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Practice Workbook

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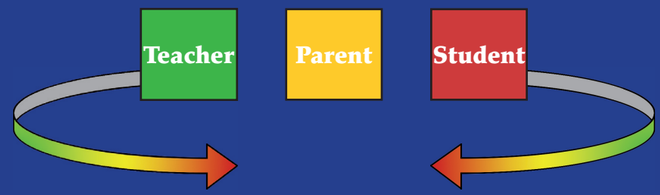
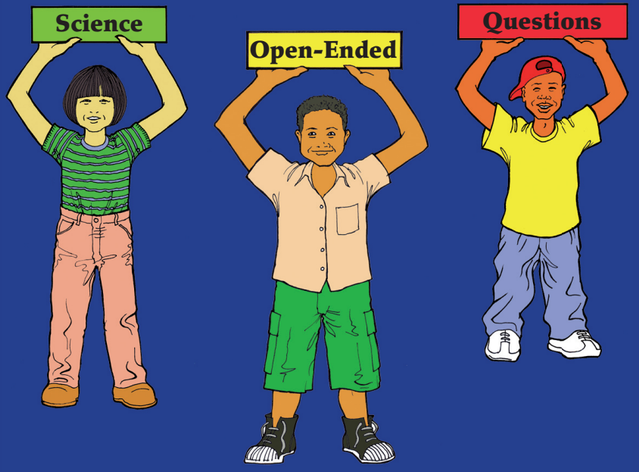
New York
Critical Thinking in Science
Open-Ended Questions



Teachers, Parents, Students a recipe for success.



Correlated to NYS Elementary Science Core Curriculum Grades K-4

Practice Workbook

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Dear Student,

Welcome to a different kind of book. This book will help you practice a special kind of question. It is called an "open-ended" question. Open-ended questions give you a chance to show what you know! They are different from multiple-choice. You do not have to pick out an answer. You can write the answer yourself.

What will the question look like?

The questions might ask you to write a few words or a few sentences. They might ask you to label a diagram or draw a graph. They will ask you to do the things scientists do every day.

How will this book help you?

This book will give you many examples of things that happen in your world. You will be able to read some information and answer questions about it. Answering the questions will let you show people how much you know!

How is this book set up?

This book has two parts. One part is about life science (like plants and animals. The other part is about physical science (like planets and matter). Each example has a part you read and some questions to answer.

First you will try to answer the questions.

Every example has a part that says "Let's talk about it". In this part the example is explained. You will get ideas on how to answer the questions.

Every example has a sample answer. You can compare your answer to the sample. You are asked to think about how you could have given a more complete answer.

Important Suggestions:

Read the paragraph carefully - You might find these paragraphs pretty interesting. They talk about science in the world around us.

Answer the question that is asked. Follow directions! - Make sure you read the words that tell you what to do in your answer. They are words like "explain", "label", "list", "give an example".

Do not write too much - For example, if the question asks for two examples, give two. You will not get a higher grade for writing more.

Use complete sentences - Sometimes the directions will say "use complete sentences". It is always a good idea to do it even if it doesn't say so.

Do not leave blanks - Make a try. Even if you are not sure, try to write something.

Have fun - Exploring science and the natural world is a lot of fun. Reading about science is fun too. Keep reading and keep learning!

Dear Teacher,

This book is designed to give your students practice in answering open-ended questions in science. You can use them in a number of ways including, but certainly not limited to, review for state exams, as formative assessments during a unit, as homework, or as a "Do Now" to begin class.

More and more standardized tests are using open-ended questions, that is, "short" and "extended" response questions to help determine what your students know and are able to do. "Short" may mean a few words or the labeling of a simple diagram and "extended" may mean several sentences or a paragraph of the design of an experiment.

All New York State Regents exams, as well as those testing elementary and intermediate learning standards, at grade 4 and 8 respectively, use open ended questions. Along with the traditional multiple choice (or "selected response") questions, students will be required to write about what they know.

Most often, open-ended questions begin with a few paragraphs describing some scenario. The scenario includes several scientific concepts with which the student should be familiar. The paragraphs are followed by questions that ask the student to apply what he or she knows about the topic. Sometimes the student will be asked to complete a graph, draw or label a diagram, analyze some data that is graphically represented, or some other skill common to science learning.

Often these questions are referred to as "reading comprehension". This is a misnomer. Of course students need to comprehend what they are reading, but open-ended questions, as they are presented on standardized science tests, are better called "real-world application". They require the student to read and understand the situation described but also to apply the science concepts studies in order to answer the questions.

Usually there are several questions asked about each situation presented. Students are required to draw on the science they have learned over time to make sense of this new context and accurately answer the questions. Questions are often "scaffolded" to help the student come to the final answer in a step by step way. They are often given hints in the question itself, such as "be sure to include…in your answer".

There are seven *New York State Learning Standard for Mathematics, Science, and Technology.* They include:

1. ***Analysis, Inquiry, and Design*** – where students will pose questions, seek answers, and develop solutions.

2. ***Information Systems*** – where students will access, generate, process, and transfer information using appropriate technologies.

3. ***Mathematics*** – where students will communicate and reason mathematically and apply mathematics to real-world settings.

4. ***Science*** – where students will apply scientific concepts, principles, and theories to the physical setting and the living environment

5. ***Technology*** - where students will apply technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs.

6. ***Interconnectedness: Common Themes*** – where students will understand relationships and common themes that connect mathematics, science, and technology and apply these themes to these and other areas of learning.

7. ***Interdisciplinary Problem Solving*** – where students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.

All of these standards might come into play in any of these open-ended response questions. Materials from Standard 4, which deals with both physical and life science content, will appear in all the questions. Standards 1, 2, 6, and 7 are also represented on state science exams so will be included in the questions asked throughout this book.

Students should be reminded that as they answer these questions, they should keep in mind what they know about the content and be prepared to write about it. Of equal importance is to practice using what they know about science to help explain the natural world. Science is all around us. The concepts and principals impact our lives every day. To be informed citizens, able to make considered decisions for ourselves and our community, we all must be able to apply what we know.

List of Standards

Each standard includes important Key Ideas. The Key Ideas explain concepts that students should be familiar with. Key Ideas at the elementary level are the same as those in the intermediate level and in high school, but the concepts and skills (called *Performance Indicators*) that students must know are specific to the elementary level and might appear on the *Grade 4 Elementary-Level Science Test*.

Standard 1. This standard includes seven Key Ideas:

Mathematical Analysis

Key Idea 1 – Abstraction and symbolic representation are used to communicate mathematically.
Students will use numbers and other symbols to compare and describe quantities and express relationships.

Key Idea 2 – Deductive and inductive reasoning are used to reach mathematical conclusions.
Students will make conclusions based on logical reasoning by recognizing patterns and relationships.

Key Idea 3 – Critical thinking skills are used in the solution of mathematical problems.
Students will explore and solve problems they find around them by using concrete objects when possible.

Scientific Inquiry

Key Idea 1 – The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.
Students will learn to ask questions for understanding of their observations, question what they hear or read about, and develop relationships about their observations in order to form their own explanations.

Key Idea 2 – Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.
Students will develop written plans for exploring some phenomenon, share their plans with others and revise if necessary, and carry out their plans through observations and the use of simple measurement instruments.

Key Idea 3 – The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.
Students will organize their observations and measurements into charts and graphs, interpret the organized data and recognize simple patterns, share their findings with others, and revise their explanations and understandings based on their findings.

Engineering Design

Key Idea 1 – Engineering design is an iterative process involving modeling and optimization (finding the best solution within given constraints); this process is used to develop technological solutions to problems within given constraints.
Students will describe objects and suggest ways they may be designed differently, investigate prior solutions and generate new solutions to a problem, plan and build a model of the solution, and discuss how best to test the solution.

Standard 4 – The Physical Setting. This standard includes five Key Ideas:

Key Idea 1 – The Earth and celestial phenomena can be described by principles of relative motion and perspective. Students can describe patterns of daily, monthly, and seasonal changes in their environment.

Key Idea 2 – Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land. Students can describe the relationships between air, water, and land on Earth.

Key Idea 3 – Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity. Students can observe and describe properties of materials using appropriate tools. They should be able to describe the differences between chemical and physical changes, including changes in states of matter.

Key Idea 4 – Energy exists in many forms, and when these forms change energy is conserved. Students can name different forms of energy and recognize the changes that occur when objects interact with forms of energy.

Key Idea 5 – Energy and matter interact through forces that result in changes in motion. Students can recognize the effects of common forces such as magnetism, gravity, and mechanical forces and how they operate across distances.

Standard 4 – The Living Environment. This standard includes seven Key Ideas:

Key Idea 1 – Living things are both similar to and different from each other and nonliving things. Students can recognize the characteristics and processes common to all living things. These characteristics may be the same or different in living and non-living things.

Key Idea 2 – Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring. Students can recognize that some traits in living things are inherited and are passed on to offspring. Others are acquired and, therefore, cannot be passed on to offspring. Students should recognize that there is a genetic continuity between generations.

Key Idea 3 – Individual organisms and species change over time. Students know that plants and animals are dependent on their environment. They have specialized structures that provide an advantage to survival.

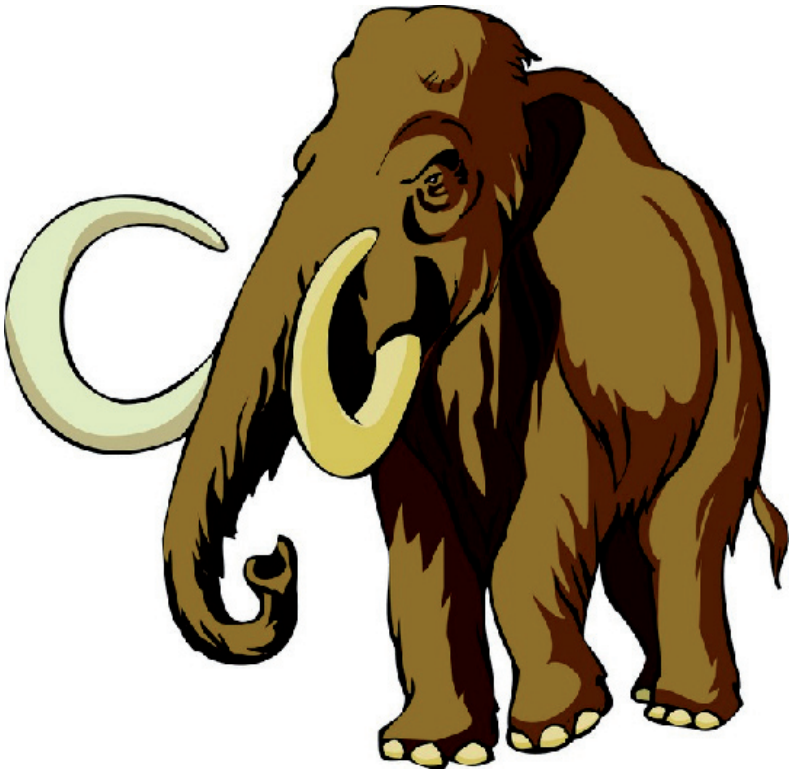
Key Idea 4 – The continuity of life is sustained through reproduction and development. Students can describe the major stages in life cycles of some plants and animals.

Key Idea 5 – Organisms maintain a dynamic equilibrium that sustains life. Students can explain the basic life functions and behaviors of living organisms. They should know what behaviors promote good health and those used for survival.

Key Idea 6 – Plants and animals depend on each other and their physical environment. Students recognize that plants and animals, including humans, depend on their environment for survival.

Key Idea 7 – Human decisions and activities have had a profound impact on the physical and living environment. Students understand that humans have an impact on their environment. They should be able to identify changes humans have caused.

"Wild and Wooly"



Mammoths are animals that lived during the Ice Age. They went extinct about 28,000 years ago. There are different kinds of mammoths. One kind is the Columbian mammoth. Columbian mammoths lived where it was warm.

About 25 years ago the bones of some Columbian mammoths were found near a river in Texas. Archeologists think these mammoths were killed by a mudslide. They could tell the animals were skinny and sickly when they died.

Scientists want to add these bones to a museum. If the bones are in a museum, they can be studied for a long time.

1. Animals have basic needs. Use this example to explain what basic needs were met for the mammoth. What needs were not met?

2. Wooly mammoths lived in cool Northern climates. Columbian mammoths lived in warmer areas. Make an inference about the differences in the mammoths' coats

Try answering the questions:

Answer to question 1

Answer to question 2

LET'S TALK ABOUT IT

1. All animals have the same basic needs to live and be healthy. They all need air to breathe, water to drink, and food to eat.

Picture the area where the mammoths lived before the mudslide.

Yes, because they lived near a river.

Yes

The archeologists said the mammoths were skinny and not healthy. They did not get enough food to eat.

Was there water to drink?

Was there air to breathe?

Did they have food to eat?

Sample answer:

The mammoths needed air, water, and food. They had air to breathe and water from the river to drink. They did not have enough food.

2. The structures of animals help them survive in their environment. The wooly mammoth lived where it was cold. It needed extra protection from freezing temperatures so it grew a thick fur coat. That's why it is called a "wooly" mammoth.

   The Columbian mammoth lived in a place that is now Texas. The temperatures are much warmer. The mammoth did not need a heavy fur coat. It grew less fur.

   In the question you are asked to "infer". To "infer" something you have to think about the information you have. Then you can make a good guess. You have information about the temperatures in each place these different mammoths lived. You can make a good guess about how thick their fur needed to be to protect them.

Sample answer:

The wooly mammoth's fur had to be thick to protect it from the cold climate. The Columbian mammoth's fur did not have to be as thick because the temperatures were higher in the warm climate.

REFLECTION

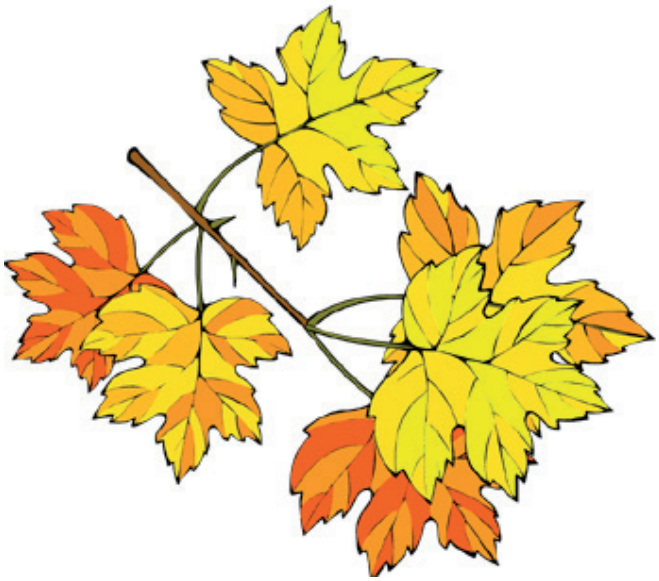
How do the sample answers compare to your answers?

How could you improve what you wrote?

Reflect on question 1

Reflect on question 2

"Fish Made From Leaves?"



Yes! Scientists have found that fish use maple leaves and other plants that grow on land for food. Of course, the fish don't go on land to eat. When the leaves fall into the water, the small fish (and insects) can eat them and get energy. When the leaves decay, the insects and fish can also use the nutrients from the plants for energy.

1. Explain how maple leaves make food for fish. First explain how plants make their own food.

2. In this example the plants, insects, small fish (and large fish) depend on each other. Name this relationship. Draw a diagram to show what you mean.

Try answering the questions:

Answer to question 1

Answer to question 2

LET'S TALK ABOUT IT

1. Plants make their own food using air, water, and energy from the Sun. This question makes sure you know that. The paragraph explains that maple leaves fall into the water where the fish can eat them. Sometimes, decomposers will break down the leaves so the nutrients can be recycled. Either way, the fish live and grow because they get energy from the leaves. Remember - that energy came from the Sun first.

Sample answer:

Plants use air, water, and energy from the Sun to make their own food. When the leaves fall into the water the fish can eat the leaves. They get the nutrients from the leaves.

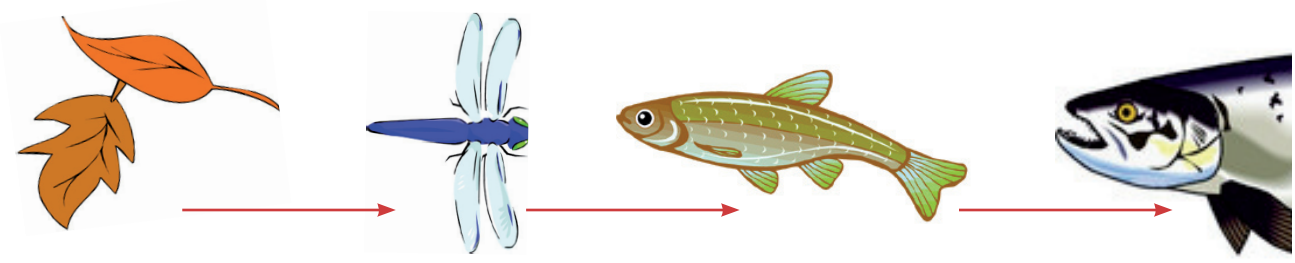
2. Plants are called "producers" because they make their own food. Animals eat plants for their food. Other animals eat those animals. This simple relationship is called a "food chain". In nature, when a lot of food chains go on at the same time in one area, it is called a "food web". This example is just a simple food chain. It is not a food web.

This question is about plants (maple leaves), insects, small fish, and large fish. You are asked to draw a diagram showing how these plants and animals depend on each other. Be sure to draw a picture of this relationship. If you just explain it in words you will not be answering the question that is asked.

Don't forget to say in your answer that this is called a "food chain".

Sample answer:

When animals eat animals that eat plants it is called a "food chain".



REFLECTION

How do the sample answers compare to your answers?

How could you improve what you wrote?

Reflect on question 1

Reflect on question 2