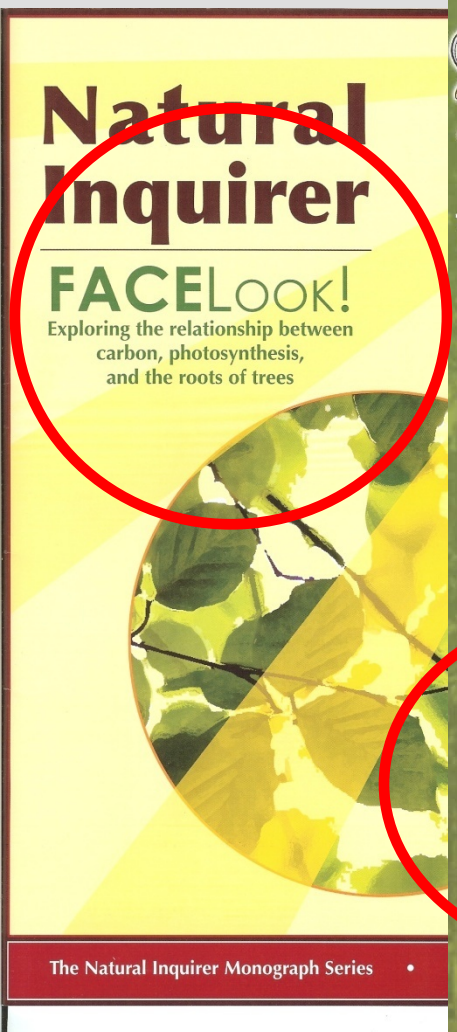
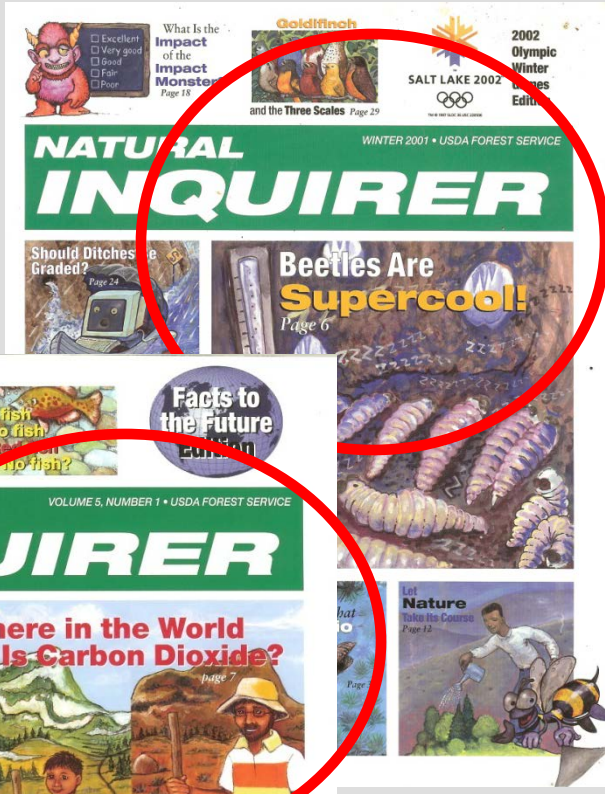
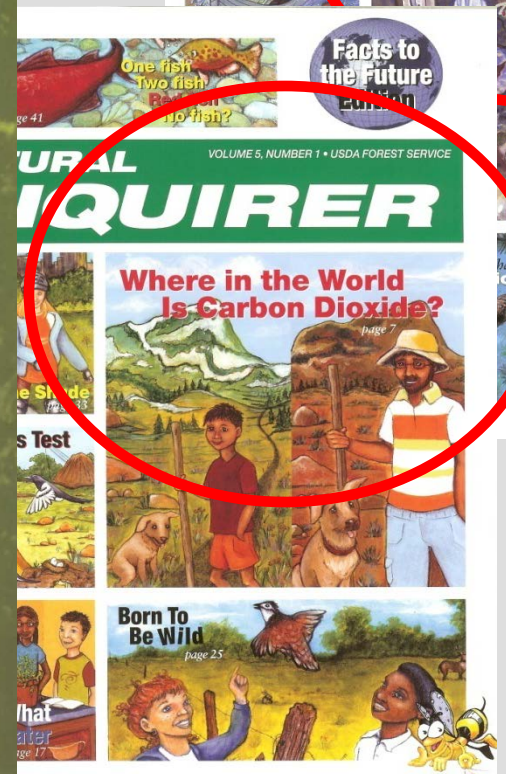
Natural Inquirer

A science education resource for climate change education…

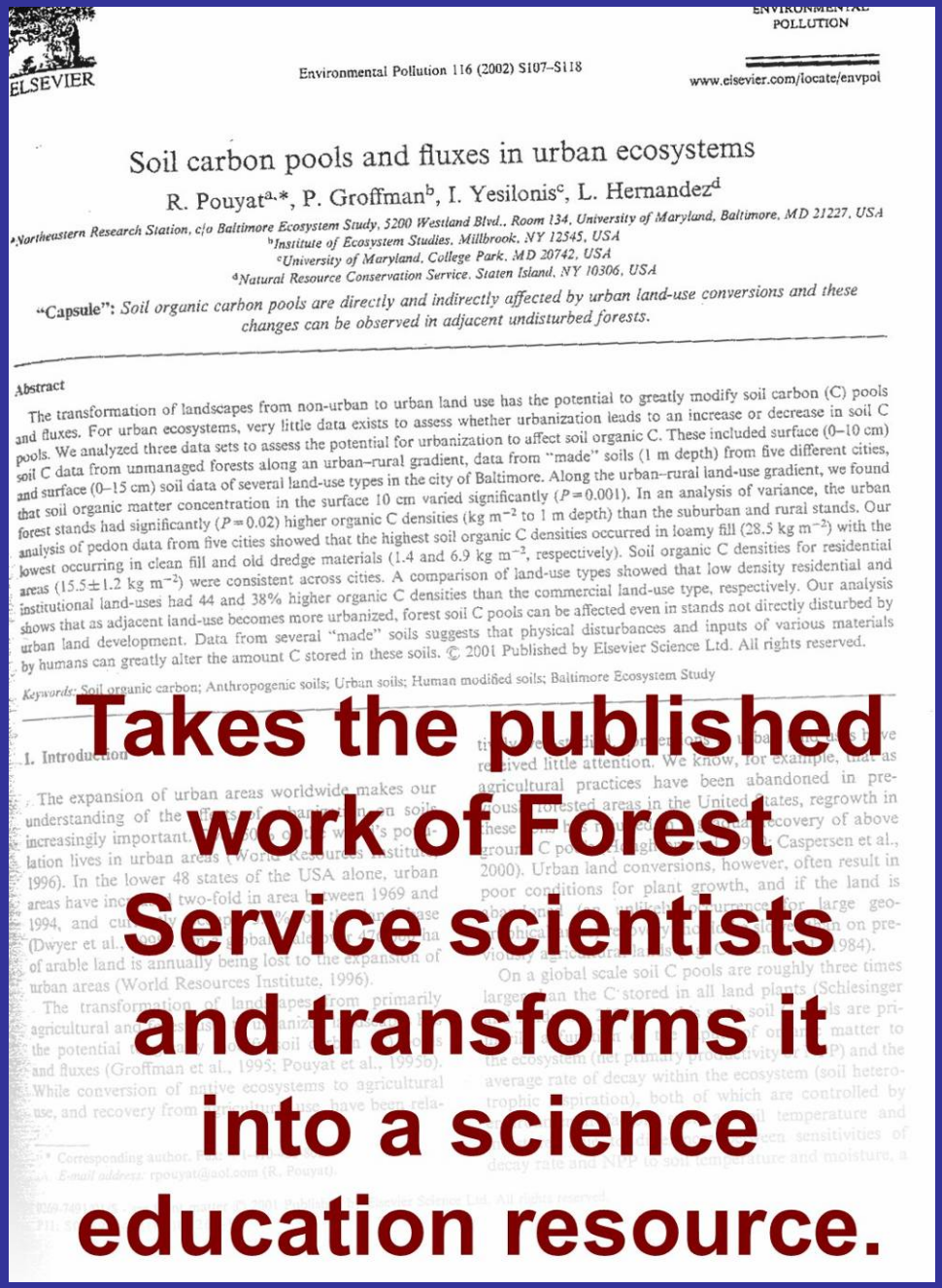






Using **Natural Inquirer** for climate change education allows your students to:

- **Practice critiquing & critically assessing current climate change information**
- **Practice critical thinking about research in general, & climate change research specifically**
- **Through such education, we create global citizens & promote environmental & cultural sustainability**
- **Make better informed judgments & decisions**



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ENVIRONMENTAL POLLUTION

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Soil carbon pools and fluxes in urban ecosystems

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"Capsule": *Soil organic carbon pools are directly and indirectly affected by urban land-use conversions and these changes can be observed in adjacent undisturbed forests.*

Abstract

The transformation of landscapes from non-urban to urban land use has the potential to greatly modify soil carbon (C) pools and fluxes. For urban ecosystems, very little data exists to assess whether urbanization leads to an increase or decrease in soil C pools. We analyzed three data sets to assess the potential for urbanization to affect soil organic C. These included surface (0–10 cm) soil C data from unmanaged forests along an urban–rural gradient, data from "made" soils (1 m depth) from five different cities, and surface (0–15 cm) soil data of several land-use types in the city of Baltimore. Along the urban–rural land-use gradient, we found that soil organic matter concentration in the surface 10 cm varied significantly ($P=0.001$). In an analysis of variance, the urban forest stands had significantly ($P=0.02$) higher organic C densities (kg m^{-2} to 1 m depth) than the suburban and rural stands. Our analysis of pedon data from five cities showed that the highest soil organic C densities occurred in loamy fill (28.5 kg m^{-2}) with the lowest occurring in clean fill and old dredge materials (1.4 and 6.9 kg m^{-2}, respectively). Soil organic C densities for residential areas (15.5±1.2 kg m^{-2}) were consistent across cities. A comparison of land-use types showed that low density residential and institutional land-uses had 44 and 38% higher organic C densities than the commercial land-use type, respectively. Our analysis shows that as adjacent land-use becomes more urbanized, forest soil C pools can be affected even in stands not directly disturbed by urban land development. Data from several "made" soils suggests that physical disturbances and inputs of various materials by humans can greatly alter the amount C stored in these soils.

Keywords: Soil organic carbon; Anthropogenic soils; Urban soils; Human modified soils; Baltimore Ecosystem Study

Takes the published work of Forest Service scientists and transforms it into a science education resource.

The heart of the NI is the scientific paper, written at the middle school level.

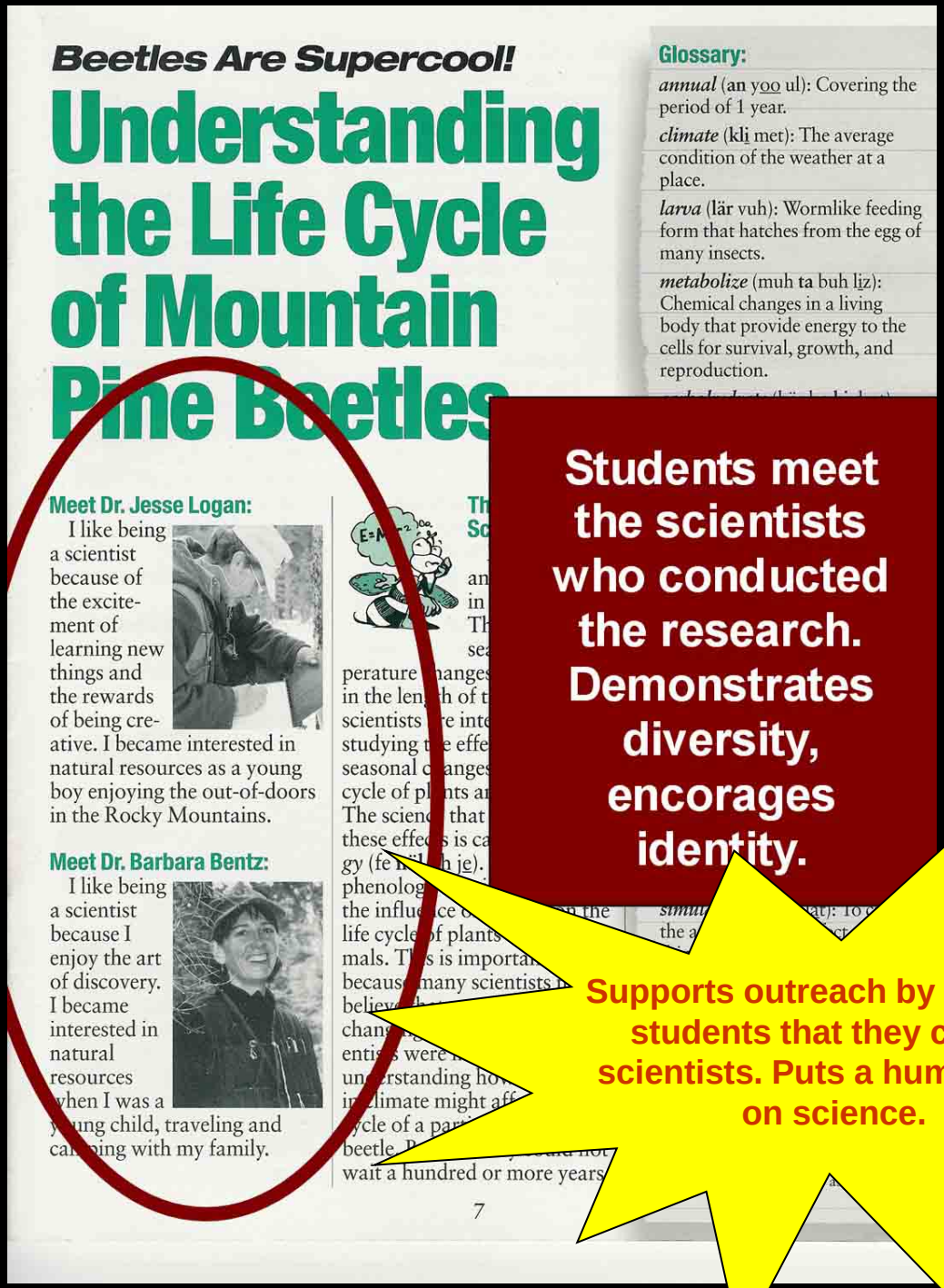
The heart of each article is the standard scientific paper format:

- Introduction
- Method
- Findings
- Discussion (or Implications)

Using **Natural Inquirer** for climate change education addresses the following **National Science Education Standards:**

- **Science as inquiry:** Abilities necessary to do scientific inquiry
- **Life science:** Regulation and behavior; Populations and ecosystems
- **Earth and space science:** Structure of the earth system
- **Science and technology:** Understandings about S&T
- **Science in personal and social perspectives:** S&T in society
- **History and nature of science:** Science as a human endeavor; Nature of science

Note: Each edition is improved based on feedback from students and educators.



Beetles Are Supercool!

Understanding the Life Cycle of Mountain Pine Beetles

Glossary:

annual (an yoo ul): Covering the period of 1 year.

climate (kli met): The average condition of the weather at a place.

larva (lär vuh): Wormlike feeding form that hatches from the egg of many insects.

metabolize (muh ta buh liz): Chemical changes in a living body that provide energy to the cells for survival, growth, and reproduction.

Meet Dr. Jesse Logan:

I like being a scientist because of the excitement of learning new things and the rewards of being creative. I became interested in natural resources as a young boy enjoying the out-of-doors in the Rocky Mountains.

Meet Dr. Barbara Bentz:

I like being a scientist because I enjoy the art of discovery. I became interested in natural resources when I was a young child, traveling and camping with my family.

wait a hundred or more years

7

Students meet the scientists who conducted the research. Demonstrates diversity, encorages identity.

Supports outreach by showing students that they can be scientists. Puts a human face on science.

Beetles Are Supercool!

Understanding the Life Cycle of Mountain Pine Beetles

A glossary of terms introduces scientific terms used in the article.

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interested in natural resources when I was a young child, traveling and camping with my family.

hinking About cience

Many plants nd animals live n *annual* cycles. hey respond to easonal tem- chan es and changes gth o the day. Some are i erested in the e ect of these chang s on the life lants nd animals. ce tha investigates cts is c lled *phenolo-* uh je). he science of y also i vestigates nce of *c mate* on the of plants nd ani- s is impo ant, many scien sts now at our clim e is changing. In this stud the scientists were interested n understanding how a ch nge in climate might affect th life cycle of a particular specie of beetle. Because they could n wait a hundred or more years

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metabolize (muh **ta** buh liz): Chemical changes in a living body that provide energy to the cells for survival, growth, and reproduction.

carbohydrate (kär bo **hi** drat): Starches and sugars that are used as food by animals.

phloem (**flo** em): Tissue that transports nutrients from the leaves to the rest of the plant.

pupa (**pyoo** puh): Intermediate stage of insect growth between larva and adult.

resin (**rez** in): Cloudy, sticky substance that oozes from some trees.

population (pop yoo **la** shun): The whole number of individuals of the same type occupying an area.

stand (stand): A group of trees growing in a continuous area.

complexity (kälm **plek** suh te): The state of being complicated or having many related parts.

simulate (**sim** yoo lat): To create the appearance or effect of something for purposes of evaluation.

indicator species (in di **kat** ür **spe** sez): Type of plant or animal that serves as a measure of the environmental health of an area.

Pronunciation Guide

a	as in ape	ô	as in for
ä	as in car	u	as in use
e	as in me	ü	as in fur
i	as in ice	oo	as in tool
o	as in go	*ng*	as in sing

Beetles Are Supercool!

Understanding the Life Cycle of Mountain Pine Beetles

Preparation to read. Students should be given background material so that they have some knowledge of the subject matter. This helps them to maintain their focus and interest (Santa, Havens, & Maycumber, 1996).

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Meet

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Thinking About Science

Many plants and animals live in *annual* cycles. They respond to seasonal temperature changes and changes in the length of the day. Some s tists are interested in studying seasonal changes on the life

wait a hundred or more years

Takes a science process concept from the article and introduces it to students. For example, teamwork in science, or the concept of various scales of inquiry.

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o as in go ng as in sing

Students need a purpose to read and comprehend well. For example, giving them background information and helping them to understand how they will use the information are powerful tools for better reading (Tovani, 2005).

Takes an environmental concept from the article and introduces it, such as species migration or the principle of adaptation.

scales, of songbird habitat, so that she could better understand which kinds of natural places songbirds prefer to live.

Thinking About the Environment

Species diversity is a particular kind of *biodiversity*. Species diversity is a measure of how many different kinds of *species* live in an area and the numbers of each species. For a natural area to be healthy, it should have many different forms of life. It is best when those species are *native* to the area. When *nonnative* species move into an area, they sometimes compete with the native species for food and homes. An example of a nonnative

species.

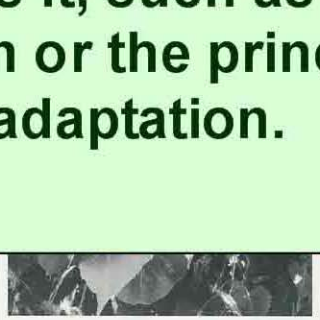


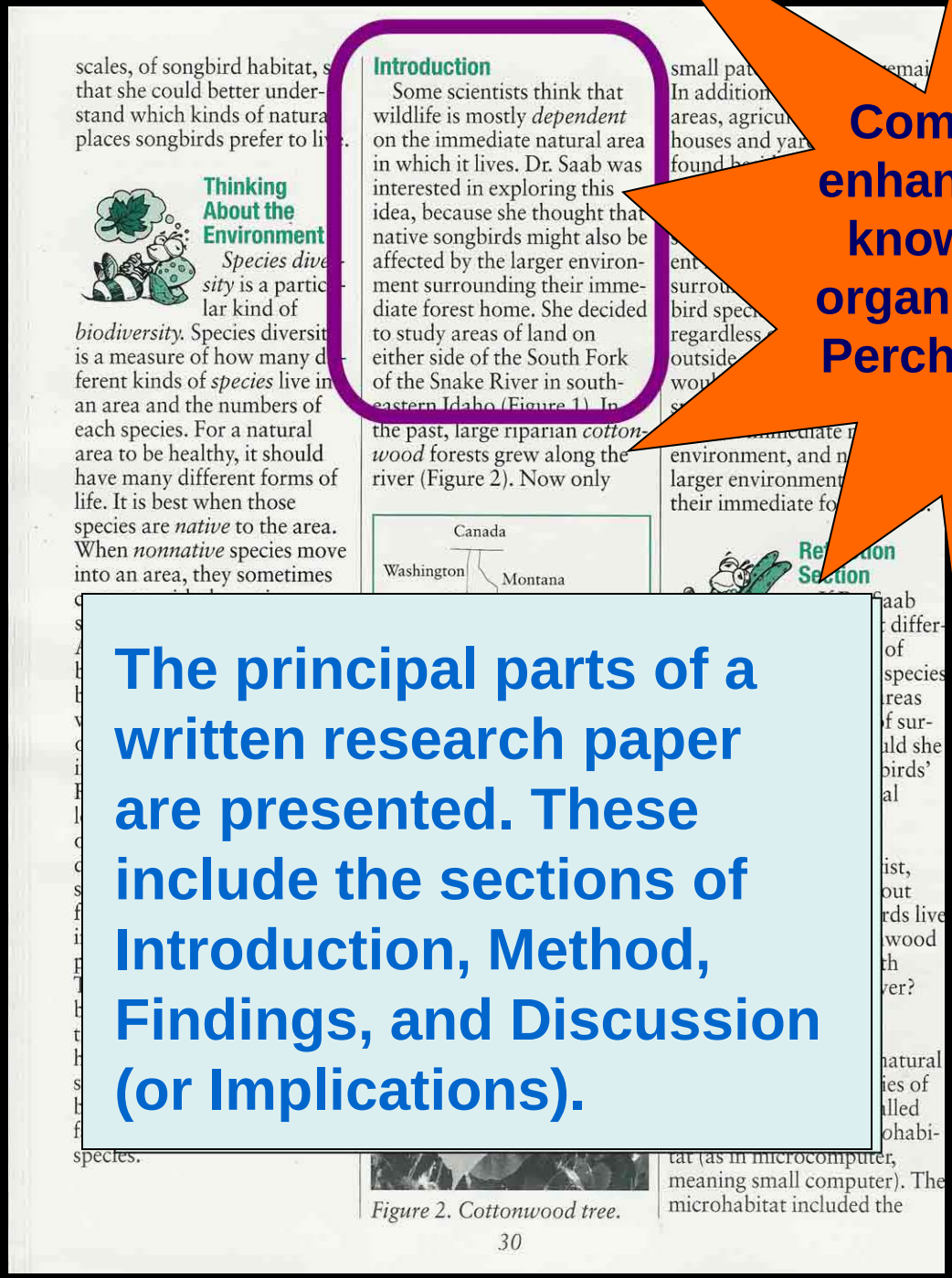
Figure 2. Cottonwood tree.

Reflection Section

- If Dr. Saab finds that different types of

habitat (as in microcomputer, meaning small computer). The microhabitat included the

Think of a newspaper. It helps to know how publications are organized.



Introduction

Some scientists think that wildlife is mostly *dependent* on the immediate natural area in which it lives. Dr. Saab was interested in exploring this idea, because she thought that native songbirds might also be affected by the larger environment surrounding their immediate forest home. She decided to study areas of land on either side of the South Fork of the Snake River in southeastern Idaho (Figure 1). In the past, large riparian *cottonwood* forests grew along the river (Figure 2). Now only

Thinking About the Environment

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Canada
Washington
Montana

Figure 2. Cottonwood tree.

30

Comprehension is enhanced if students know how a text is organized (Coutant & Perchemlides, 2005).

The principal parts of a written research paper are presented. These include the sections of Introduction, Method, Findings, and Discussion (or Implications).

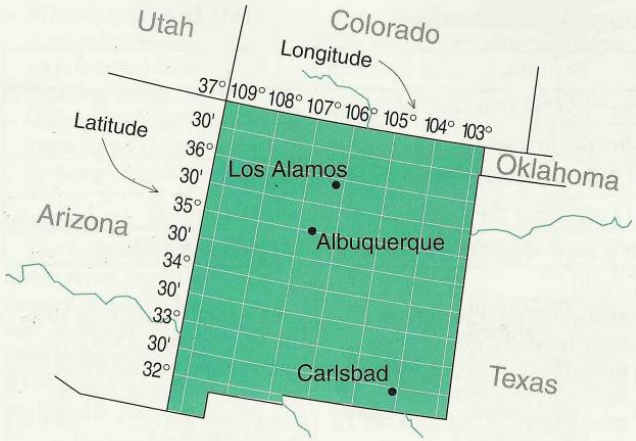
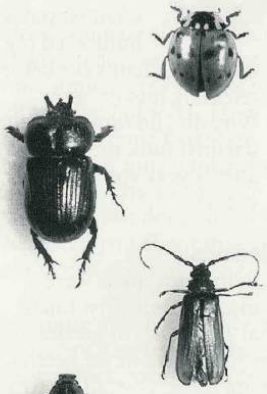


Figure 2. *Map of New Mexico with lines of latitude and longitude. Latitude consists of imaginary lines around the Earth from the equator to the poles. Longitude also consists of imaginary lines around the Earth. Each line of longitude circles the Earth through both the North and South Pole. These lines are used to identify locations on the Earth. Both latitude and longitude are identified by degrees (°), minutes (′), and seconds (″). The study area for this project was 36°, 31′ latitude north, 103° 3′ longitude west. See if you can locate where in New Mexico the scientist conducted her study.*

Figure 3. *A research assistant purposely setting fire to an area of prairie.*



2.47.) Within this area, the scientist marked off 12 separate

The scientist observed and measured six things. The six

Geography, math, and social studies are integrated into the articles where appropriate.

Figure 4. Percentage of permanent and migratory birds.

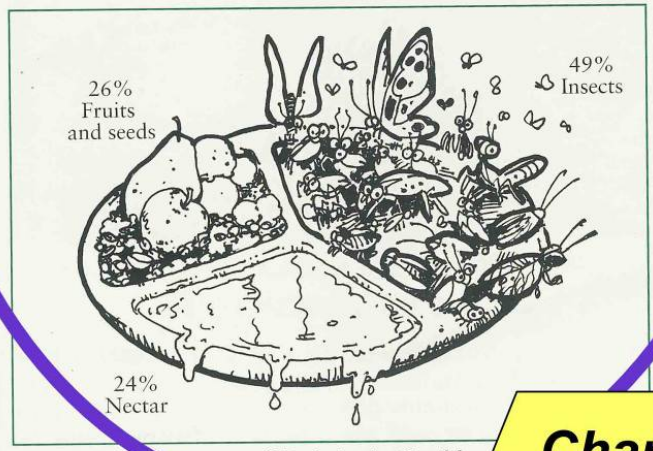


Figure 5. Food sources of birds in the Caribbe

resident birds can live in the same place at one time. With this information, people can make sure that resident and migrant birds have the kinds of places in the tropics that they need to survive. By protecting and protecting the forests that different kinds of birds need, people can help reduce the declining numbers of songbirds in the future.

Reflection Section

- A food web
- and the animals
- food. Think about insect-eating birds. What would happen to the population of insects if the birds were not there to eat the insects?
- How might protecting some tropical forests help reduce the declining number of songbirds in North America?

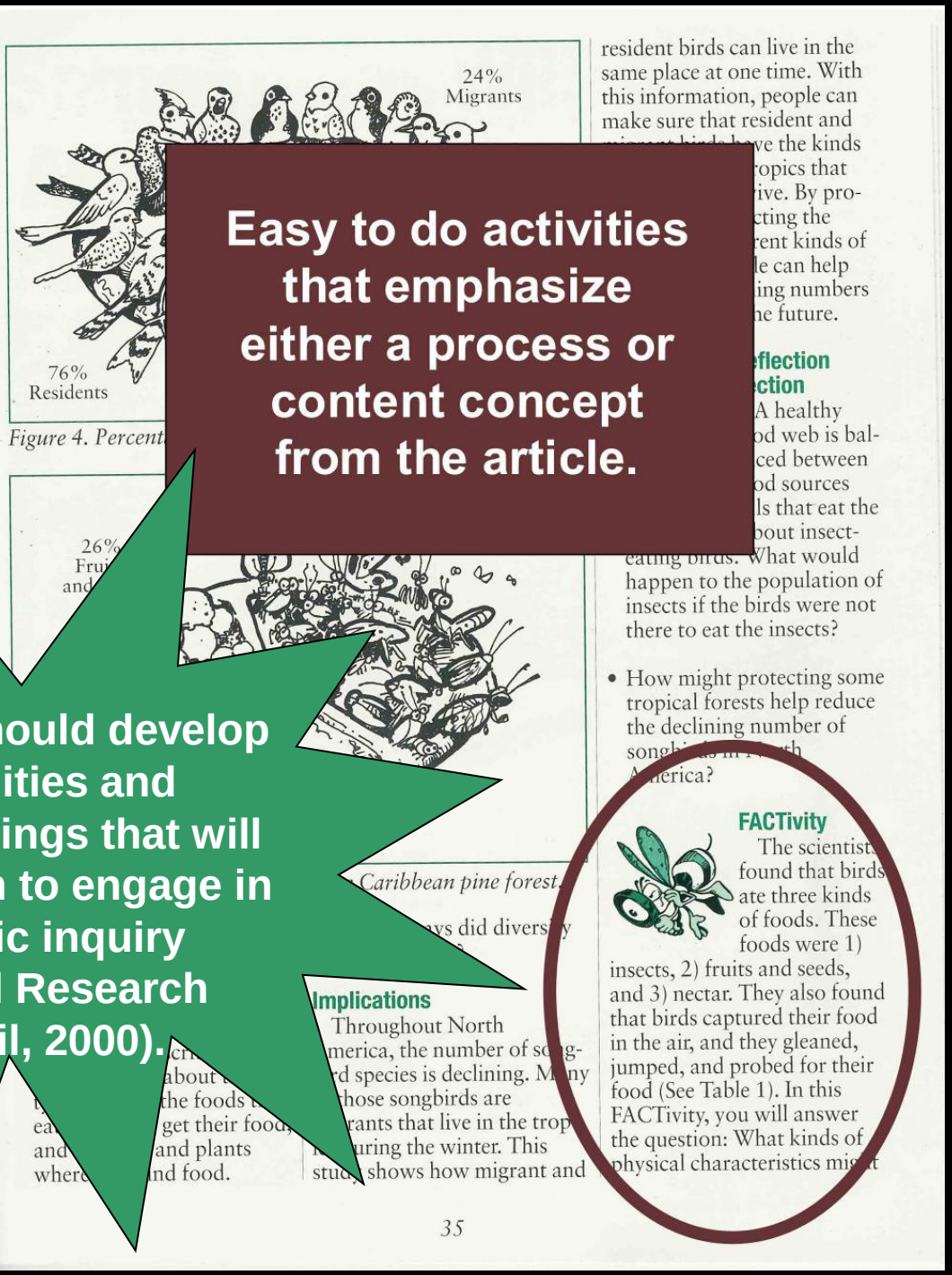
Reflection Section

- Name two examples of diversity described in this article. Think about the type of birds, the foods they eat, how they get their food, and the trees and plants where they find food.

Implications

Middle school students should learn how to read and interpret charts and graphs.

Charts and graphs display findings in an easy to read and fun format.



Easy to do activities that emphasize either a process or content concept from the article.

Students should develop the abilities and understandings that will enable them to engage in scientific inquiry (National Research Council, 2000).

Reference to Project Learning Tree activities added in later editions.

For Today's Activity, You Can Follow the Lesson Plan Yourself!

1. Divide into groups

2. Each group gets a Natural Inquirer article
3. Read your article:
   (skip glossary, scientists, reflection sections, FACTivity)

1. Complete the questions

2. Discussion

Introduction: Provides background about the problem. Leads to the research question. States the research question.

Method: Outlines the methods used to answer the research question. Should include information about the variables studied (and their definitions), time frames and design of data collection, and type of analysis (data handling: summary, comparisons, etc.

Findings: Gives the results of the analysis.

Discussion or Implications: Discusses the findings in light of the original problem. Provides possible implications, the “so what” of the findings in light of the original problem.

This article's title:

The topics covered by this article include climate change and…. (check all that apply)

- [ ] Trees and plants
- [ ] Insects and diseases of plants or animals
- [ ] Weather or climate
- [ ] Invasive species (plants or animal species that are not native)
- [ ] Fresh water
- [ ] Oceans or ice
- [ ] Coastal
- [ ] Carbon/carbon dioxide
- [ ] Ecological (dealing with natural relationships)
- [ ] Economic (dealing with the value of goods, services, or the environment)
- [ ] Social or cultural
- [ ] Dealing with the scientific discover process itself

This article's title

What was the **problem** the scientists addressed in the research?

What **question or questions** did the scientists want to answer?

What **variables** did the scientists study?

When, where, and how were the **data collected**?

How did the scientists **summarize, compare, or otherwise analyze** their data?

What did the scientists **find or discover**?

What **implications** were discussed? In other words, what potential impact will the findings

What is the **source** of the research article? For example, did the information originally come from a scientific journal, a conference proceedings, or from an interview? Your teacher may need to help you with this.

On a scale of 1 to 5, how much confidence do you have in the research findings? In other words, is there enough information provided about how the research was done to give you confidence in the findings? 1=little confidence, 5=a lot of confidence

Why did you give the rating that you did?