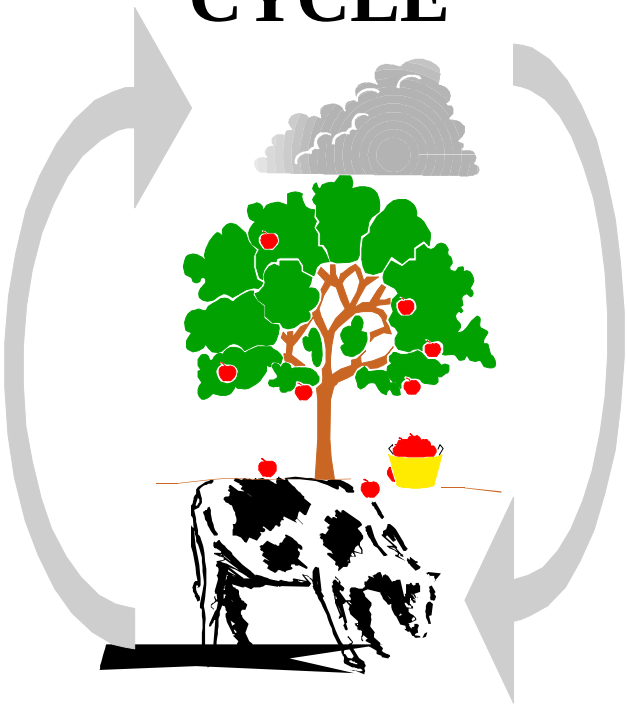
# THE NITROGEN CYCLE



**CFE 3275V**

OPEN CAPTIONED
UNITED LEARNING INC.
1994
Grade Levels: 7-12
14 minutes
1 Instructional Graphic Enclosed

## DESCRIPTION

Nitrogen is important to all living things. Explores how plants and animals get it and differentiates between *fixed* and *free* nitrogen. Explains how nature plays a role in combining nitrogen with other elements to produce fixed nitrogen. Presents the nitrogen cycle and mentions causes and effects of nitrogen pollution. Ends with a quiz.

## INSTRUCTIONAL GOALS

- To stress that nitrogen is important to all living things.
- To examine two ways in which fixed nitrogen is formed in nature.
- To explain the two parts of the nitrogen cycle: *synthesis* and *decomposition*.
- To examine the beneficial and harmful effects of fertilizer and manure.
- To observe the effects of nitrogen pollution on the air.

## BEFORE SHOWING

1. Read the CAPTION SCRIPT to determine unfamiliar vocabulary and language concepts.
2. Show the placement of nitrogen on the periodic table.
3. Display a pie graph showing the composition of air. Compare the abundance of nitrogen with that of oxygen.

## DURING SHOWING

1. View the video more than once, with one showing uninterrupted.
2. Pause at the scene with the caption “nitrogen makes up more than three quarters of the air . . . ” Change this figure to a percent.
3. Pause at the scene with the caption “good old Bossy.” Clarify what this means.

## AFTER SHOWING

Discussion Items and Questions

1. Why do living things need nitrogen?
2. Why can't living things use the kind of nitrogen found in the air?
3. What is *fixed nitrogen*?
4. How does lightning aid in the production of fixed nitrogen?
5. What are *legumes*?
6. Why do farmers plant corn one year and soybeans the next year?
7. What is the symbiotic relationship between legumes and nitrogen-fixing bacteria?
8. Explain the two parts of the nitrogen cycle: *synthesis* and *decomposition*.
9. What are *denitrifying bacteria*?
10. In what way are nitrogen-rich fertilizer and manure harmful to the environment?
11. What happens when there is excess nitrogen in streams and rivers?
12. What is the cause of excess nitrogen in the air?
13. What are the effects of acid rain?

Applications and Activities

1. Design a pictorial display of the nitrogen cycle.
2. Report on the discovery of nitrogen.
3. List some uses of nitrogen gas.
4. Visit a farm and observe the nodules on the roots of various legumes such as alfalfa, soybeans, and clover.
5. Obtain slides of cross sections of various legumes and observe under a microscope.
6. Legumes and nitrogen-fixing bacteria help convert nitrogen in the soil to useable nitrogen compounds.
    a. Report on other organisms that can do this.
    b. Report on how the plants make use of these nitrogen compounds.
7. Research methods of crop rotation.

8. Obtain a bag of soil fertilizer. Discuss the compounds that make up the fertilizer.

9. List some plant-eating animals and some meat-eating animals. Specify how each acquires the nitrogen needed.

10. Visit a nearby pond or lake and look for decayed matter.

11. Discuss how human intrusion can negatively affect the nitrogen cycle.

12. Research cities that are the most affected by nitrogen pollution of the air.

13. Report on what is being done to counteract the effects of acid rain.

## INSTRUCTIONAL GRAPHICS

One instructional graphic is included with this lesson guide. It may be enlarged and used to create transparencies or copies.

- VIDEO QUIZ

## WEBSITES

Explore the Internet to discover sites related to this topic. Check the CFV website for related information (http://www.cfv.org).

## CAPTION SCRIPT

Following are the captions as they appear on the video. Teachers are encouraged to read the script prior to viewing the video for pertinent vocabulary, to discover language patterns within the captions, or to determine content for introduction or review. Enlarged copies may be given to students as a language exercise.

Ferns and fish;

bears and butterflies;

petunias and prairie dogs--

the variety of life with which
we share this earth is truly amazing.

But, as different as
living things can be,

they all share one
thing in common.

They all need certain
life-giving chemicals to survive.

One of the most important
of these is nitrogen,

and today we'll see how living things
get the nitrogen they need,

and how it's recycled
through nature.

All living things--
be they birds,

a mushroom on a rotting log,
'gators on the prowl,

or any other organism--
must have nitrogen.

Without it, they can't make
the amino acids, proteins,

and other compounds they must have.

Most plants absorb the nitrogen
they need from the soil

or water in which they grow.

Animals, in turn, get the nitrogen
they need by eating plants,

or, in the case of meat-eaters,
by eating animals that feed on plants.

But no matter how organisms
get their nitrogen,

the fact remains--
without it they'd die.

Obviously then, it's vital that
nature doesn't run out of nitrogen.

And, at first glance, it wouldn't
seem there's much chance of that.

That's because
nitrogen makes up more than
three quarters of the air around us.

And with the atmosphere
that rich in nitrogen,

you would think that there would be
more than enough to go around.

That's not the case, however,

because the nitrogen in the air
around us is the wrong kind.

And that's because most plants
can't use nitrogen

in the pure gas form
in which it occurs in the atmosphere.

Instead, they need nitrogen
that's been fixed,

or combined with other elements,
into compounds.

Fortunately, nature has several
ways of doing this.

[thunder crashes]

Lightning is
one of them.

It causes nitrogen and oxygen atoms
in the air to combine.

The resulting nitrogen compound then
mixes with rain and falls to the earth,

where it undergoes
chemical changes

that make it easier for plants
to absorb the nitrogen it contains.

Such lightning-powered fixation provides
large amounts of nitrogen for plants.

However,
far more is fixed in the soil,

a fact farmers have long
taken advantage of by rotating crops,

such as corn, that quickly use
up soil nitrogen with soybeans,

peas, clover and alfalfa.

Such plants are called "legumes."

Legumes act as natural
"fertilizer factories,"

and they pump large amounts
of nitrogen back into the soil.

And here we see the
small pea-shaped nodules

that grow on the roots
of soybeans and other legumes.

These nodules
are at the heart of the legume's
amazing natural fertilization process.

They're caused by bacteria,
such as the ones we see here,

magnified millions of times, in this
cross section of a soybean nodule.

These bacteria fix, or change,
nitrogen into a form plants can use,

and they live in a symbiotic--
or mutually beneficial--

relationship with legumes.

As their part of the bargain,

the host legumes
supply the carbohydrates

the bacteria use as food.

In return, the bacteria convert--

or fix--nitrogen gas in the soil

into compounds host legumes can use.

This process often produces
surplus nitrogen

that's released into the soil,
thus fertilizing it.

As important as the bacteria are that
live with soybeans and other legumes,

they're not the only microbes
that fix nitrogen.

[tractor engine hums]

The soil also is home to free-living,
nitrogen-fixing bacteria.

Like those living with legumes,
these microbes also fix nitrogen.

Once nitrogen has been fixed
in one way or the other,

plants--such as grass--
can then absorb it

and make it part
of their own tissues.

When animals eat these plants,

some of the nitrogen in them
is used by the animals to synthesize,

or make their own tissues.

[thunder booming]

So far today,
we've seen how lightning and bacteria
fix nitrogen atoms into compounds

that can be used by plants
and made part of their tissues,

and those of the animals
that eat them.

This binding of nitrogen atoms

into living plant and animal tissues

is the synthesis,

or building-up part
of the nitrogen cycle.

In addition, the nitrogen cycle
also has a down side.

The decay, or breaking down
side of the cycle,

takes place when dead organisms,
manure, and other such wastes, decay,

and in the process, free nitrogen
compounds from their rotting tissues,

thus making them available for use
by a new generation of living things.

Not all the nitrogen compounds freed
by decay are reused immediately.

Instead,
some are acted upon by various
so-called *denitrifying* bacteria.

These bacteria get energy
from decaying tissues.

They convert some of the nitrogen in
rotting tissues into free nitrogen gas.

This gas is released
back into the environment

where it's free to begin
the cycle all over again.

Earlier, we saw how farmers benefit
from nature's nitrogen cycle

by planting soybeans
and other legumes such as clover,

to restore nitrogen
to their fields.

Farmers also become involved
in the nitrogen cycle

when they use
artificial fertilizers.

Many modern high-yield crops
need the extra nitrogen

such fertilizers provide.

Unfortunately, however,
their use is not problem-free.

In many areas, water supplies have
been seriously polluted by nitrogen.

For example,
water in some areas is so loaded with
nitrogen that it's hazardous to drink.

Experts think nitrogen fertilizers
cause much of this pollution

when they seep down through the soil
into the underground water supply.

Even large waterways,
such as the Chesapeake Bay,

America's largest estuary,
are being polluted by nitrogen.

In the Bay's case, most of the problem
comes from nitrogen-rich fertilizers

and the millions of tons of manure--
and the nitrogen it contains--

that good old "Bossy"
and her likes produce.

These nitrogen-rich pollutants
wash off farms

and into the many streams
and rivers that run into the Bay.

This excess nitrogen
can cause water plants to grow so fast

that conditions develop which rob
the water of its dissolved oxygen,

suffocating fish and
other organisms in the process.

But today's modern farming techniques
and the huge amounts of fertilizer,

and the manure-producing animals
that so often are a part of it,

isn't the only human activity
that's upsetting the nitrogen cycle.

The exhausts from
our fossil-fuel powered vehicles,

and the emissions from
our electric generating plants

also add large amounts
of nitrogen to the environment.

And when water in the atmosphere
combines with this nitrogen pollution,

it often returns to earth as acid rain,
snow, or other precipitation

that is helping to ravage
so many of the world's woodlands.

Acid precipitation is also making
many of our waterways so acid

that a large number
of aquatic species--

many of which are
of great commercial importance--

are being seriously harmed.

[crickets chirping]

As we've seen today,
nitrogen is vital to all life.

Without it there
could be no plants, animals,

or other organisms--
no life at all.

Fortunately, the natural recycling
process we call the nitrogen cycle

assures that we,
and all other living things,

get all we need.

The following questions
will help you

to find out how much you remember
about the nitrogen cycle.

The directions are simple:

mark the boxes on your answer sheet
either true or false,

or fill in the blank with the correct
answer when you see this: ( ).

Okay.
Now here's the first question:

True or false:

Nitrogen makes up about
50% of the air around us.

Okay, here's another.

True or false:

Both corn and soybeans are legumes.

Here's a fill-in-the-blank question:

Some of our waterways are being
harmed by agricultural nitrogen
pollution from manure and ( ).

True or false:

Most plants absorb the nitrogen
they need from the soil
or water in which they grow.

Here's another true or false:

The nodules that grow on legumes'
roots are home to symbiotic bacteria.

Here's another fill in the blank.

Meat eaters get the nitrogen they need
by eating animals that feed on ( ).

All right, here's another question.

True or false:

Most of the nitrogen that plants use
is fixed by lightning.

The nitrogen
in vehicle exhaust and power plant
emissions contributes to ( ).

Here's another.

Most plants can only use nitrogen
that has been combined with
other elements or ( ).

And here's the final question.
True or false:

When organisms rot or decay,
they free or release nitrogen atoms

that can then be used by
the next generation of living things.

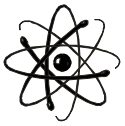
Funding for purchase
and captioning of this video

was provided by the
U.S. Department of Education:

PH 1-800-572-5580 (V).

CFE 3275 V THE NITROGEN CYCLE

# VIDEO QUIZ



**DIRECTIONS:** **Mark the boxes either *true* or *false*, or fill in the blank with the correct answer.**

1. Nitrogen makes up about 50% of the air around us.
   ☐ True ☐ False

2. Both corn and soybeans are legumes.
   ☐ True ☐ False

3. Some of our waterways are being harmed by agricultural pollution from manure and _____.

4. Most plants absorb the nitrogen they need from the soil or water in which they grow.
   ☐ True ☐ False

5. The nodules that grow on legumes' roots are home to symbiotic bacteria.
   ☐ True ☐ False

6. Meat eaters get the nitrogen they need by eating animals that feed on _____.

7. Most of the nitrogen that plants use is fixed by lightning.
   ☐ True ☐ False

8. The nitrogen in vehicle exhaust and power plant emissions contributes to _____.

9. Most plants can only use nitrogen that has been combined with other elements or _____.

10. When organisms rot or decay, they free or release nitrogen atoms that can then be used by the next generation of living things.
    ☐ True ☐ False