THE OXYGEN STORY

TEACHER'S GUIDE
The Carbon Cycle

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Teacher’s Guide

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THE OXYGEN STORY

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THE OXYGEN STORY

Viewing Time: 15 minutes

INTRODUCTION

Oxygen, the most common element on earth, is key to the survival of most organisms. Most living things could not exist without it; it makes up some sixty-five percent of our own bodies and fully half the earth’s crust by weight.

The Oxygen Story acquaints students with the important role that oxygen plays in both living and non-living systems and explains the way in which oxygen atoms are recycled and thus used over and over again.

PROGRAM GOALS

The goals of this program are to explain...

• The structure of oxygen atoms and the nature of the molecules into which they combine.
• The role of oxygen in biotic and abiotic systems.
• The relationship between photosynthesis and cellular respiration.
• How these processes combine to produce the oxygen cycle.

STUDENT OBJECTIVES

After viewing the video and participating in the follow-up activities, students in the 5th through 9th grades should be able to accomplish the following objectives:

• Describe the basic structure of an oxygen atom.
• Describe the molecular configuration of atmospheric oxygen and ozone.
• Explain the role of ozone at ground level and in the upper atmosphere.
• Describe some of the ways in which organisms get oxygen from their surroundings.
• Define the process of oxidation and give examples of the different rates at which it takes place.
• Explain the process of photosynthesis and how it produces atmospheric oxygen.
• Describe the oxygen cycle in terms of its component processes: photosynthesis and respiration.

SUMMARY OF THE VIDEO PRESENTATION

The video, The Oxygen Story, opens by introducing viewers to the importance of oxygen to both the biotic and abiotic worlds. It then goes on to describe the structure of both atmospheric oxygen and ozone and explain the role of ozone at ground level and in the upper atmosphere.

From there the presentation moves on to a discussion of the oxidation process. At this point, the concepts of cellular respiration and photosynthesis are introduced and the key point is made that green plants are the source of the oxygen on which nearly all living things depend. The presentation then closes with an explanation of the oxygen cycle and how oxygen atoms are recycled through it.

THE VIDEO QUIZ

The video presentation of The Oxygen Story is followed by a “video quiz.” This quiz consists of ten questions, and you can elect to have your students answer them orally or use the quiz form provided as Blackline Master 3.

TEACHER PREPARATION

We suggest that you preview the video and familiarize yourself with this teacher’s guide and the accompanying blackline masters before using this program. In this way you will become familiar with the materials and be better prepared to adapt the program to the needs of your class.
We also suggested that the video presentation take place before the entire class and under your direction. The lesson activities grow out of the content of the video; therefore, the presentation should be a common experience for all students.

As you review the following Suggested Instructional Procedures, you may find it necessary to make some changes, deletions, or additions to fit the specific needs of your class. We encourage you to do so, for only by tailoring this program to your students will they obtain the maximum instructional benefits afforded by the materials.

Duplicate the blackline masters you intend to use.

**SUGGESTED INSTRUCTIONAL PROCEDURES**

**INTRODUCING THE VIDEO**

*The Oxygen Story* is about the “breath of life,” and one very effective way of introducing it is to ask your students to hold their breath. You can then make the point that the video they are about to see is about the very heart of what’s involved each time they take a breath — oxygen.

Another way to introduce the presentation is to bring a green plant of some kind (it does not matter in the least what kind it is) and make the point to your class that they and the plant in question are linked in one of the most vital relationships on the planet — the oxygen cycle.

Current events can also provide useful ways of introducing the subject. For example, an article about ozone depletion or the destruction of the planet’s rain forests could provide very effective topic “hooks” to introduce *The Oxygen Story.*

Before presenting the video to your class, see Discussion Topics Guide/Quiz on page 4 and decide if you want to use them before or after you show the video.
You may also want to tell the students about the Video Quiz that is at the end of the video presentation and distribute Blackline Master 3 before showing the video portion of this lesson.

Present the video, *The Oxygen Story*. The viewing time is 15 minutes.

**DISCUSSION TOPICS GUIDE/QUIZ**

You can use the following four discussion topics in different ways. One useful approach is to use them as stimulants for classroom discussion. This can be done either before or after you show the video.

The same topics are also provided as Blackline Master 4. You can make copies of this master and use them as a quiz to test your students’ grasp of the material either before or after you show the video.

1. **What are the structural differences between normal atmospheric oxygen and ozone molecules?**
   
   *Normal atmospheric oxygen molecules are composed of two oxygen atoms. Ozone molecules are made up of three oxygen atoms.*

2. **Name the two “sides” or parts of the oxygen cycle and briefly describe them.**
   
   *The two sides of the oxygen cycle are photosynthesis and respiration. During photosynthesis green plants take in water and carbon dioxide from their surroundings and give off oxygen as waste. During respiration organisms use oxygen and give off carbon dioxide and water as waste.*

3. **Describe the term “oxidation” and give an example of both its rapid and slow forms.**
   
   *Oxidation is the most common way in which oxygen combines with other substances. Combustion, or burning, is an example of rapid oxidation. Rusting and cellular respiration are examples of slow oxidation.*
4. How will the destruction of large areas of the earth’s rain forest impact the oxygen cycle?

While rain forests cover a relatively small percentage of the Earth’s surface (about six to eight percent) their impact on the planet’s oxygen supply is major. This is because the photosynthesis that goes on in their highly productive green vegetation is estimated to produce almost a third of the planet’s oxygen supply.

VIDEO QUIZ

It is suggested you review the questions and answers to the Video Quiz after completing with your class all of the follow-up discussions and Blackline Master activities. You may find it helpful to either show the video again or just repeat the Video Quiz portion.

DESCRIPTION OF BLACKLINE MASTERS

Blackline Master 1 is a glossary of some of the more important terms used in this lesson.

Blackline Master 2 is a vocabulary review.

Blackline Master 3 is the student handout to accompany the Video Quiz. (Suggested answers are provided under Answer Key to Blackline Masters on page 6 of this guide.)

Blackline Master 4 is the student handout of the Discussion Topics Guide/Quiz presented. Suggested answers are provided on pages 4 and 5 of this guide.

Blackline Master 5 is a concept map dealing with ozone.

Blackline Master 6 is a concept map dealing with oxidation.

Blackline Master 7 is a concept map dealing with the oxygen cycle.
ANSWER KEY TO BLACKLINE MASTERS

Answers to Blackline Master 2 - Vocabulary Review

1. G. recycle–To use a material more than once.

2. D. ozone–A colorless gas whose molecules are composed of three oxygen atoms.

3. E. compound–Any substance consisting of two or more kinds of atoms.

4. F. photosynthesis–The chemical process by which green plants make their food.

5. H. oxygen–A colorless, odorless gas that is the most common element on earth.

6. C. respiration–Chemical reactions that release energy for the support of cell life.

7. B. cycle–A periodically repeated sequence of events.

8. A. oxidation–The most common way in which oxygen combines with other substances.

Answers to Blackline Master 3 - Video Quiz

1. True. Combustion is a kind of rapid oxidation.

2. Rain forest plants produce about 30 percent of the oxygen in our atmosphere.

3. When photosynthesis takes place in green plants, oxygen atoms are freed by the splitting of water or water molecules.

4. False. Oxygen atoms are very reactive. They combine with most other elements.

5. Oxygen atoms can bond in a three-atom form called ozone.
6. The oxygen cycle can be thought of as having two sides. One is photosynthesis, and the other is respiration.

7. **False.** Photosynthesis needs light energy.

8. Rain forests are often found in warm regions close to the equator.

9. **False.** Green plants have produced nearly all the free, or molecular, oxygen in the atmosphere.

10. Two of the wastes that respiration produces that are important to the oxygen cycle are water and the gas carbon dioxide.

**Answers to Blackline Master 4 - Discussion Topics Guide/Quiz**

*These answers are provided on pages 4 and 5 of this guide.*

**Answers to Blackline Master 5 - Concept Map: Ozone**
Answers to Blackline Master 6 - Concept Map: Oxidation

Oxidation

Cellular respiration and burning are forms of slow oxidation.

Burning is a form of rapid oxidation.

Oxidation produces the iron oxide, which causes rust.

Oxides combine with other substances.

Answers to Blackline Master 7 - Concept Map: The Oxygen Cycle

The oxygen cycle can be thought of as having two sides or parts.

One is photosynthesis during which green plants take in carbon dioxide and water and give off oxygen as waste.

And the other is respiration which uses oxygen and gives off carbon dioxide and water as waste.
Script of Recorded Narration
THE OXYGEN STORY

You can’t see it.

You can’t smell it.

Fires go out when it’s not around,...

...and you’re dead without it.

It’s oxygen, and we — along with almost all other living things, whether they’re at home in water, flying through the air, or on the ground — can’t get along without it. Oxygen is also a chemical with a very interesting story.

Let’s begin it with an experiment. Our friend here is going to try holding her breath. How long do you think she’ll last? Let’s see.

Well, so much for that. She lasted a little over 15 seconds.

And just why is it that our friend here — or you and I — can’t comfortably hold our breath much longer than that?

The answer is the oxygen we breathe. About 21 percent, by volume, of the air at sea level is oxygen — oxygen upon which we all depend to keep the fires of life burning.

But the air around us isn’t the only part of our world that’s oxygen-rich.

Water is also full of oxygen, containing about 89 percent oxygen by weight.

And then there’s us humans. Believe it or not, about 65 percent of the human body is made of oxygen. Oxygen is, in fact, so plentiful that it makes up about half of the earth’s crust by weight — making it the most plentiful element on the planet.
And here’s a diagram of an oxygen atom. It’s made up of a nucleus surrounded by orbiting electrons.

Oxygen atoms like company, and in the normal, free gaseous form in which we find them in the atmosphere, they exist as two atoms bonded together.

Oxygen atoms also bond together in a three-atom form called ozone. This ozone has a split personality.

Here at ground level, ozone is a big part of smog pollution.

However, high above the earth’s surface, ozone molecules form a life-giving shield that protects living things from many of the sun’s potentially deadly ultraviolet rays.

Oxygen is also very reactive. Remember this burning building we saw earlier? The flames shooting from it are the result of oxidation — a common way in which oxygen combines with other substances.

When something — in this case a building — burns in air, we call the reaction rapid oxidation, or combustion. Most oxidation, however, does not take place nearly this fast.

The rust on this tractor is an example of oxidation that is taking place at a much slower pace.

Such oxidation occurs when oxygen combines with iron to form the iron oxide compound we call “rust.” Oxidation also takes place in almost all living things. Called “cellular respiration,” this kind of oxidation occurs within the cells of plants, animals, and other organisms — when oxygen combines with chemicals from their foods.

It’s this oxidation that produces the energy organisms need. It also generates both carbon dioxide and water as a byproduct.
Different kinds of organisms get the oxygen they need to carry on this cellular respiration in different ways.

Land plants, for example, take in oxygen through tiny holes in their outer surfaces, while underwater plants absorb dissolved oxygen from the water in which they grow.

Land animals, such as these goats, get the oxygen they need from the air around them.

Fish, on the other hand, and nearly all other aquatic organisms, survive on oxygen that’s dissolved in the water in which they live.

In the case of us humans — and other land animals — the oxygen we need passes into our bloodstream by way of our lungs.

Fish, on the other hand, handle the business of getting oxygen differently.

Instead of using lungs, they absorb oxygen that’s dissolved in the water around them through their gills.

Notice the slits on the side of this shark’s head. They’re where water that’s passed over its gills leaves its body.

No matter how it gets there, however, once oxygen enters an organism, it’s carried to its cells. There it combines with other chemicals during the process of respiration.

With oxygen such a big part of things on planet earth, a natural question is, “Where does it come from?”

Well, here’s the answer — green plants.

They’re what you should thank the next time you take a breath.
No matter what kind, or where they live, all green plants share one ability in common...and do one stunningly important thing: All green plants produce oxygen.

This simple setup will give us a glimpse of how they do it.

The plant is called elodea, and when there’s enough light, it starts to photosynthesize — or make its food.

Several hours later we can see the result — this bubble. It’s oxygen — oxygen the elodia gave off as a byproduct of its photosynthesis.

So that’s the answer — photosynthesis — to where the earth’s oxygen comes from.

Over the eons, photosynthesis has produced nearly all the planet’s oxygen, and it’s carried out by all the many different kinds of green plants with which we share the planet.

The photosynthesis green plants use to make their food is a complex process. The general flow of what happens is, however, easy enough to follow. The four key ingredients are...

...light energy, in this case from the sun,...

...chlorophyll — the chemical that gives green plants their color,...

...water, which the plant’s roots absorb,...

...and carbon dioxide — a gas plants take in from the air around them.

During photosynthesis, green plants use light energy to split water molecules into the hydrogen and oxygen atoms from which they are formed. Some of the hydrogen atoms then combine with carbon dioxide to make the sugar and other carbohydrates which are the plant’s food.
Plants use some of the oxygen freed during photosynthesis for their own cellular respiration. Much of it though is released into their surroundings.

It’s this way — the splitting of water molecules during photosynthesis — that green plants form the oxygen that you and I breath.

From this it’s clear that green plants, of all different kinds, are absolutely vital to our survival. Not only do they provide us with food, and the food our animals eat, green plants also provide the oxygen we — and nearly all other living things — must have to survive.

And here we see an example of one of the planet’s most important masses of green plants — a rain forest — usually found in warm, tropical, rain-drenched regions close to the equator. Worldwide, the area of such forests is relatively small — covering, as they do, only some six to eight percent of the earth’s surface.

But, don’t let their relatively small area fool you, because, when it comes to the earth’s oxygen supply, it’s hard to over-estimate the importance of rain forests. That’s because the green plants in them produce about 30 percent — almost a third — of the planet’s oxygen supply.

With that in mind, you’d think we would be doing all we can to preserve the world’s rain forests.

Wrong! In many areas, they’re being chopped down as fast as possible. If this stupidity continues, by early in the next century we’ll have largely destroyed one of the planet’s most important sources of oxygen.

As we’ve seen today, green plants — and other organisms, such as ourselves — are bound together in complex relationships.

One of the most important of these is called the “oxygen cycle,” and it involves the recycling of oxygen back and
forth between living organisms and the air or water in which they live.

The oxygen cycle can be thought of as having two closely-related "sides," or parts: one is photosynthesis, the other, respiration.

As we've seen, during photosynthesis, green plants take in water and carbon dioxide and give off oxygen as waste.

During respiration, the other side of the cycle, organisms use oxygen and give off carbon dioxide and water as waste, thus completing the cycle and making oxygen atoms available to be used again as they have been since the first green plants evolved, and as they will so long as green plants share the planet with us — providing for us, and so many other organisms, the breath of life.

**Video Quiz:**
*Also provided as Blackline Master 3. The answers can be found on pages 6 and 7 of this guide.*

The following ten questions will help you review some key points from *The Oxygen Story*.

The directions are simple. Just mark the boxes on your answer sheet either “true” or “false,” or fill in the blank with the correct answer when you hear this tone.

Ok, now here’s the first question. True or False. Combustion, or burning, is a kind of oxidation.

Here’s a fill in the blank question. Rain forest plants produce about ______ percent of the oxygen in our atmosphere.

Here’s another. When photosynthesis takes place in green plants, oxygen atoms are freed by the splitting apart of ______.

Here’s a true or false. Oxygen atoms do not combine with many other elements.
Oxygen atoms can bond in a three-atom form called _______.

The oxygen cycle can be thought of as having two sides. One is photosynthesis, and the other is ________.

True or False. The sun’s heat energy is one of the four key ingredients needed for photosynthesis.

Rain forests are often found in warm regions close to the _______.

True or False. Green plants have produced about one-third of the oxygen we breathe.

And here’s the last question. Two of the wastes that respiration produces which are important to the oxygen cycle are water and the gas ________. 