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Overview

Every Student Learns Teacher's Guide is a lesson-by-lesson companion to Scott Foresman *Science*. It has been designed to provide manageable support for teachers and their students who are challenged by language issues in science, no matter what the first language may be.

Every Student Learns Teacher's Guide is built upon the three pillars of English language learning as identified by Dr. Jim Cummins of the University of Toronto.

- Activate Prior Knowledge/Build Background Knowledge
- Access Content
- Extend Language

Read more about how to use the three pillars to support ESL students in learning the language of science on the following pages.

For every chapter, the **Picture It!** page is a blackline master to use with the How to Read Science page in the Student Edition. Help students use these masters to practice using target reading skills as they read. Each master provides guided practice using a picture or graphic organizer with text. Teaching notes and answers can be found on the page that follows it (Lesson 1 of the chapter).

For every lesson in each chapter, teaching strategies are provided using the three pillars, with scripted direct instruction highlighted in bold type.

- **Activate Prior Knowledge/Build Background Knowledge** Suggestions are provided to help you relate science concepts and vocabulary to students' experiences using strategies such as brainstorming, discussion, and demonstrations with concrete examples or visual aids (Picture/Text Walk).
- **Access Content** Discussion suggestions are provided in **Picture/Text Walk** to help students use context and picture clues, referring to pictures in the Student Edition.
- **Extend Language** A variety of strategies are provided to help students develop language skills and proficiency in academic language.

You may choose to use any or all of these suggestions and strategies as needed. **Every Student Learns Teacher's Guide** is a flexible tool that will work in a wide range of classrooms. Use these pages in conjunction with the ESL support notes throughout your Teacher's Edition to provide complete support for your second language learners.

Supporting ESL Students in Learning the Language of Science

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Because language is infused into all aspects of the teaching of science, students whose knowledge of English is limited are likely to have difficulty accessing scientific concepts and expressing their understanding of these concepts in oral and written language. Therefore, teachers are faced with the challenge of modifying their instruction in ways that will assist ESL students.

Effective academic language instruction for ESL students across the curriculum is built on three fundamental pillars:

1. Activate Prior Knowledge/Build Background Knowledge
2. Access Content
3. Extend Language

In developing scientific knowledge through language, and language abilities through science, we can apply these three instructional principles in powerful ways.

1. Activate Prior Knowledge/Build Background Knowledge

Prior knowledge is the foundation of learning. When students read a scientific text, they construct meaning by bringing their prior knowledge of language, science, and of the world in general to the text. Students may not explicitly realize what they know about a particular topic or issue. Activating their prior knowledge brings it to consciousness and facilitates learning.

Activating prior knowledge and building background knowledge are important for all students, but particularly for ESL students who may be struggling with unfamiliar vocabulary and grammatical structures in addition to complex new concepts. Building this context permits students to understand more complex language and to pursue more cognitively demanding activities. It lessens the cognitive load of the text and trees up brain power.

Activation of prior knowledge enables teachers to validate ESL students' background experiences and affirm their cultural knowledge. Inviting students to contribute what they already know to the class discussion communicates to students that the cultural and linguistic knowledge they are bringing into the classroom is valuable.

Strategies for activating prior knowledge and building background knowledge.

A variety of strategies to activate students' prior knowledge are embedded in Scott Foresman *Science.*

- ***Brainstorming/Discussion*** This type of language interaction can happen in the context of a whole class, in small groups, or in pairs; for example, students can interview a partner to find out what each one knows about a particular topic. Discussion can also be highly effective in making concepts more concrete and comprehensible.
- ***Use of graphic organizers*** These can be used to capture the results of brainstorming and discussion. K-W-L- charts, word webs, and many other graphic organizers enable students to record and organize their information.
- ***Visuals in texts*** Photographs, charts, and graphs can be used to stimulate discussion about aspects of what is depicted and to encourage students to predict what the text is likely to be about.
- ***Short-term direct experiences*** Quick activities and questions about students' experiences provide opportunities for students to observe science-related phenomena and can stimulate discussion of what students have observed. Teachers help students relate their observations or experiences to the content of the science lesson.
- ***Long-term direct experiences*** Class projects and formal inquiry activities provide opportunities for students to deepen their knowledge of concepts.
- ***Writing about what we know*** Dialogue journals for note taking and responses to written prompts are useful means for the student to both record information and review it later.

2. Access Content

We can also support or *scaffold* students' learning by modifying the input itself. We provide this scaffolding by embedding the content in a richly redundant context with multiple routes to the meaning in addition to the language itself. Building this redundancy enables ESL students to access the content despite any limitations in English language proficiency.

Strategies that improve student access to academic content.

The following methods, which you will find embedded in Scott Foresman *Science*, can help students more effectively get access to meaning.

- ***Use Visuals*** Visuals enable students to "see" the basic concept we are trying to teach much more effectively than if we rely only on words. When students are reading science textbooks, we can systematically draw their attention to the importance of context and picture clues in figuring out the meaning. The Picture/Text Walk feature in Scott Foresman *Science* Every Student Learns Teacher's Guide draws attention to specific pictures and offers models of language the teacher can use to talk about those pictures with the students to clarify the meaning.

- ***Dramatize/Act Out*** For beginning ESL students, *Total Physical Response,* where students physically represent a phenomenon or act out commands, can be highly effective.
- ***Clarify Language*** Language-oriented activities aim to clarify the meanings of new words and concepts. Teachers can modify their language by paraphrasing ideas and explaining new concepts and words. They explain new words by providing synonyms, antonyms, and definitions either in English or in the home language of students. Important vocabulary can be repeated and recycled as part of the paraphrasing of ideas. The meaning can also be communicated and/or reinforced through gestures, body language, and demonstrations.
- ***Make Personal and Cultural Connections*** Scripted questions in the Scott Foresman *Science* Every Student Learns Teacher's Guide suggest ways to link content to students' everyday experiences. These content connections validate students' sense of identity and make the learning more meaningful.
- ***Make Cross-Curricular Connections*** The more cognitive operations students perform related to a particular issue or problem, the deeper their comprehension becomes.
- ***Provide Hands-on Experiences*** The more we can contextualize or personalize concepts by embedding them in students' hands-on experiences, the more comprehensible they will become for students. Hands-on projects also allow students to link the conversational language they use in the "real" world and the more and specialized language they are learning in science. Discussions about concrete phenomena and problems demystify the language of science. The concepts we learn in science help us understand what we see with our very own eyes and vice-versa.
- ***Encourage Learning Strategies*** Learning strategies are useful for all students, but particularly for ESL students who face obvious challenges in accessing curricular content. Examples of strategies included in Scott Foresman *Science* are: planning tasks or activities, visualization, grouping and classifying information, taking notes and summarizing information, questioning for clarification, and using multiple resources and reference materials to find information or complete a task.

3. Extend Language

A systematic focus on and exploration of language is essential if students are to develop knowledge of the specific vocabulary and text structures that are used in scientific discourse. Students can systematically collect the meanings of words and phrases they encounter in science texts in a personal or group *language bank*.

Strategies that help students accelerate their acquisition of academic language.

A variety of strategies to extend students' language knowledge and awareness are embedded in Scott Foresman *Science.*

- ***Explore Etymology*** Paradoxically, the complexity of scientific language provides some important opportunities for language exploration. A large percentage of the less frequent academic and technical vocabulary of English derives from Latin and Greek roots. So word formation often follows some very predictable patterns.
- ***Identify Rules and Conventions*** When students know some of the rules or conventions of how academic words are formed, they have an edge in extending their vocabulary. It helps them not only figure out the meanings of individual words but also how to form different parts of speech from these words.
- ***Relate Academic Words to Students' First Language*** This encourages students to relate the English word to their prior knowledge of the word (or related words in their first language). It also provides students with an opportunity to display and feel proud of their first language linguistic expertise.
- ***Identify and Practice Conjugates*** When we demystify how academic language works, students are more likely to recognize parts of speech in their reading of complex text across the curriculum and to become more adept at inferring meanings from context. For example, the student who recognizes that *acceleration* is a noun (rather than a verb or adjective) has taken a step closer to the meaning of the term in the context of a particular sentence or text.
- ***Model Appropriate Academic Language*** If teachers provide good models, then students can extend their own command of more formal registers of language. In addition, students must be given the opportunity and incentive to use academic language in both oral and written modalities.

Conclusion

Science will assume relevance to students and be learned much more effectively when students can relate the content of instruction to their prior experience and current interests. In addition to activating students' prior knowledge and building background knowledge, we may need to modify our instruction in specific ways to make the content accessible to ESL students who are still in the process of catching up to native-speakers in academic English language proficiency.

These supports should focus not only on making the scientific content comprehensible to students but also on extending their awareness of how the language of science works. In this way, students can develop insights about academic language that will bear fruit in other areas. When we integrate these active uses of language with the science curriculum, students benefit both with respect to their knowledge of scientific content and language abilities.

References

Chamot, A. U., and J. M. O'Malley. 1994. *The CALLA Handbook: Implementing the Cognitive Academic Language Learning Approach*. Reading, Mass.: Addison-Wesley.

Collier, V. P., and Thomas, W. P. 1999. Making U.S. schools effective for English language learners, Part 1. *TESOL Matters,* 9:4 (August/September), pp. 1 and 6.

Cummins, J. 2001. *Negotiating identities: Education for empowerment in a diverse society. 2nd edition.* Los Angeles: California Association for Bilingual Education.

Diaz-Rico, L., and K. Z. Weed. 2002. *The crosscultural, language, and academic development handbook: A complete K–12 reference guide. 2nd edition.* Boston: Allyn & Bacon.

Gibbons, P. 1991. *Learning to learn in a second language.* Newtown, Australia: Primary English Teaching Association.

Meyer, L. 2000. Barriers to meaningful instruction for English learners. *Theory into Practice, 34*(2), 228–236.

Neuman, S. B. 1999. Books make a difference: A study of access to literacy. *Reading Research Quarterly, 34*(3), 286–311.

Schmitt, N. 2000. *Vocabulary in language teaching.* Cambridge, U. K.: Cambridge University Press.

Name _____

Picture It!

Use with Chapter 1, page 5.

Classifying Plants and Animals

Write the ways that the owl and the mouse are alike.
Write the ways they are different.

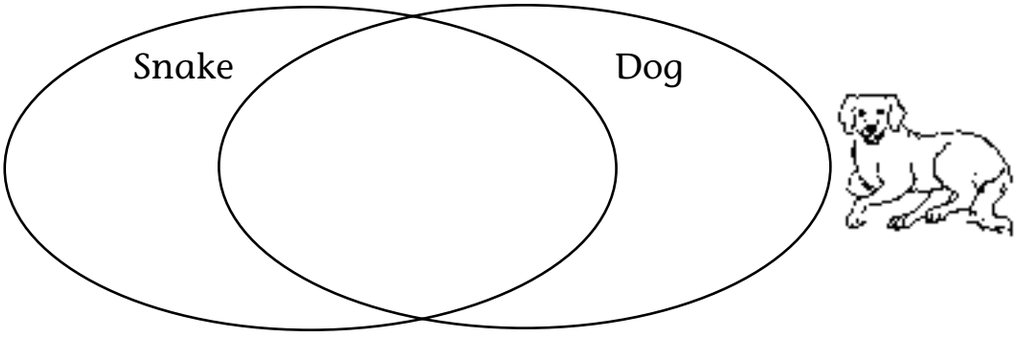
Owl  Mouse

An owl and a mouse are both vertebrates. A mouse is a mammal. A mouse has two eyes, a nose, and a mouth. A mouse has four legs and fur. An owl is a bird. An owl has wings and feathers.

Alike	Different

Compare and Contrast

Look at the pictures. Compare and contrast the snake and dog. Write about the snake in the left circle. Write about the dog in the right circle. In the center section, write what is the same.



Use with pages 6–9.

Lesson 1: What are the building blocks of life?

Vocabulary

*cell	*cytoplasm	*chloroplast
unit	tissue	organism
*nucleus	organ	virus
cell membrane	organ system	

Activate Prior Knowledge/Build Background

Allow students to make structures using connecting cubes or building blocks. Help students see that no matter what the structures look like, they are all made of the same material. **Living things are the same way. All living things are made of cells. Cells are too small to see with your eyes. Some living things are made of just one cell. Other living things are made of many cells.**

Access Content

Picture/Text Walk

Pages 6–7: **Microscope and microscopic images**
Point to the microscope. **What is this called? What is it for? How do you use it?** Explain that a microscope helps people see cells.

Page 9: **Parts of a cell**
This is a picture of a plant cell. Point out and name the parts of the cell. Explain that every cell has a nucleus. It controls the cell. Cytoplasm in the cell contains the things that the cell needs to live. The cell membrane and cell wall keep everything together. However, only plant cells have *chloroplasts.* These special parts turn sunlight into food energy.

Picture It! Classifying Plants and Animals

Discuss the ways that the owl and mouse are alike and different. Guide students as they write the answers under the headings "Alike" and "Different." Then discuss the ways that the snake and dog are alike and different. Help students complete the Venn diagram by writing common traits of the snake and dog in the middle of the overlapping circles.

Use with pages 10–13.

Lesson 2: How are living things grouped?

Vocabulary

sort	kingdom	fungi
groups	bacteria	*genus
classify	protists	*species

Activate Prior Knowledge/Build Background

Picture/Text Walk

Page 10: **Dandelions and mushrooms**
Point to pictures on page 10. **What are these?** Show the frog on page 1. **What is this? How is it different from the dandelion and the mushroom?** Explain that the dandelion is a plant, the mushroom is a fungus, and the frog is an animal. Scientists sort living things into groups called kingdoms.

Access Content

Picture/Text Walk

Page 11: **Kingdoms of living things**
Point to and name each of the six kingdoms. Explain that ancient bacteria, true bacteria, and protists are one-celled organisms. Have students name organisms that belong to the animal and plant kingdoms.

Page 13: **Animal kingdom**
Explain that the animals in the top row are all part of the animal kingdom. Review each classification from top to bottom. Point out that as the qualifications for each group become more specific, the size of that group gets smaller.

Extend Language

Write the words *classify* and *classification.* Pronounce each word. Circle the suffix *-ation.* It means the process of doing something. *Classification* means the process of classifying something. Point out how the suffix also changes the word function. The verb *classify* becomes a noun, *classification.* Repeat using the words *organize/organization* and *adapt/adaptation.*

Use with pages 14–17.

Lesson 3: How are plants classified?

Vocabulary

biologist	tissue	cone
nutrients	vascular	spore
tubelike	nonvascular	

Activate Prior Knowledge/Build Background

Point to the veins in your hands and wrists. Explain that veins carry blood and nutrients throughout our bodies. Then pass around leaves from a tree (or detailed pictures). Point out the tubelike structures in the leaves. **These tubes are like our veins. The tubes carry nutrients to all parts of a plant.**

Access Content

Picture/Text Walk

Pages 14–15: **Bamboo, moss, hornwort, liverwort**
These are plants. But they are not all the same. Show the bamboo tissues. Bamboo is a vascular plant. Vascular plants have the tubelike structures discussed earlier. **Moss, hornwort, and liverwort are nonvascular plants. They do not have tubes. They pass water and nutrients from one cell to another.**

Page 16: **Soybean, pine cone, spore cases**
Explain that different kinds of plants have different kinds of seeds. **These are the seeds of a soybean plant. This is the seed cone of a pine tree. This fern has spores, not seeds.**

Extend Language

Remind students that leaves are vascular or nonvascular. Explain that the prefix *non-* means "not." *Nonvascular* means "not vascular." Give other examples such as *nonsense, nonfiction, nonviolent,* and *nonstop.*

Use with pages 18–25.

Lesson 4: How are animals classified?

Vocabulary

backbone	mammal	insect
*vertebrates	*invertebrates	exoskeleton
amphibian	arthropod	mollusk
reptile		

Activate Prior Knowledge/Build Background

Picture/Text Walk

Pages 18–19: **Python and backbone**
How is this animal like us? (has a head, backbone) **Animals that have backbones are called vertebrates. Humans are vertebrates.**

Access Content

Picture/Text Walk

Page 18: **Animals with backbones**
Point to and name each animal. Discuss how the groups differ. Share examples of organisms that belong to each group. Encourage students to think of additional members of each division.

Pages 20–21: **Life cycle of a reptile**
Help students sequence the events in the life of a Burmese python. Discuss how the snake's cycle is different from or similar to the human life cycle. Invite students to comment on the life cycles of other animals they know, such as birds or cats.

Pages 22–23: **Invertebrates**
Not all animals have backbones. Animals without backbones are called invertebrates. Point to and name each invertebrate. Explain that arthropods are invertebrates that have jointed legs and an exoskeleton, like an insect.

Pages 24–25: **Life cycle of the brown snail**
Help students follow the sequence of events in the life cycle. Ask how the snail's life cycle is similar to and different from the snake's life cycle.

Use with pages 26–33.

Lesson 5: How do animals adapt?

Vocabulary

inherit	predator	migration
traits	instinct	hibernation
adaptation		

Activate Prior Knowledge/Build Background

Picture/Text Walk

Pages 26–27: **Duck, seal, polar bears**
What do these animals need to live? Explain that all animals need air, water, food, and shelter. Adaptations are special features that plants or animals have. Adaptations help animals get what they need in their environments. **A duck has feet that help it swim. A seal has fur that keeps it warm.**

Access Content

Picture/Text Walk

Pages 28–29: **Protective adaptations of poison frog, zebra**
Is it easy or hard to see the rock ptarmigan in winter? Why? Explain that some animals are colored in ways that let them blend into their environments. Other animals have designs that make them look like other things. This protects them from predators. Some animals have poison. Others run very fast.

Pages 30–31: **Migrating geese, hibernating animals**
Where are these birds going? Why? Explain that during the winter, many animals can't get the food, water, or shelter they need. Canadian geese migrate to warmer places. Other animals find warm places to store food or sleep until spring comes. These instincts are also adaptations.

Pages 32–33: **Animals learning from each other**
Explain that animals can also learn certain behaviors. Ask what the baby animals might be learning from the adults. Invite students to discuss what they learn by watching their parents.

Draw Conclusions

Read the paragraph below. Then look at the pictures. Write conclusions based on what you learn about plant stems.

Some plant stems are soft and flexible. Some plant stems are strong and thick. Strong, thick stems allow a plant to grow large. Plants with soft stems are usually smaller. All stems carry water, minerals and food to the leaves.

This is a daisy with a soft stem. Here are two things I know:

_____

_____

This tree has a strong stem or trunk. Here are two things I know:

_____

_____

Use with pages 47–49.

Lesson 1: What are plants' characteristics?

Vocabulary

cell	organ	*photosynthesis
tissue	nutrient	*chlorophyll

Activate Prior Knowledge/Build Background

Draw a two-column chart on the board. Write *Animals* in one column and *Plants* in the other. Invite students to tell what they know about each. Draw a line through the characteristics plants and animals share. Circle the characteristics unique to plants.

Access Content

Picture/Text Walk

Page 48: **Stem and leaves**
Invite a volunteer to identify the leaves and stem of the plant pictured. Explain that plants make their own food during photosynthesis. **Where does photosynthesis happen?** (the leaves) **Which part of the plant carries water and nutrients to the leaves?** (the stem)

Page 49: **Leaf cell**
Remind students that photosynthesis happens in a plant's leaves. Point to the diagram and explain that it represents one leaf cell. Point to each section of the cell as you read its corresponding caption. **Where are the chloroplasts? What do they do?** (trap energy from sunlight) **Where is the cell membrane? What are these tiny openings called?** (stoma)

Picture It! Drawing Conclusions

First, read the paragraph aloud as a class. Then invite students to look at the pictures and match them with the sentences. **Which plant has a soft stem? Which plant has a strong, thick stem?** Ask students to write two conclusions for each plant based on what they read in the paragraph. Answers could include: Daisies are small. Their stems are flexible. The tree is large. The stem is strong.

Use with pages 50–53.

Lesson 2: What are the parts of plants?

Vocabulary

fibrous root	taproot	root hair

Activate Prior Knowledge/Build Background

Hold up pictures of different kinds of plants. Lead students in a discussion of how the plants are similar and how they are different.

Access Content

Picture/Text Walk

Page 51: **Leaves**
Point to the various leaves pictured. **Do these leaves look the same? How are they different?** Remind students that a leaf's job is to make food for the plant. Explain that leaves are shaped in ways that make this job easier.

Page 51: **Stems**
Discuss the difference between woody and flexible stems. Point to the woody stem pictured. **What kind of stem is this? What are two jobs that all stems have?** (They carry food, water, and minerals between the roots and the leaves; they support the plant.)

Pages 52–53: **Onions, daisies, radish**
Point to each root. **What kind of root is this?** (fibrous root or taproot) Explain that all roots have the same jobs. They keep the plant in the ground. They also absorb water and nutrients from the ground.

Use with pages 54–57.

Lesson 3: How do plants reproduce?

Vocabulary

petal	*pistil	*ovary
pollen	*stamens	*fertilization
*sepal	anther	

Activate Prior Knowledge/Build Background

Bring a few flowers to class. Invite students to choose one of the flowers and draw a picture of it. Encourage students to label each part of the flower, as they are able.

Access Content

Picture/Text Walk

Pages 54–55: **Flowers**
Discuss each part of the plant. Invite volunteers to point to and name each plant part. **Which part of the flower produces pollen?** (stamen) **Which part of the flower protects the flower bud?** (sepals) **Which part of the flower is the most colorful?** (petal) **Which part makes egg cells?** (pistil) **Which part makes pollen?** (stamen)

Page 56: **Bees and bat pollinating flowers**
Have you ever seen a bird or insect near a flower? Explain how animals help plants reproduce. Pollen from the plant rubs off onto the animal. The animal carries this pollen to the next plant.

Page 57: **Fertilization**
What is one way that pollen moves from one plant to another? (animals) **What is moving the pollen in this picture?** (wind)

Extend Language

Talk about how the word *fertilization* is used. It is a noun, coming from the adjective *fertile*. When a being is able to reproduce, we say it is fertile. *Fertilization* refers to the process of reproducing. Ask students to use the words *fertile* and *fertilization* in sentences.