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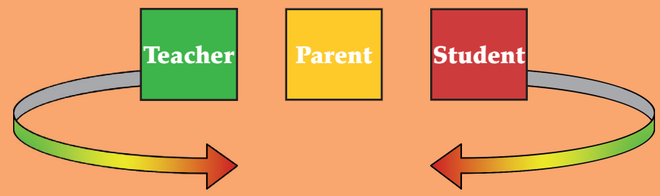
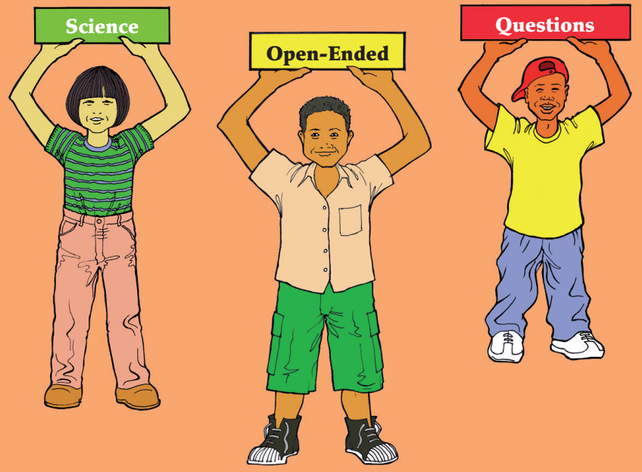
Practice Workbook

New York
Critical Thinking in Science
Open-Ended Questions



Teachers, Parents, Students a recipe for success.



Correlated to Intermediate Level Science Core Curriculum Grades 5-8

Practice Workbook

Dear Student,

Every year, New York students in the eighth grade take a series of exams that test how much they have learned in school. One of these is the **Grade 8 Intermediate-Level Science Test.** Along with multiple choice questions the science test (as well as several other state exams) also has a type of question called "open-ended".

What is an "open-ended" question?

Some questions are "multiple choice" where you are asked to choose the answer from 4 or 5 possibilities the test maker has provided.

"Open-ended" (or "open-response" or "constructed response") questions expect you to write an answer, not just a letter or a number. You might be asked to write a few words or many sentences. These kinds of questions help teachers better understand what you actually know about the subject. Sometimes you will be asked to complete a graph, draw or label a diagram, or set up a data table, for example. These are all skills that scientists use everyday.

What will this question look like?

Often open-ended questions start off with one paragraph or a few paragraphs that describe a situation. These paragraphs will be followed by a series of questions about the reading. The questions might ask for some facts that you should know, like the organs in the respiratory system. Most likely they will ask you to take what you know and use it to figure out what is happening in the situation described.

Sometimes the questions will give you hints to help with the answer. In our example of the respiratory system the hint might be "be sure to include the organs outside the chest cavity in your answer." When you read that it should remind you to include the nose and mouth!

Other times your answer might include labeling a diagram or setting up a data table. Again, in our example you might be asked to complete a graph that shows the relationship between exercise and respiration rate.

An important thing to remember about these questions:

You might be familiar with reading passages on other tests. Sometimes they are called "reading comprehension" questions. These questions are different. Sure, you have to understand what you are reading. The difference is that you will be asked to apply the science you know to the situation that you have just read. These are also called "real-world application" questions. Getting practice in applying scientific concepts and the skills you have learned will help you understand that science is happening all around you every day.

How will the book help me?

This book will give you lots of practice reading about every day science issues and using what you know to understand what is happening. By thinking about what you have learned, you will be able to explain the natural phenomena around you.

Most of these examples are taken from newspaper and magazine articles that millions of people are reading every day. They have been summarized for you but they deal with questions and issues that exist in the real world. They will give you an idea of the kinds of problems scientists and government leaders must face on a day-to-day basis.

In addition, by completing the questions in the book, you will be getting more practice with this type of question. You will be seeing this type of question more and more on classroom tests and on standardized tests you will be taking for graduation and for college admission.

How is the book set up?

This book has two parts. It has examples that deal with life science issues and those that deal with physical science issues. But remember, in the real world, these two areas often overlap so you might have to think of what you learned about chemistry, for example, to help answer a question about pollutants affecting baby birds.

Each of the examples will have a few paragraphs summarizing the situation. There will be several questions related to the situation.

For each question there is a ***Discussion*** section that will help you review what you should know about the topic. This section describes the kinds of information you should have been thinking about as you answered the question.

There is a ***Sample answer*** section which gives an ***example*** of an acceptable answer. Remember that your answer does not have to be exactly like this one but it should contain the same kind of information.

You can compare your answer to the sample one. Think about what you wrote and change it for a more complete answer if necessary.

Important Suggestions:

Read the passages carefully. You will probably find that the situations are very interesting. They may even be about something in the news that you are especially interested in, like space travel, or snowmobiles, or pollution. Read carefully and go back to the passages to review what has been said as you answer the questions.

Answer the question that is asked. If the question says "explain" you should explain. If the question says "diagram" you should diagram. You won't get credit for an answer if you do not follow the directions. Learning science involves learning concepts and skills. Teachers want to know that you understand both. If you explain the concept of a food web, for example, when the test question is designed to make sure you know how to draw a food web, you will not have answered the question correctly.

Do not write too much. If the question asks for two examples, give two. If you add more examples you may run the risk of giving inaccurate information. On the state exams you will lose credit for doing that.

Look for hints in the question and/or directions. Sometime there will be guidelines built right into the question. You might be asked to make a list of the planets in our solar system "starting with Mercury". By looking for hints, you will already have one of the answers.

Use complete sentences. Sometimes you will be directed to use complete sentences in your answer but even if you are not, it is still a good idea. You may know exactly what you mean with a word or two but the person reviewing your answers may not. If you use complete sentences and describe what you mean, your ideas will be understood better.

Do not leave blanks. Make a try. One of the nice things about open-ended response questions is that you have a chance to give some of your ideas on a subject even if you are not 100% sure of the answer. If you are asked about sound waves but you can only remember information on light waves, you can try to make some comparisons or generalizations. You may be surprised on how close you come to the answer.

Remember rubrics and scoring guides. You many have heard your teachers talking about "rubrics" or you may have used them yourself in your class work. Rubrics are guidelines that explain what information should be included in an answer or a project. Teachers are given scoring guides to use as they review your answers. Many of the questions on state tests allow the teachers to give part credit for your work.

Have fun. Exploring science and the natural world is a lot of fun. You should keep this in mind as you work in your science classes, travel around outside your school, or try to figure out how things work. Hopefully, the passages you read in this book and the science concepts and skills that you review will help you on your exams and keep you interested in learning more and more science!

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.

Many standardized tests use open-ended questions like, "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 studied 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.

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 need to know that the cell is the basic unit of structure and function for all living things. Human beings are made up of cells, tissues, and organs which all function together as systems to carry out life functions.

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 need to know that all organisms require specific instructions for specifying traits. These instructions are passed from one generation to the next by reproduction.

Key Idea 3 – Individual organisms and species change over time. Students need to know that species change over time through a series of adaptations that make them better suited to survive in a particular environment.

Key Idea 4 – The continuity of life is sustained through reproduction and development. Students need to know that survival of a species depends on the ability to produce offspring. Life cycles involve both reproductive and developmental stages.

Key Idea 5 – Organisms maintain a dynamic equilibrium that sustains life. Students need to know that organisms must obtain and use resources, grow, reproduce and maintain equilibrium in order to live and thrive.

Key Idea 6 – Plants and animals depend on each other and their physical environment. Students need to know that all organisms interact with one another and are dependent on their physical environment. Energy flows from one organism to another.

Key Idea 7 – Human decisions and activities have had a profound impact on the physical and living environment. Students need to know that organisms need various things from their environment such as light, air, and water. Humans have a responsibility to protect and sustain their environment.

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 need to know about celestial objects and their motion in the universe. They should recognize cyclical changes.

Key Idea 2 – Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land. Students need to know Earth is a set of interacting systems and describe 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 need to know that matter takes up space and has mass. All matter is composed of elements.

Key Idea 4 – Energy exists in many forms, and when these forms change energy is conserved. Students need to know that energy can be transformed from one form to another but cannot be created or destroyed.

Key Idea 5 – Energy and matter interact through forces that result in changes in motion. Students need to know that all motion is an interaction between matter and energy.

"A River of Salad Dressing!"

Biologists have recently been studying organisms in a river in Spain called the Rio Tinto. They have discovered hundreds of species of microscopic life including algae, fungi, yeast, amoebas, and bacteria. All of these organisms are living in an environment with a pH that is more acidic than vinegar!

Local people thought this river was polluted because of copper mining. The scientists found that the bacteria themselves are turning the sulfur and iron in the river into sulfuric acid and iron oxide. These organisms are able to live in water that has a pH of 2. Yet, they still have a normal pH inside their cells.

1. Which kingdoms of organisms are represented in the Rio Tinto?

2. Which part(s) of the cells would be involved in maintaining a normal pH inside the cell while the organism is floating in a highly acidic environment?

3. By comparing genetic material, researchers have found that some of the species in the Rio Tinto are very similar to species that live and thrive in normal conditions. Explain how the Rio Tinto bacteria have adapted to life in these acid conditions.

Try answering the questions:

Answer to question 1

Answer to question 2

Answer to question 3

DISCUSSION

1. Biological classification systems have changed a lot since Linnaeus first began classifying plants and animals in the 1700's. We now separate living organisms into six different kingdoms. The kingdoms represented in the waters of the Rio Tinto include:

   Eubacteria – the single-celled bacteria
   Fungi – the fungi and yeast which live on dead and decaying material
   Protists – mostly single-celled organisms, some of which have plant characteristics, some have animal characteristics

   Algae are also found in the river. Some taxonomists (scientists who specialize in classifying organisms) place algae in the "Plant" kingdom because some of them can make their own food. More often algae are placed in the "Protist" kingdom because only some are producers. Others eat producers.

Sample answer:

The kingdoms represented in the Rio Tinto are Eubacteria, Fungi, and Protist.

2. The cell membrane is the part of the cell (organelle) which controls the passage of materials into and out of the cell.

Answer:

The cell membrane

3. Some bacteria in the river probably died because of the acidic conditions. Those that did not die had mutations in their genes that helped them survive. When they reproduced, those genes were passed on so the offspring were also able to survive the acidic conditions. Bacteria reproduce very quickly. Before too long, the acid conditions were not life threatening.

Sample answer:

Some bacteria were able to survive the acidic river because of mutations in their genetic makeup. The survivors were the ones that reproduced so their offspring also had the adaptation.

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

Reflect on question 3

"Now You See It, Now You Don't!"

In the deserts of the southwestern United States tiny rock pocket mice run all over collecting seeds for food. They are usually sandy-colored so are safe on the desert floor. However, some rock pocket mice live in areas where ancient volcanoes erupted. These volcanoes left large areas of black rock. Scientists have observed that these mice have dark fur. When the scientists examined the DNA sequences, they found mutations of the genes in every dark-colored mouse.

Rock pocket mice feed at night. Researchers wanted to know if fur color made any difference in the dark. They released light and dark colored mice in an enclosed space. They found that owls, a mouse's major predator, could easily spot a mouse on a background that was a different color from the fur color.

1. State a hypothesis that the researchers who were interested in the advantages of fur color might have investigated.

2. Why were scientists looking at DNA sequences for gene mutations? In what part of the cell would they find this information?

3. Diagram the food chain that is occurring in the deserts of the Southwest. Include the organisms in the paragraph in your answer.

Try answering the questions:

Answer to question 1

Answer to question 2

Answer to question 3

DISCUSSION

1. In order to explain natural phenomenon, researchers would formulate their question, identify appropriate references, and develop their hypothesis. In this case they wanted to know whether different colored mice on different color backgrounds were safe from predators. The scientists were especially interested in this question because they knew the mice were most active in the nighttime.

Sample answer:

At night, light colored mice are only safe from owl predators when they are on light colored backgrounds.
OR
At night, owls can see mice on different colored backgrounds more easily than on the same colored background
OR
At night, fur color is an advantage when hiding from predators.

2. Genes are composed of DNA that makes up the chromosomes of the cell. Hereditary information is contained in genes. Each gene carries a single unit of information. Chromosomes are found in the nucleus of cells.

Sample answer:

Genes contain genetic information and are composed of DNA.
Genes are found in the cell's nucleus.

3. A food chain is a graphic way to show the flow of energy in an ecosystem. In this paragraph we learned about mice eating seeds and owls eating mice. Seeds come from plants, which are producers. The mice and the owls are consumers or heterotrophs.

Sample answer:

Seeds → mouse → owl

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

Reflect on question 3