get their classroom involved with Monarch Watch. In addition to rearing Monarchs, ongoing research projects that rely on student-scientist partnerships include Tagging Monarchs, Larval Monitoring, Monarch Size and Mass, Monarch Flight Vectors, and Hydrogen Isotopes. Students are also encouraged to showcase their research or school projects on the Monarch Watch web site. Curriculum materials are available online.

Tomatosphere www.tomatosphere.org

Tomatosphere has a dual-purpose: to educate and inspire young students and to open the door for extended space exploration, eventually leading to Mars. Teachers receive two packages of tomato seeds, one package to use as the control group; the second package contains the same seeds but they have been subjected to conditions that simulate the process of aerocapture as the space vehicle enters the atmosphere of Mars. The scope of the experiment will depend on the teacher. There are extension ideas that involve many aspects related to plants, space and space travel, and its application to life on Earth. Results are sent electronically to be posted to enable participants to compare their results with those of other classrooms across the country.

Audubon Society Christmas Bird Count www.audubon.org/bird/cbc

The Christmas Bird Count is an early-winter bird census, where volunteers follow specified routes through a designated 15-mile (24-km) diameter circle, counting every bird they see or hear all day. It's not just a species tally—all birds are counted all day, giving an indication of the total number of birds in the circle that day. All individual CBC's are conducted in the period from 14 December to 5 January each season, and each count is conducted in one calendar day.

IN CANADA

NatureWatch www.naturewatch.ca/english

NatureWatch includes a suite of monitoring programs such as FrogWatch, IceWatch, PlantWatch and WormWatch which form the founding components of NatureWatch. These programs encourage schools, community groups, individuals, naturalists, back-yard enthusiasts, Scouts and Guides to engage in the monitoring of soil, air, water and other aspects of environmental quality.

Center:

Owl Pellets

Multiple Intelligence:
Naturalist

Objective:

Examine owl pellets for evidence of rodent, vole, shrew, or bird bones.
Classify and identify bones.
Optional: Reconstruct a rodent skeleton

Benchmarks:

Knows that objects can be classified by their physical properties. (Science 10, Level I)

Knows that living things can be sorted into groups in many ways using various properties to decide which things belong to which group; features used for grouping depend on the purpose of the grouping. (Science 4, Level II)

Knows that all animals depend on plants; some animals eat plants for food while others eat animals that eat the plants. (Science 8, Level II)

Knows that all species ultimately depend on one another; interactions between two types of organisms include producer/consumer, predator/prey, parasite/host, and relationships that can be mutually beneficial or competitive. (Science 7, Level III)

Effectively uses mental processes that are based on identifying similarities and differences (compares, contrasts, classifies). (Life Skills: Thinking and Reasoning 3, Levels I, II, and III)

Skill for Living:

Concentration — being able to focus attention.

Materials:

Owl Pellets (See description in *Center Directions*.) — one per student or student group
Toothpicks — one per student
Paper plates — two per student
Owl Pellets — Bone Identification Chart (Copy Master page 13) — one per student
Optional: magnifying glasses for students to share
Optional: spray bottle of water—for teacher to use to spray pellets to make them easier to break apart.

Teacher Preparation:

Order owl pellets. They are available from Pellets, Inc., Kim and Bret Gaussoin, PO Box 5484 Bellingham, WA 98227, Phone: 360-733-3012 OR (fax) 360-738-3402, http://www.pelletsinc.com.
Allow one week for delivery.
Make copies of *Owl Pellets — Bone Identification Chart.*
Copy and laminate *Center Directions*.

Reflection Questions:

1. What kinds of bones did you find in the pellet?
2. Were the bones difficult to identify and classify?
3. What techniques and strategies did you develop as you took apart the pellet and classified bones? What will you do the same or differently when you work with the pellets next time?
4. What information did the pellets give you about the owl's diet? Is the owl an herbivore or a carnivore? A predator or prey?

Note: Students have a lot of fun with this activity and can get very excited as they find the bones. I suggest that you do this activity first with the whole class, and then set up the materials at a center for students to explore again during center time.

Center Directions:

Owl Pellets

At this center you will:

Take apart owl pellets to discover information about the owl's diet.
Identify and classify the bones you find.

Materials you should find at this center:

Owl Pellets — one per student or student group
Toothpicks — one per student
Paper plates — two per student
Copy of *Owl Pellets —Bone Identification Chart* — one per student

What you need to bring to this center:

Paper and pencil
Concentration — being able to focus attention.

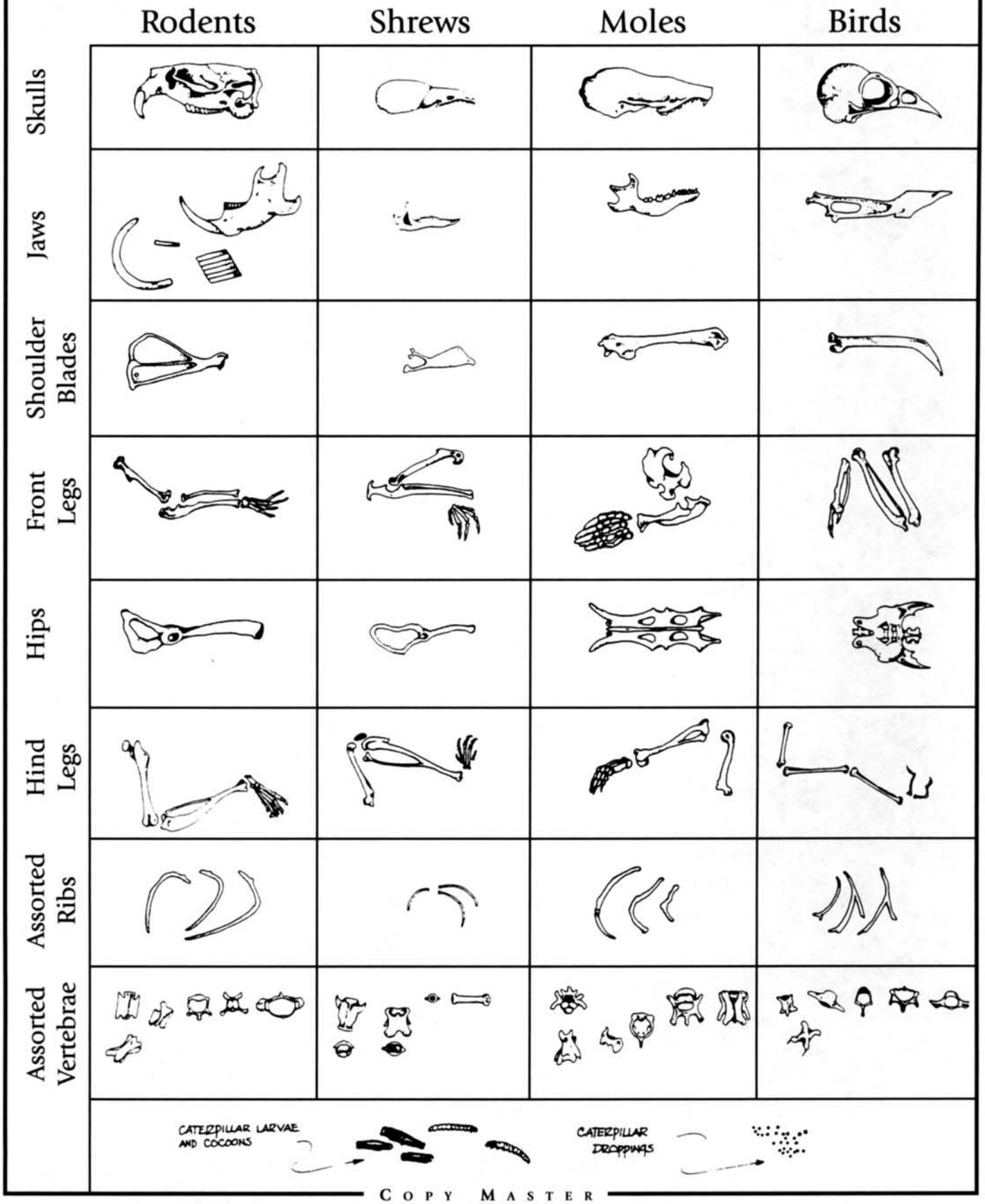
Student Directions:

1. Owl pellets are the compact undigested parts (bones and fur) from an owl's diet. Several hours after a meal, an owl will spit out a pellet. Put the owl pellet on one of your paper plates.
2. Using the toothpick, gently begin pulling it apart. As you separate the pellet you will find tiny bones mixed in with the fur. Wetting the pellet with water can sometimes help to loosen the fur.
3. Put the bones on the other paper plate. Use the *Bone Identification Chart* to identify the bones you find. Sort them by putting them in different parts of the paper plate. For example, the skulls go in one area, the leg bones in another, the ribs in another. You may have one area on your plate for unidentified bones.
4. Once you have sorted all of the bones in your pellet, count how many of each type you found and write the information on your paper. You may use this information at a later time.
5. Keep the bones in a place designated by your teacher. Throw away the toothpicks, paper plates, and fur. **Wash your hands.**

Extension Activities:

Put together a complete skeleton of a rodent.
Graph the amounts of each kind of bone that the class found.

Bone Identification Chart



COPY MASTER