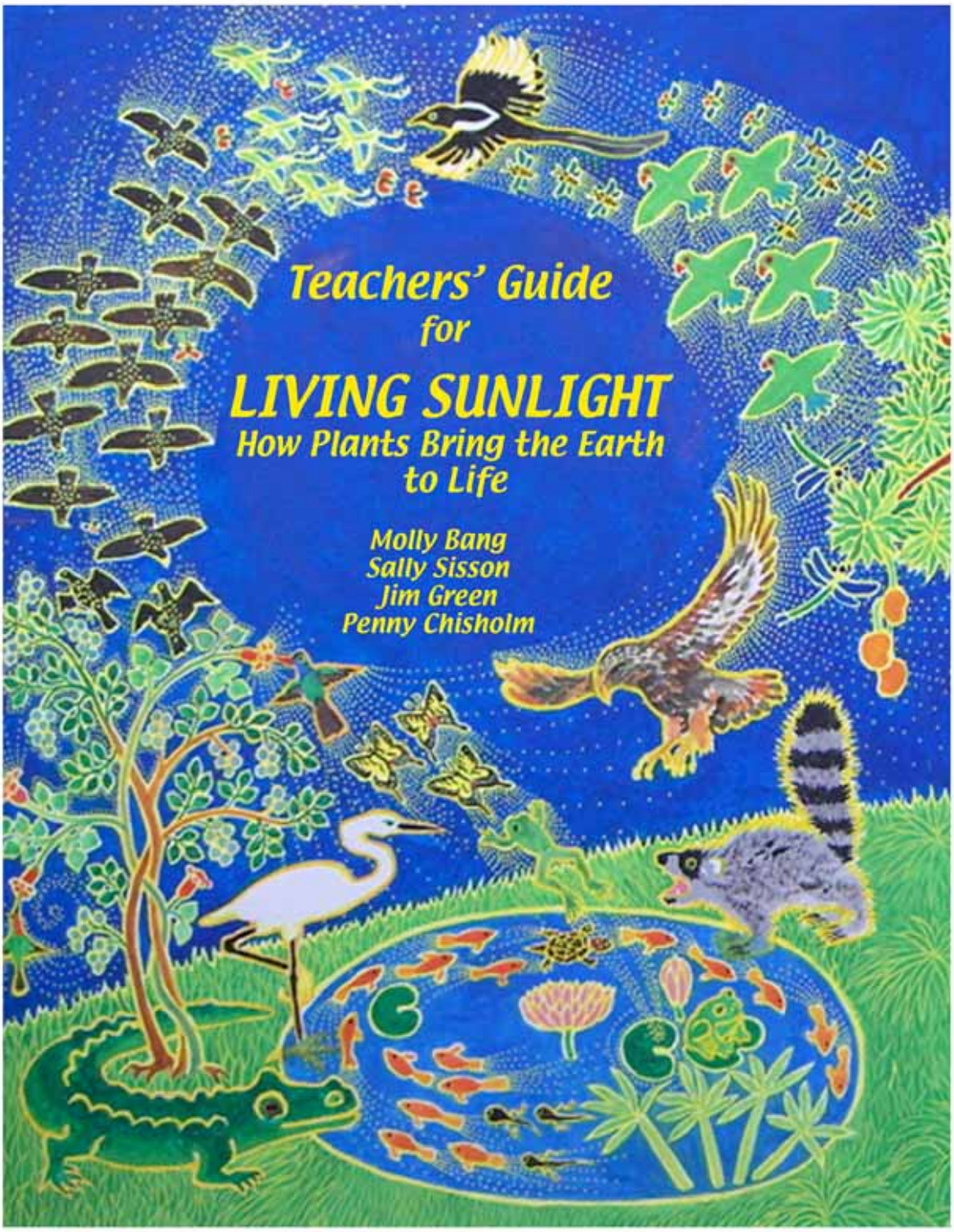


For Grades K-2

Table of Contents

Posted September 24, 2009

Introduction

How to Use *Living Sunlight*

Use *Living Sunlight* to teach about…

- the importance of green plants (without plants there would be no life on Earth)
- photosynthesis (the most important natural process on Earth)
- the sun (the source of nearly all energy for life on Earth)
- food chains (what is produced by one organism is consumed by another)

Reading and discussing *Living Sunlight* with your class is an ideal way to gently introduce complex concepts that will be covered in-depth in later grades. The most important message — that all of life depends on plants! — will resonate with even the youngest readers.

Living Sunlight also provides an opportunity to teach young students literacy skills. The lessons below model ways to use pictures in a book to help students understand text and the text to help them understand pictures. The lessons and the book help students develop an important literacy skill — the ability to interpret the visual representation of complex concepts. Finally, you can use the lessons to teach students about sequences and processes and how they can be represented visually.

What's in This Teacher's Guide

Lesson Plans: These give suggested directions and conversations for before, during and after reading the book. Use them as a guide for class discussions.

Printables: This section, which contains puzzles and worksheets that align with the lesson plan, can be downloaded separately. The worksheets can also be used as assessments.

Activities & Experiments: Extend the learning in the lesson plans with these creative hands-on projects. Pick one or more ideas that suit your needs, based on your timeframe and curriculum.

Related Standards: This is a list of relevant national science standards from National Research Council and McREL, and of state science standards from California, Massachusetts, and Texas.

K–2 Lesson Plans:

The Goal: We Are Living Sunlight

Science Objectives

The overall goal is for students to understand that they and all other living things are living sunlight — that the energy for all of life comes from eating green plants (or things that have eaten green plants) and that green plants get all of their energy from the sun.

More specifically, that means…

1. Students will be able to explain that energy is "what makes things go" and to give examples. And they'll be able to explain that living things need energy to grow.
2. Students will be able to explain that green plants get the energy that they need to live from sunlight.
   - The green plants use the energy of the sunlight to make sugar and use the energy stored in the sugar to do all of the things they need to do to stay alive.
3. Students will be able to explain that animals get the energy that *they* need to live from the food they eat.
   - Animals can't get their energy from sunlight.
   - Animals get the energy they need from green plants.
     - Some animals eat green plants to get the energy they need.
     - Some animals eat other animals that ate green plants.
     - Some animals eat green plants *and* other animals that ate green plants.

Literacy Objectives

In addition to science objectives, teachers can use *Living Sunlight* to teach literacy objectives. For example, moving back and forth between the text and the illustrations can help students improve their reading comprehension. They will learn to relate illustrations to text and text to illustrations and they will learn to use the illustrations to make sense of the text and the text to make sense of the illustrations.

Note: What follows may seem like a script. It is not intended to be used as a script, but rather to suggest questions and comments that you might make as you read Living Sunlight with your students.

Pre-Reading: Prior Knowledge and Anticipatory Set

Necessary Prior Knowledge — What is energy?
Students should have some basic ideas about energy (energy makes things go) and to know that all living things need energy to grow and to go about the activities of daily life. It's probably best not to try to tell the students what energy is. Use questions like the ones below to give them the idea first, and then summarize.

Ask the following questions and acknowledge the students' answers:

What makes a car go?
gasoline
The gasoline gives energy to the car.

What makes a windmill turn?
wind
The wind gives energy to the windmill.

What makes a lightbulb glow?
electricity
The electricity gives energy to the lightbulb.

What enables us to run and jump and sing and think and to do all of the other things we need to do to stay alive?
food
Food gives us energy.
What makes it possible for us and other living things to grow?
Food
Food gives us the energy we need to grow.
Summarizing:
Energy is what makes things go. *Living things need energy to grow.*

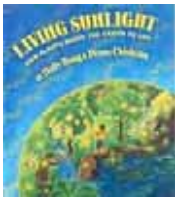
Anticipatory Set — Where do plants get *their* energy?
Summarize the discussion about energy… **We get our energy from the food we eat**. Then ask, **Do plants eat? Where do plants get their energy?** Give students opportunities to propose answers to the questions, but the goal is to get students thinking, not to get correct answers. The goal is to prepare students to learn the answers as you read the book.

This guide was almost finished when Nutmeg Media asked if they could make a DVD of the book. Penny and Molly happily agreed, and the DVD Nutmeg made is great! It also includes some comments by Penny and Molly about how they made decisions as they worked on the book. If you decide to include the DVD in your lesson about photosynthesis, we suggest that you show it at this point, after the discussion above and before you read the book as in the dialogue below.

Reading the Book: Suggested Questions and Comments

The goal as you move from page to page is to follow the little yellow dots that represent light energy from the sun. That energy and the little yellow dots move from the sun, to the leaves of plants, to sugar stored inside the plants, to the plants themselves, to the animals that have eaten the plants. Sometimes the energy is shown as little yellow dots, sometimes as a glowing yellow halo around the molecule or plant or animal that contains it, sometimes as a starburst inside the animal or plant.

<u>Title page</u>



What's the title of this book? ***Living Sunlight***
Down at the bottom it says, "How plants bring the Earth to life?" Does anyone know what that is called? **The subtitle. Subtitles give us a clue about the subject of a book.**
Who wrote the book***?*** **Molly Bang and Penny Chisholm**
Who made the pictures for the book? **Molly Bang.** How do you know?

Now look at the picture. What do you see? **A child and a tree...sitting on a ball.**
What's the ball? **The Earth.** And what's all around the Earth? **Space**.
And what are all these little yellow dots? **They show the light energy coming from the sun.**
Do you think there are REALLY little yellow dots coming from the sun?
No, not really, but Molly Bang had to show the sunlight-energy somehow. So she showed the sunlight-energy as waves of little yellow dots.
As we read, let's watch the yellow dots…

<u>pp 6-7 (child on swing)</u>

(very quietly) Can everybody feel how warm you are? Do you feel your heart pumping? Do you feel your energy?
Where is the sunlight-energy in this picture?
What's inside the child on the swing? **Yes! Little yellow dots**.
Hmm…how can there be light inside of us?

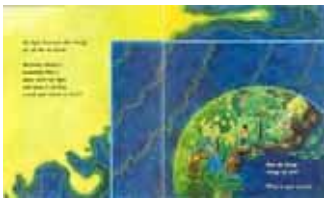
<u>pp 8-9 (sun and Earth)</u>

What do you see in this picture? **The huge sun…the tiny Earth.** (Note: The sun is bigger than one million Earths all put together!)

<u>pp 10-11 (sun with four rectangles)</u>

(As you read each phrase ask the children to point to the picture that illustrates what you have just read…) I warm your land (**point**) and seas (**point**), etc. With each picture, where are the yellow dots of sunlight-energy?
What are the four things that the sunlight-energy is doing?
Warming the land. Warming the seas. Melting the glaciers. Making the wind.
Yes, and it does even more than that! I wonder what?

pp. 12-13 (sun with larger Earth)



Where are the dots of sunlight-energy now? **In the child, the bear, the fish, the tree, the plants, etc.** How does it get there? (The children don't know yet.)

pp 14-15 (plants with four rectangles)

Teachers: For your own reference, here's what the four small pictures in the rectangles show, from left to right):

1. *The first rectangle shows water molecules moving into the roots of the plant. You can tell they're water molecules because water is H_2O and Molly's water molecules have a large white dot, the oxygen atom, and two small blue dots, the two hydrogen atoms.*
2. *The second rectangle from the left—the one that looks like a vase—shows chlorophyll inside a leaf. The chlorophyll is catching the sunlight-energy and is glowing from the captured light-energy.*
3. *The third rectangle shows the plant using the captured light-energy to split water molecules into oxygen and hydrogen. The double white balls heading up are the oxygen molecules (O_2) and the blue balls streaking down are hydrogen.*
4. *The fourth rectangle shows the plant trapping the captured light-energy in little "packets."*

Take a minute to make sure that students understand what's special about the pictures inside the rectangles. Ask, What's different about the illustrations inside the four rectangles? **They show things that are happening *inside* the leaves or roots of the green plant. These are things that are far too small to see without a microscope or even too small to see with a microscope.**

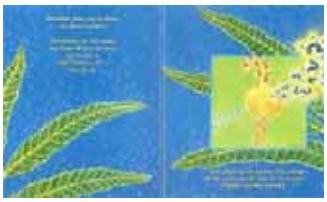
There are complicated things happening in those illustrations. Stay focused on the yellow dots and the yellow glow that shows the captured sunlight energy.

Read the sentence, "In daylight, green plants catch my energy with their chlorophyll." Ask students to point to the rectangle that shows chlorophyll catching the sunlight energy. **The second rectangle.** The chlorophyll is in the vase-like thing and it's "catching" the little yellow dots, the sunlight energy. (By the way, chlorophyll is what makes green plants green.)

Read the sentence, "But as plants break apart water, they trap my energy as little packets." Ask students to point to the rectangle that shows the energy getting put into "little packets." **The fourth rectangle.** The glowing "packets" are important because they're involved in what happens on the next page.

Summarize: the sunlight energy was trapped by the chlorophyll in the leaves and now it's in the little packets. What happens next?

pp 16-17 (leaves with one big square)



The picture in the square is supposed to show the plants using the sunlight-energy that's been trapped in the energy packets to make… something special. But we won't find out what that is until the next page.

Look at what's happening in the rectangle. Where is the sunlight-energy in this picture? Where are the energy packets? **They are the glowing orange blobs that come in from the top.**

(Notice that the orange blobs leaving at the bottom have lost their glow. They've transferred their energy to the strange clusters of black, white, and blue balls floating off the page to the right. We're getting complicated at this point, but hang with us. *Just follow the energy*. It's gone from the sun, to the chlorophyll, to the packets, and now to the strange clusters. We'll find out what those clusters are on the next page.)

Point out to students that the glow is now attached to the strange clusters of black, white, and blue balls that are going off the page to the right. What are those clusters? Where are they going?

pp 18-19 (green hills with sugar in the sky)

What are the strange clusters of black and white and blue balls? **Sugar!**
Where are the dots of sunlight-energy in this picture? **They're in the sugar and in all the plants!**

What do plants build with the sunlight-energy? **Yes—sugar! Plants make sugar inside their leaves!** (It's not the same as the white sugar crystals we eat. Think of it as "plant sugar.")

Can everybody say "photosynthesis"? What does photosynthesis mean?
It means making life with sunlight.

Before you move on to the next page, ask students where the sunlight energy (the yellow glow) is now. **It's in the sugar *and* it's in all of the plants, in their leaves and stems and fruit and flowers.**

pp 20-21 (brown hills with only animals)

Read the text on page 20. (Beginning, "But wait! You are not green!" and stopping at "...whole wide world.")

As students to look at the picture and compare it to the picture on pages 18-19. What's the difference? **In the first picture there are no animals. In the second picture there are no plants.**

Where is the sunlight energy in the second picture? **It's in the sunlight (the little yellow dots), but it's not in the animals.** How can you tell? **The animals don't glow.**

Now read the text on page 21. Beginning, "So…"

<u>pp 22-23 glowing, green hills with both plants and animals)</u>
Read the text and then ask students, What's happened to the animals in this picture? **They're glowing because they have sunlight energy in them**. How did they get the sunlight energy? **By eating plants.**

Summarize: The sunlight energy has gone from the sun, to the chlorophyll, to the energy packets, to the sugar, to all the parts of the plants. Now the sunlight energy is in the animals that ate the plants.

<u>pp 24-25 (big leaves and sky)</u>
This page is not about energy. It's about oxygen. Plants breathe out oxygen as part of photosynthesis. It's in the air. We get our oxygen—all of the oxygen we breathe—from green plants.

<u>pp 26-27 (child breathing in)</u>
What's the child in the picture doing? **Breathing in, inhaling.**
Breathe in. What's in the air that you breathe in? **Oxygen—from plants!**

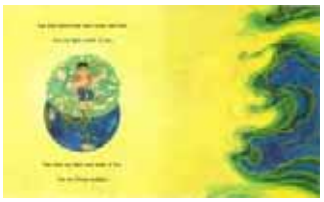
The four sentences on page 27 are the basic take-home message of the book. "Without plants you would have no oxygen. Without plants, you would have no food. Without plants, you could not live. Without plants, there would be no life on Earth." So take a minute or two with that page. For younger children especially, even if they don't understand the details of photosynthesis, they should be able to get this point.

<u>pp 28-29 (child and other animals breathing out)</u>
What's the child in the picture doing? **Breathing out, exhaling.**
Breathe out. What's in the air that you breathe out? **Carbon dioxide.**
And what happens to the carbon dioxide? **The plants breathe it in and use it to make more sugar.**

Breathe in. What goes in? **Oxygen that comes from plants.**
Breathe out. What goes out? **Carbon dioxide that goes to plants.**
In and out. Inhale and exhale. Oxygen and carbon dioxide. Plants' gift to us. Our gift to plants.

pp 30-31 (life circling around)

pp 32-33 (circles of animals and plants)
Where is the sunlight-energy? **In the plants and the animals. From the plants to the animals. There is sunlight-energy in all of us.**



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After Reading: Review and Assessment

Review with the students how we get energy and how plants connect us all. Use the visual teaching aid **Sunlight Energy Comes Alive** (Printable 1 in the **Printables** section of this guide) and go over the steps shown in the picture. (Go to www.mollybang.com or click here to download the **Printables**.)

You can use Printable 1 to review the concepts of *Living Sunlight* with students and then use Printable 2, 3 or 4 as worksheets or assessments. Printables 2, 3 and 4 are alternate versions of the same activity. Printables 2 and 3 are simple fill-in-the-blank activities. Printable 4 is a more difficult task. It gives students the steps in the process in jumbled order and asks them to put the steps together in the correct order. The most difficult task (there's no printable for this one) would ask students to remember the steps and put them in the correct order.

Printable 5 is a crossword puzzle that reviews some of the information from the book. Printables 6, 7, 8 and 9 are worksheets that review information from the book. Some of these, Printable 9 for example, may go into more detail than is appropriate for young students.

Reviewing the Core Concepts from *Living Sunlight*

Q: How do green plants get energy?

- *Do they eat dirt from the ground?*
- *Do they eat worms??*

A: **NO! They catch sunlight! Green plants use the energy of sunlight to make their food. They are the only living creatures able to do this!**

Let's start with SUNLIGHT
(Draw a picture of the sun with wavy rays on the board or use Printable 1 on an overhead projector.)

Q: What is sunlight?
A**: Sunlight is energy.**
(Write the word ENERGY inside the circle of the sun.)

Q: Which part of the plant catches energy from sunlight?
(Draw a simple plant with several leaves and roots below.)
A: **That's right, the leaves (or the chlorophyll in the leaves) catch the energy.**
(Draw an arrow from the sun to a leaf.)

Q: What do plants with the captured sunlight-energy?
A: **Plants use the sunlight-energy to make sugar. This sugar is the plants' food, and they use it to make all of their parts, like leaves, seeds, fruits and flowers.**

Q: What is the process called?
A: **Photosynthesis.**

Q: How do animals and people get their energy?
A: **By eating green plants or by eating animals that ate green plants.**

Q: So where does all our energy to run and grow and be alive actually come from, right at the beginning?
A**: From sunlight.**

Q: Besides energy, what do animals and people get from plants—something they need to survive?
A: **Oxygen from the air. They use oxygen to breathe and to slowly burn their food.**

Q: What do animals and people exhale when they breathe out?
A: **Carbon dioxide, or CO_2.**

Q: And what living things need carbon dioxide to survive?
A**: Plants. Plants need this carbon dioxide to make more food (or to "photosynthesize") so they grow and survive.**

And so it goes, round and round, just like in the picture. **We really are all Living Sunlight!**

Assessment

Now choose one or more of the worksheets from the Printables section to reinforce these concepts or to assess students' understanding.

Extensions

Experiments

How does sunlight affect plants?

Put one houseplant in sunlight and one in a dark closet for several days (or cover one with a paper bag rather than putting it in a closet, if you don't have one in your classroom). Then observe the differences between the two plants. This can be done in a casual or more formal manner, with or without daily recordings of observations.

Plant seedlings, either in paper cups with soil or on wet paper towels in plastic bags, and experiment by putting some in a sunny spot, and others in darkness.

During a sunny weather spell, stake off a square of grass in your schoolyard and cover it with a shoebox or other lightweight object. After several days, remove the box and see how lack of sunlight affected the grass.

Plant a bed of grass in your classroom in a large container. A long rectangular flowerbox for windowsills would be ideal. Divide it into sections and experiment by covering some sections with construction paper and exposing others to sunlight.

Tape small leaf-size pieces of black construction paper over several leaves on a plant. After several days take off the black paper and compare those leaves with the leaves that were untouched. What do you conclude?

Do green plants really give off oxygen?

Put a green leaf in a jar full of water and put it on a sunny windowsill. Later, use a magnifying glass to observe closely and you'll see tiny bubbles on the leaf. Why are there bubbles on the leaf?

Do the same thing with another leaf but do not expose it to light. Do you see bubbles? What do you conclude from this?

Collect pond water and some pondweed, put in a large jar or recycled plastic bottle, and observe the pondweed with a magnifying glass to see if you can detect bubbles. Does this mean that all green plants breathe out oxygen? Even underwater ones?

If growing seedlings, place a clear jar over them and place on a windowsill. Leave overnight, then check in a.m. Condensation should collect on the inside, as evidence of transpiration—the plants were "breathing" out oxygen overnight

How do plants breathe?

Conduct an experiment to see which side of a plant leaf "breathes" gases. Where does the carbon dioxide go in and the oxygen go out? Rub Vaseline on the top side of five leaves on a plant. Then rub Vaseline on the bottom side of five other leaves on a plant. Observe the leaves each day for a period of time and see what happens. What do you conclude?

Activities

Sunlight

- Make sun tea – Harness the power of the sun instead of using a kettle! Fill a glass jar with cold water and put in about one tea bag for every two cups of water (stronger if you like but most kids don't like it too strong). Leave in the sun for one hour. Take out the tea bags and stir in some maple syrup to sweeten (or have an adult make a simple syrup by boiling two parts water to one part sugar). Add lemon if you like. Have a tea party to celebrate sunlight.
- Make solar leaf prints – Place leaves in patterns on construction paper. Leave in the sun for a certain period of time; when you take off the leaves you'll see outlines of the leaf shapes and see the mark of the sun's energy.

Leaves

Go on a leaf hunt. Collect leaves of different shapes and sizes and bring them back to the classroom. There are several things you can do with them:

- categorize them according to shape, color, etc
- make leaf prints with paint – paint the leaves, then place them paint-side down on construction paper, put another piece of paper on top and press down like a printing press –examine the veins, stems, and other details in the leaf prints, then label them w/ arrows
- make leaf rubbings – choose a variety of different leaves - cover a leaf with thin recycled computer paper and rub it lightly with a green crayon or colored pencil – examine the different vein patterns and talk about what happens inside the leaf during photosynthesis

Plants—general

- Make a "Living Sunlight" mural for your classroom wall. Write the subtitle of the book at the top: "How Plants Bring the Earth to Life."

- Learn about plant parts by having a Salad Party! Students volunteer to each bring in a different plant part for the salad – a vegetable that's a flower (like broccoli), a stem (like celery), a root (like a carrot) or a fruit (like tomato or peppers, etc). Begin with categorizing by plant parts. Then have kids help wash and prepare the salad, and then eat it all together as a celebration of plants.

Food cycles / "air" cycles

- Make a terrarium and observe the mini ecosystem in your classroom. Add a couple creatures (like snails, salamanders) along with plants. Observe each day. Talk about how the air and water and sunlight energy and plants and animals are all connected in their little world.

- Make a collage using magazine clippings and pictures printed from the Internet of plant and animals that could live in one ecosystem. Paste the pictures on a poster and draw arrows to show the flow of energy.

- Make simple food chain mobiles with sun, plant, animal, etc.

Web Links

Online Activities for Kids

Parts of a Plant and the Plant Life Cycle
http://www.brainpopjr.com/science/plants/

The Great Plant Escape
http://urbanext.illinois.edu/gpe/case1/c1facts2c.html

Fun with Food Webs
http://www.harcourtschool.com/activity/food/food_menu.html

Chain Reaction: Build your own food chain
http://www.ecokids.ca/pub/eco_info/topics/frogs/chain_reaction/index.cfm

Web of Life: Blue Planet Challenge
http://www.bbc.co.uk/nature/blueplanet/webs/flash/main_game.shtml

Build-your-own Food Webs & Food Web Mysteries
http://www.gould.edu.au/foodwebs/kids_web.htm

The Carbon Cycle Game
http://www.windows.ucar.edu/earth/climate/carbon_cycle.html

Short video clips on photosynthesis for K—5
http://www.neok12.com/Photosynthesis.htm

NOVA Online: Illuminating Photosynthesis – flash animation and game
http://www.pbs.org/wgbh/nova/methuselah/photosynthesis.html

National Geographic for Kids: "Quick Flick" movie on photosynthesis
http://magma.nationalgeographic.com/ngexplorer/0204/quickflicks/

Teacher Resources

NOVA Online: Illuminating Photosynthesis
http://www.pbs.org/wgbh/nova/methuselah/photosynthesis.html

Photosynthesis guide from Newton's Apple
http://www.newtonsapple.tv/TeacherGuide.php?id=915

Sugar and Carbon – How the Earth Works
http://science.howstuffworks.com/earth3.htm

Photosynthesis – How the Earth Works
http://www.howstuffworks.com/search.php?terms=photosynthesis

Online videos:

Photosynthesis: The Process
http://videos.howstuffworks.com/hsw/17173-photosynthesis-the-process-video.htm

Plants: Photosynthesis
http://videos.howstuffworks.com/hsw/11886-plants-photosynthesis-video.htm

Assignment Discovery: Photosynthesis (from the Discovery Channel)
http://videos.howstuffworks.com/discovery/29603-assignment-discovery-photosynthesis-video.htm

Plants: Plants in the Tropical Rainforest
http://videos.howstuffworks.com/hsw/11888-plants-plants-in-the-tropical-rain-forest-video.htm

Exploring Time: The Carbon Cycle (from the Science Channel)
http://videos.howstuffworks.com/science-channel/28782-exploring-time-the-carbon-cycle-video.htm

Relevant Science Standards

Examples of Relevant National Standards

National Research Council Standards

Source: National Committee on Science Education Standards and Assessment, National Research Council

Grades K–4

Life Science. Content Standard C.

LIFE CYCLES OF ORGANISMS AND THEIR ENVIRONMENTS

All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.

All organisms cause changes in the environment where they live. Some of these changes are detrimental to the organism or other organisms, whereas others are beneficial.

McREL Benchmarks for Science

Source: McREL (http://www.mcrel.org/)

Standard 6. Understands relationships among organisms and their physical environment

Level Pre-K (Grades Pre-K)

1. Understands that living things have similar needs (e.g., water, food)

Level I (Grades K–2)

1. Knows that plants and animals need certain resources for energy and growth (e.g., food, water, light, air)
2. Knows that living things are found almost everywhere in the world and that distinct environments support the life of different types of plants and animals

Examples of Relevant State Standards

TEXAS Elementary Science Standards

Grades 1 and 2

(9) Science concepts. The student knows that living organisms have basic needs. The student is expected to:

(A) identify the external characteristics of different kinds of plants and animals that allow their needs to be met; and

(B) compare and give examples of the ways living organisms depend on each other and on their environments.

CALIFORNIA Elementary Science Standards

Grade 1

STANDARD SET 2. Life Sciences

2. b. Students know both plants and animals need water, animals need food, and plants need light.

2. c. Students know animals eat plants or other animals for food and may also use plants or even other animals for shelter and nesting.

2. e. Students know roots are associated with the intake of water and soil nutrients and green leaves are associated with making food from sunlight.