

# Science and Technology for Children<sup>TM</sup>

## SECOND-GRADE UNITS

Grade	Life, Earth, and Physical Sciences and Technology			
1	Organisms	Weather	Solids and Liquids	Comparing and Measuring
2	<b>The Life Cycle of Butterflies</b>	<b>Soils</b>	<b>Changes</b>	<b>Balancing and Weighing</b>
3	Plant Growth and Development	Rocks and Minerals	Chemical Tests	Sound
4	Animal Studies	Land and Water	Electric Circuits	Motion and Design
5	Microworlds	Ecosystems	Food Chemistry	Floating and Sinking
6	Experiments with Plants	Measuring Time	Magnets and Motors	The Technology of Paper

# Second-Grade STC™ Units and the NSES (K–4)

National Science Education Standards for Grades K–4	The Life Cycle of Butterflies	Soils	Changes	Balancing and Weighing
<b>Science as Inquiry</b>				
Abilities necessary to do scientific inquiry	●	●	●	●
Understandings about scientific inquiry	●	●	●	●
<b>Physical Science</b>				
Properties of objects and materials		●	●	●
Position and motion of objects				●
Light, heat, electricity, and magnetism			●	
<b>Life Science</b>				
Characteristics of organisms	●	●		
Life cycles of organisms	●			
Organisms and environments	●	●		
<b>Earth and Space Science</b>				
Properties of earth materials		●	●	
Objects in the sky				
Changes in earth and sky			●	
<b>Science and Technology</b>				
Abilities of technological design		●	●	●
Understandings about science and technology	●	●	●	●
Abilities to distinguish between natural objects and objects made by humans				
<b>Science in Personal and Social Perspectives</b>				
Personal health	●		●	
Characteristics and changes in populations				
Types of resources	●			
Changes in environments	●			
Science and technology in local challenges				●
<b>History and Nature of Science</b>				
Science as a human endeavor	●	●	●	●
<b>Unifying Concepts and Processes</b>				
Systems, order, and organization		●	●	●
Evidence, models, and explanation	●	●	●	●
Constancy, change, and measurement	●	●	●	●
Evolution and equilibrium				●
Form and function	●	●		●

# The Life Cycle of Butterflies

## Narrative Summary

This unit introduces students to the concept of life cycles by inviting them to investigate one organism—the Painted Lady butterfly (*Vanessa cardui*). During an eight-week period, students observe, record, and describe the metamorphosis from caterpillar to chrysalis and from chrysalis to butterfly. In many cases, they watch the butterfly lay eggs. The butterfly ultimately dies a natural death, thereby completing students' observations of the life cycle. The children compare the life cycle of the butterfly with that of other organisms, an experience that deepens their understanding of the diversity of life and the patterns that characterize animal life cycles.

## Science Content

Characteristics of organisms, the life cycle, and organisms in their environment are the focus of this unit. Resource needs for food and habitat are introduced as students observe the stages in the life of the Painted Lady butterfly. As the butterfly emerges, students observe the process, identify the butterfly body parts, and learn how the body parts function. Students focus on, explore, reflect on, and communicate about butterflies and their transformations during their life cycle. Throughout the unit, emphasis is placed on developing observational and recording skills. Read-aloud stories about the discovery and history of silk add to the content of this unit.



## Assessment

In a pre-unit assessment, students share their prior knowledge of caterpillars and then draw what they think a caterpillar looks like and how it changes during its life. Matched post-unit assessments give teachers evidence of growth in students' understanding of life cycles, observation skills, and ability to engage in cooperative learning. Throughout the unit, students' drawings and shared observations can be used to assess

their observational skills and understanding of life cycles. Midway through the unit, students are asked to reflect on their own progress and to apply their knowledge of the butterfly's life cycle to life cycles of other organisms. Additional assessments at the end of the unit allow teachers to compare student drawings with similar illustrations done in Lesson 1 and to write a story about the butterfly's life. A teacher's record chart of student progress provides teachers with another method for assessing student products, learning goals, and general skills used in the unit.

## **Goals for The Life Cycle of Butterflies**

In this unit, students observe the life cycle of the Painted Lady butterfly. Through their experiences, they are introduced to the following concepts, skills, and attitudes.

### **Concepts**

- The different stages of a butterfly's life cycle are egg, larva, caterpillar, chrysalis, and adult.
- Caterpillars need food, air, and space to live and grow.
- The caterpillar forms a chrysalis, and a butterfly emerges from the chrysalis.
- A butterfly needs food to live, but it does not grow after emerging from the chrysalis.
- A butterfly lays eggs, which hatch into larvae.

### **Skills**

- Observing, describing, and recording growth and change in the larva.
- Predicting, comparing, and discussing the larva's appearance and change over time.
- Communicating observations through drawing and writing.
- Relating observations of the butterfly's life cycle to students' own growth and change.
- Extending knowledge of butterflies through reading.

### **Attitudes**

- Developing an interest in studying insects.
- Appreciating the needs of living things.
- Valuing scientific information that has been collected over time.



# The Life Cycle of Butterflies

## Fundamental Concepts and Principles Addressed (K–4)

### Science as Inquiry

#### *Abilities necessary to do scientific inquiry*

- Ask a question about objects, organisms, and events in the environment.
- Employ simple equipment and tools to gather data and extend the senses.
- Use data to construct a reasonable explanation.
- Communicate investigations and explanations.

#### *Understandings about scientific inquiry*

- Scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.
- Scientists use different kinds of investigations, depending on the questions they are trying to answer. Types of investigations include describing objects and organisms and classifying them.
- Simple instruments, such as magnifiers and rulers, provide more information than scientists obtain using only their senses.

### Life Science

#### *Characteristics of organisms*

- Organisms have basic needs. For example, animals need air, water, and food. Organisms can survive only in environments in which their needs can be met. The world has many different environments, and distinct environments support the life of different types of organisms.
- Each plant and animal has different structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.

- The behavior of individual organisms is influenced by internal cues (such as hunger) and external cues (such as a change in the environment). Humans and other organisms have senses that help them detect internal and external cues.

#### *Life cycles of organisms*

- Animals have life cycles that include being born, developing into adults, reproducing, and eventually dying. The details of this life cycle are different for different organisms.
- Plants and animals closely resemble their parents.

#### *Organisms and their environments*

- An organism's patterns of behavior are related to the nature of that organism's environment, including the kinds and numbers of other organisms present, the availability of food and resources, and the physical characteristics of the environment.

### Science and Technology

#### *Understandings about science and technology*

- People have always had questions about their world. Science is one way of answering these questions and explaining the natural world.
- Scientists often work in teams with different individuals doing different things that contribute to the results.
- Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things that they could not otherwise see, measure, and do.

## **Science in Personal and Social Perspectives**

### *Personal health*

- Nutrition is essential to health. Students should understand how the body uses food and how various foods contribute to health and growth.

### *Types of resources*

- Resources are things that we get from the living and nonliving environment to meet the needs and wants of a population.
- Some resources are basic materials, such as air and water; some are produced from basic resources, such as food; and some are nonmaterial, such as beauty.

### *Changes in environments*

- Environments are the space, conditions, and factors that affect an individual's and a population's ability to survive.

## **History and Nature of Science**

### *Science as a human endeavor*

- Many people derive great pleasure from doing science.

## **Unifying Concepts and Processes**

### *Evidence, models, and explanation*

### *Constancy, change, and measurement*

### *Form and function*

# Soils

## Narrative Summary

In this unit, students investigate the chief components of soil—sand, clay, and humus—and explore the relationship between soil and plant growth. Early in the unit, they create their own compost bags. This activity enables them to observe the decomposition of different types of organic materials over time. Students observe and read about earthworms to learn about their connection to plant roots and soil. The students also conduct tests that enable them to observe and compare such properties of soil as odor, appearance, and texture. Phenomena such as settling, water content, and soil consistency are also explored. These observations are then related to plant growth, as students plant cucumber seeds in a clear plastic tube. By observing root growth, students learn about the role of roots in keeping the plant anchored and upright. In a final activity, students apply what they have learned to investigate a sample of local garden soil.

## Science Content

Soils are a complex mix of many materials and different-sized particles. Students investigate the physical properties of three major soil components and then extend their investigations to observations of plant growth in various soil mixtures. In order to investigate organisms and their environments, students observe plants and animals—including redworms—within soil samples. Students keep records and synthesize information from multiple



investigations. Using simple tools, students record heights of plants. They then pool their data and draw conclusions about what their local soil contains and its effect on plant growth. Reading selections extend the content of the unit and address such concepts as how people of various cultures use earth materials to build homes and other structures.

## Assessment

Prior knowledge about soils is assessed through a brainstorming activity in Lesson 1 and revisited throughout the unit and during a post-unit assessment. Through a series of investigative activities, students learn about the components of soils. Their results and data records can be evaluated or observed to determine growth in skills, attitudes, and concepts addressed in the unit. Two embedded assessments challenge students to apply soil tests used throughout the unit to new soil samples. In Lesson 8, students use soil tests to analyze an unfamiliar mixture of soil components. In Lessons 14 and 15, students apply these same tests to a local soil sample. Suggestions for additional assessments include guidelines for conducting student conferences, evaluating student work products, and encouraging students to share what they have learned with visitors.

## Goals for *Soils*

In this unit, students investigate the properties of three soil components—sand, clay, and humus—as well as their own local soil. They also explore the relationship between soil, roots, and plants. From their experiences, they are introduced to the following concepts, skills, and attitudes.

### Concepts

- Soil contains particles of different sizes.
- Soil may contain animals, plants, and their remains.
- Over time, dead plants become part of soil.
- Composting—especially with worms—is an effective way to recycle old plants and other discarded organic matter.
- Sand, clay, and humus are three of the basic components in soil.
- Every soil component has unique properties that can be identified using simple tests.
- Different soils absorb water at different rates.
- Many factors, including soil, affect plant and root growth.

### Skills

- Performing simple tests to describe and identify soil components.
- Observing, recording, and organizing test results.
- Interpreting test results to draw conclusions about soil composition.
- Reflecting on test results to predict how plants will grow in different soils.
- Assembling laboratory materials for soil experiments.
- Communicating results and ideas through writing, drawing, and discussion.
- Applying previously learned concepts and skills to analyze unfamiliar soil samples.

### Attitudes

- Developing enthusiasm for investigating soil.
- Appreciating the importance of soil for plant growth and animal life.
- Accepting that a range of outcomes is valid.
- Valuing the importance of recycling.



# Soils

## Fundamental Concepts and Principles Addressed (K–4)

### Science as Inquiry

#### *Abilities necessary to do scientific inquiry*

- Plan and conduct a simple investigation.
- Employ simple equipment and tools to gather data and extend the senses.
- Use data to construct a reasonable explanation.
- Ask a question about objects, organisms, and events in the environment.
- Communicate investigations and explanations.

#### *Understandings about scientific inquiry*

- Scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.
- Scientists use different kinds of investigations, depending on the questions they are trying to answer.
- Simple instruments, such as magnifiers, provide more information than scientists obtain using only their senses.
- Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).
- Scientists make the results of their investigations public; they describe the investigations in ways that enable others to repeat the investigations.
- Scientists review and ask questions about the results of other scientists' work.

### Physical Science

#### *Properties of objects and materials*

- Objects have many observable properties, including size, weight, shape, color, and the ability to react with other substances.
- Objects can be described by the properties of the materials from which they are made, and those properties can be used to separate or sort a group of objects or materials.

### Life Science

#### *The characteristics of organisms*

- Organisms have basic needs.
- Each plant or animal has different structures that serve different functions.

#### *Organisms and their environments*

- An organism's patterns of behavior are related to the nature of that organism's environment, including the kinds and numbers of other organisms present, the availability of food and resources, and the physical characteristics of the environment.
- All organisms can cause change in the environment in which they live. Some of these changes are beneficial. Others are detrimental.

### Earth and Space Science

#### *Properties of earth materials*

- Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties which make them useful in different ways, for example, as resources for growing plants.
- Soils have properties of color and texture, capacity to retain water, and ability to support growth of plants.

### Science and Technology

#### *Abilities of technological design*

- Identify a simple problem.
- Propose a solution.
- Implementing proposed solutions.
- Evaluate a product or design.
- Communicate a problem, design, and solution.

#### *Understandings about science and technology*

- Science is one way of answering questions and explaining the natural world.
- Scientists and engineers work in teams.

- Women and men of all ages, backgrounds, and groups engage in a variety of scientific and technological work.
- Tools help scientists make better observations and measurements. They help scientists see, measure, and do things they could not otherwise see, measure, and do.

## **History and Nature of Science**

### *Science as a human endeavor*

- Science and technology have been practiced by people for a long time.
- Men and women have made a variety of contributions throughout the history of science and technology.

## **Unifying Concepts and Processes**

*Systems, order, and organization*

*Evidence, models, and explanation*

*Constancy, change, and measurement*

*Form and function and measurement*

# Changes

## Narrative Summary

In this unit, students expand their understanding of solids, liquids, and gases by exploring changes in state. They investigate freezing, melting, evaporation, and condensation of water. In a sequence of lessons, students produce a mixture of two solids and a mixture of solids with liquids and observe the results. They work through several methods to separate mixtures: sieving, filtration, evaporation, and chromatography. The students set up races that involve sugar dissolving in water and observe the effects of particle size and water temperature on the rate at which the sugar dissolves. They also observe crystals formed as a result of evaporation. Students observe some changes that occur immediately and some that occur over time, and they begin to recognize the characteristics of chemical reactions. They investigate rusting, and they observe and collect the gas formed by mixing an effervescent tablet in water. Students have several opportunities to practice their new skills in lessons in which they devise ways of separating a mystery mixture and plan and carry out investigations that involve other changes.

## Science Content

This unit focuses on the foundations of scientific inquiry as students conduct simple investigations to observe everyday changes. Students make and record observations, mix substances, and observe the formation of new substances. They explore concepts from physical science, such as the ability of objects to react with other substances and changes of state.



Designing solutions and problem solving are also emphasized as students try to find the fastest method for melting their ice cubes. Presenting results to others and comparing observations are at the heart of this unit.

## Assessment

*Changes* begins with a pre-unit assessment in which students share what they know and their questions about solids and liquids and how they change. Looking at “Change Cards” that

illustrate everyday scenes, students identify solids and liquids and predict how the materials pictured might change over time. Students also make and record observations of what happens when a solid and a liquid are mixed. These pre-unit assessment activities are matched to a post-unit assessment. Two embedded assessments provide guidelines for assessing students’ progress. In Lesson 11, students apply their experiences from the first 10 lessons to identify and separate components of a mystery mixture. In Lessons 15 and 16, students use the concepts and skills learned in the second half of the unit to create their own “recipe” of changes. Student progress can be measured individually or in small groups by evaluating record sheets and student journal entries; by comparing pre- and post-unit investigations; and through class discussions, questions, and investigations. Additional assessments at the end of the unit include a student self-assessment, a listening activity, and suggestions for creating portfolio assessments.

## Goals for *Changes*

In this unit, students expand their understanding of solids, liquids, and gases and how they change. Through their experiences, students are introduced to the following concepts, skills, and attitudes.

### Concepts

- Changes occur all the time in the world around us.
- Some changes happen quickly, and others take place over a period of time.
- Substances can be classified as solids, liquids, or gases.
- Solids, liquids, and gases can be described by their properties. These properties include color, size, shape, odor, texture, and weight.
- Water can freeze into a solid and then melt into a liquid again.
- Water can evaporate into a gas and then condense into a liquid again.
- Mixtures can be made by combining solids, liquids, or gases, or a combination of these.
- A substance can change in appearance yet remain the same substance.
- Some mixtures can be separated using a sieve, a filter, or the processes of evaporation and chromatography.
- When some solids—such as salt and sugar—are added to water, they dissolve and seem to disappear.
- Some dissolved solids can be recovered as crystals through evaporation.
- When a solid is dissolving in a liquid, the size of the solid particles, the temperature of the liquid, and stirring can affect the speed at which the solid dissolves.
- When two or more substances are mixed, a chemical reaction may occur. Indicators of a chemical reaction can include a change in color, a change in temperature, or the production of a new substance, such as rust or gas.

### Skills

- Observing and describing changes that occur in everyday experiences.
- Observing and describing the properties of solids, liquids, and gases.
- Observing and describing changes that result from mixing substances.
- Observing and describing water as it freezes, melts, evaporates, and condenses.
- Comparing mixtures.
- Separating mixtures with a sieve, a filter, and the processes of evaporation and chromatography.
- Performing tests to investigate a mystery mixture.
- Communicating ideas, observations, and experiences through writing, drawing, discussion, and presentation.
- Predicting, observing, classifying, and recording results in a journal and on record sheets, class charts, and brainstorming lists.
- Designing and testing a recipe in which substances are mixed to create a chemical reaction.

### Attitudes

- Becoming curious about the changes that occur in the world around us.
- Developing an interest in investigating changes in the properties of solids and liquids.
- Developing an appreciation for the importance of recording and organizing information on record sheets, science journals, and class charts.



# Changes

## Fundamental Concepts and Principles Addressed (K–4)

### Science as Inquiry

#### *Abilities necessary to do scientific inquiry*

- Ask a question about objects, organisms, and events in the environment.
- Plan and conduct a simple investigation.
- Employ simple equipment and tools to gather data and extend the senses.
- Use data to construct a reasonable explanation.
- Communicate investigations and explanations.

#### *Understandings about scientific inquiry*

- Scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.
- Scientists use different kinds of investigations, depending on the questions they are trying to answer.
- Simple instruments, such as magnifiers, provide more information than scientists obtain using only their senses.
- Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).
- Scientists make the results of their investigations public; they describe the investigations in ways that enable others to repeat the investigations.
- Scientists review and ask questions about the results of other scientists' work.

### Physical Science

#### *Properties of objects and materials*

- Objects have many observable properties, including size, shape, color, temperature, and the ability to react with other substances.
- Materials can exist in different states—solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling.

#### *Light, heat, electricity, and magnetism*

- Heat can be produced in many ways, one of which is by mixing one substance with another.

### Earth and Space Science

#### *Properties of earth materials*

- Earth materials are solid rocks, soil, water, and the gases of the atmosphere. These materials have different physical and chemical properties.

#### *Changes in the earth and sky*

- Weather changes from day to day and over the seasons.

### Science and Technology

#### *Abilities of technological design*

- Identify a simple problem.
- Propose a solution.
- Implementing proposed solutions.
- Evaluate a product or design.
- Communicate a problem, design, and solution.

#### *Understandings about science and technology*

- People have always had questions about their world. Science is one way of answering questions and explaining the natural world.
- Scientists and engineers often work in teams in which different individuals do different things that contribute to the results.
- Tools help scientists make better observations, measurements, and equipment for investigations.

## **Science in Personal and Social Perspectives**

### *Personal health*

- Safety and security are basic needs of humans. Safety involves freedom from danger, risk, or injury. Student understanding includes following safety rules for home and school.

## **History and Nature of Science**

### *Science as a human endeavor*

- Many people derive great pleasure from doing science.

## **Unifying Concepts and Processes**

*Systems, order, and organization*

*Evidence, models, and explanation*

*Constancy, change, and measurement*

# Balancing and Weighing

## Narrative Summary

This unit introduces students to the relationship between balance and weight. Experiences with a beam balance introduce students to the concept that amount of weight, position of weight, and position of the fulcrum affect balance. Work with an equal-arm balance challenges students to place objects in serial order on the basis of weight and to appreciate that weighing is the process of balancing an object against a certain number of standard objects. In the final lessons, students turn to a series of problem-solving investigations with the equal-arm balance and cupfuls of four different foods. These activities provide an opportunity to explore the relationship between weight, density, and volume.

## Science Content

This unit provides students with a variety of experiences and materials that help them build conceptual models for further investigations in the physical sciences. Using a fulcrum and beam, students investi-



gate how the amount, distance, and position of objects affect balance. Designing and building mobiles gives students the opportunity to apply their knowledge of fulcrums and equilibrium to a new situation. Students build on their knowledge of standard units as they use an equal-arm balance to investigate weight, density, and volume.

## Assessment

A matched pre- and post-unit brainstorming session and activity help

teachers assess students' growth in concepts and skills. An embedded assessment in Lesson 5 and a culminating assessment in Lesson 16 allow teachers to assess the knowledge and skills that students have attained in previous lessons. Additional assessments at the end of the unit provide suggestions for evaluating student journal entries and class products. Guidelines for conducting student conferences are given.

## Goals for *Balancing and Weighing*

In this unit, students expand their understanding of the relationship between balance and weight as they explore activities in balancing, comparing, and weighing. Their experiences introduce them to the following concepts, skills, and attitudes.

### Concepts

- Balance is affected by the amount of weight, the position of weight, and the position of the fulcrum.
- Weighing is the process of balancing an object against a certain number of standard units.
- The weight of an object is not determined by its size.
- Equal volumes of different foods will not all have equal weights; equal weights of different foods will not all have equal volumes.

### Skills

- Performing simple experiments with balance.
- Applying previous experiences with balancing to build mobiles.
- Using an equal-arm balance to compare and weigh.
- Predicting the serial order for the weights of objects and foods.
- Applying strategies for comparing and weighing to solve problems.
- Recording results on record sheets, bar graphs, line plots, data tables, and Venn diagrams.
- Communicating ideas, observations, and experiences through writing, drawing, and discussion.
- Reading to learn more about balancing and weighing.

### Attitudes

- Developing an interest in investigating balancing and weighing.
- Appreciating the importance of balancing and weighing in the everyday world.
- Accepting that a range of results is valid.
- Valuing the importance of simple scientific tools.



# Balancing and Weighing

## Fundamental Concepts and Principles Addressed (K–4)

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### Science as Inquiry

#### *Abilities necessary to do scientific inquiry*

- Ask a question about objects, organisms, and events in the environment.
- Plan and conduct a simple investigation.
- Employ simple equipment and tools to gather data and extend the senses.
- Use data to construct a reasonable explanation.
- Communicate investigations and explanations.

#### *Understandings about scientific inquiry*

- Scientists use different kinds of investigations depending on the questions they are trying to answer.
- Simple instruments, like rulers, provide more information than scientists obtain using only their senses.
- Scientists develop explanations using observations and what they already know about the world.
- Scientists make the results of their investigations public.
- Scientists review and ask questions about the results of other scientists' work.

### Physical Science

#### *Properties of objects and materials*

- Objects have many observable properties, including size, weight, shape, and color. These properties can be measured using tools, such as balances.
- Objects can be described by the properties of the materials from which they are made, and those properties can be used to separate or sort a group of objects.

#### *Position and motion of objects*

- The position of an object can be described by locating it relative to another object.

### Science and Technology

#### *Abilities of technological design*

- Identify a simple problem.
- Propose a solution.
- Implementing proposed solutions.
- Evaluate a product or design.
- Communicate a problem, design, and solution.

#### *Understandings about science and technology*

- Science is one way of answering questions and explaining the natural world.
- Scientists and engineers work in teams.
- Women and men of all ages, backgrounds, and groups engage in a variety of scientific and technological work.
- Tools help scientists make better observations and measurements. They help scientists see, measure, and do things they could not otherwise see, measure, and do.

### Science in Personal and Social Perspectives

#### *Science and technology in local challenges*

- People continue inventing new ways of doing things, solving problems, and getting work done.

## **History and Nature of Science**

*Science as a human endeavor*

- Science and technology have been practiced by people for a long time.
- Men and women have made a variety of contributions throughout the history of science and technology.
- Many people derive great pleasure from doing science.

## **Unifying Concepts and Processes**

*Systems, order, and organization*

*Evidence, models, and explanation*

*Constancy, change, and measurement*

*Evolution and equilibrium*

*Form and function*