RESET EARTH

TEACHER'S HANDBOOK

EPISODE 2 LESSON 2

UN environment programme | ozone secretariat

with support from

WHY IT MATTERS

The ozone layer is an invisible shield that exists 15-35km above the earth's surface, protecting us from harmful ultraviolet, or UV, radiation, and in doing so protecting all earth.

But in the 1980s, scientists discovered a huge and harmful hole in the ozone layer. The hole was caused by chemicals and gases known as ozone-depleting substances, which at the time were found in almost everything – from aerosol cans to fridges, from computer equipment to the soles of your shoes!

The story of the ozone layer and how the world joined together to protect it, is a story of hope.

Across the world, scientists, policy makers and governments worked together, taking urgent steps to control and phase out these ozone-depleting substances. Together they developed the Vienna Convention, and then the Montreal Protocol which became one of the most successful environmental treaties of all time, universally endorsed by 197 nations of the world and the European Union.

And it worked! Thanks to the Vienna Convention, followed by the Montreal Protocol, the hole in the ozone layer is healing, with ozone expected to return to pre-1980s levels by the 2060s.

But the story is not over. In fact, it might never be over. We have to make sure we keep monitoring the gases that enter our atmosphere and the impact that they have on the ozone layer.

The next generation of young people faces many challenges. But the story of the ozone layer and how the world joined together to protect it, is a story of hope. A story that proves that it can be done. That when we act together, and are guided by science, we can solve major global crises.

DEAR TEACHERS

In January 2021 the Ozone Secretariat of the United Nations Environment Programme launched a short animation series and mobile game called Reset Earth to raise awareness and inspire action among young people about the importance of the ozone layer, and the continued need to protect it.

This teaching toolkit has been designed to build on this, and provide you with ideas, activities, games and discussions that will empower you to engage your students on the issues of the ozone layer. Using the Reset Earth animation series as the foundation, three different lessons have been developed. An accompanying teacher toolkit to help navigate through the content has also been created, including a corresponding student workbook. These printable documents can be adapted and made your own to share with your students.

INSPIRE YOUNG PEOPLE TO CONTINUE PROTECTING THE OZONE LAYER: *ANIMATIONS, INTERACTIVE GAMES, DISCUSSIONS AND ACTIVITIES.*

The lessons are diverse and varied. Teachers are encouraged to use what will work best for their students, or adapt and make it their own. Whether the lessons run over three days, three weeks or three months; only one idea is used, or all of them, it is up to you, the teacher, to decide, as you know what's best for you and your students. Most of all we at the Ozone Secretariat hope that through the animations, games, discussions, and activities, you can help us bring the story of the ozone layer to life, and inspire the next generation of young people to continue to protect the ozone layer and the global environment.

Lesson plans and workbooks are based on fictional animations and not entirely on scientific fact. For facts and accurate timelines, please visit https://ozone.unep.org/. If you've used any of our teacher resources, please send feedback, photos or any related learner artwork to stephanie.haysmith@un.org.

CONTENTS

What is the ozone layer and how does it protect us?

Watch Episode 2 of Reset Earth and the extra educational video to understand what the ozone layer is, how it protects us and what happened to cause the hole in the ozone layer.

- **Video & discussion:** Watch Episode 2 of Reset Earth and talk about what caused the hole in the ozone layer, who the heroes in the story are and what they will need to do to protect the ozone layer.
- **Activity 1:** Ozone Layer Game – play a fun game with your class, where students take on the role of ozone molecules, chlorofluorocarbons, or CFCs, and UV rays and play to understand how the ozone layer works to protect us.
- **Worksheet:** Have the students design or create a pamphlet/poster based on what they know about the ozone layer and CFCs.
- **Activity 2:** Pair and share – divide the class into groups to present and discuss the pamphlets they designed, and what they learned while working on them.

Additional resources:

Educational animation: Short video explaining how the ozone layer protects us.

GLOSSARY

SCIENCE

HUMAN IMPACT

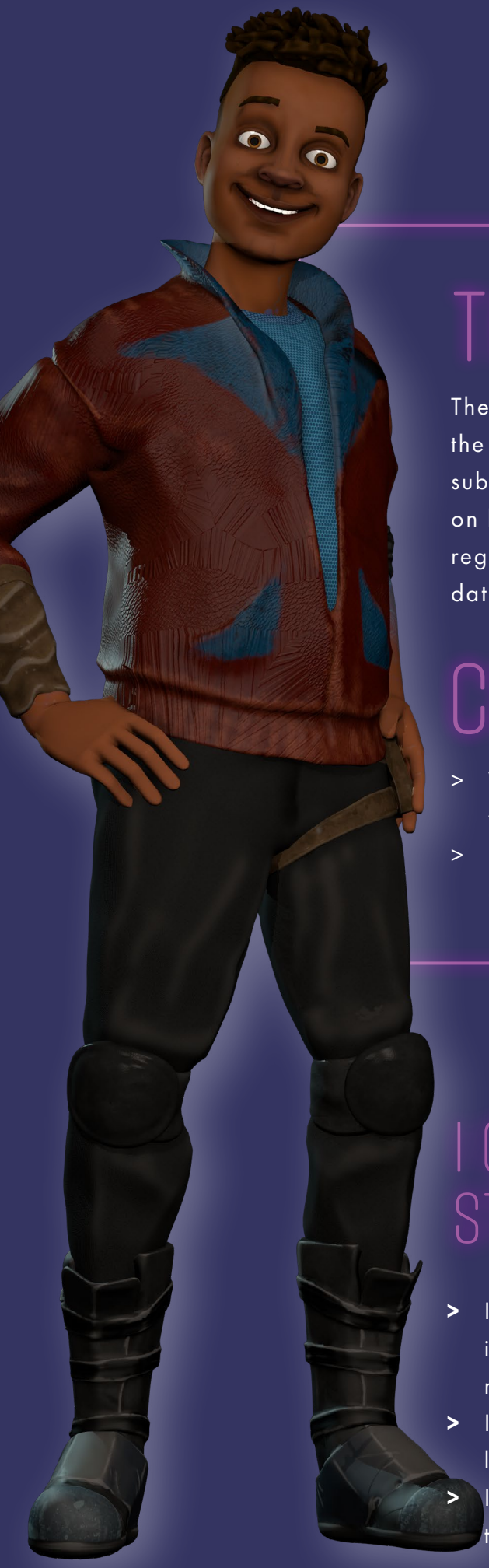
LONG-TERM PROGRESS

EXTRA EXAMPLES

WRITTEN ACTIVITY

DISCUSSION POINTS

WATCH A VIDEO



THE BIG IDEA

The ozone layer has depleted over time through the introduction and use of ODSs (ozone-depleting substances), which have had environmental impacts on humans. Reducing ODSs allows the ozone later to regenerate over time. Access to information and scientific data play a key role in driving environmental change.

CRITICAL QUESTIONS

> What is the ozone layer, how is it formed, and where is it in the atmosphere?
> How do emissions of manmade gases lead to ozone layer depletion?

I CAN / I WILL / OUTCOME STATEMENT FOR STUDENTS

> I can describe ozone layer formation, and its role in protecting humans from harmful ground level UV radiation.
> I understand the key substances leading to ozone layer depletion and their role in society.
> I can communicate/demonstrate these harmful effects to others.

LESSON 2 GUIDE

The below suggested times of activities are a helpful guide for this lesson. Actual time can differ based on needs and interests of students, resources, and available time.

INTRO AND PRIMER VIDEO

LESSON TIME:
0-10 MINS

GLOBAL COMPETENCY:
N/A

LESSON DESCRIPTION:
Watch Reset Earth Episode 2 & have a popcorn-style review.

GO TO
Reset Earth Episode 2

CLASS ACTIVITY

QUESTIONS TO ASK:

- Who are the heroes in the Reset Earth Animation?
- What is the problem?
- Why do they need to act?
- What is threatening the people in 2055 and 2084?

LEARNER OBJECTIVES:

Knowledge

Science
S1 - Explain ozone layer formation / characteristics.
S2 - Recognise the important role of the ozone layer in protecting species from UV radiation.
S3 - Identify how the ozone layer and climate are connected, but not causal.
S4 - Acknowledge ozone layer recovery and seasonal changes.
S5 - Understand natural impacts on the ozone layer such as volcanoes and the sun.

Human Impact
H1 - Identify the pollution that affects the ozone layer - ODS (ozone-depleting substances such as CFCs and the halons).
H2 - Recognise that pollution from the previous generation persists and will impact future generations.
H3 - Appreciate that this challenge requires international regulations and cooperation.

Long-term Progress
L1 - Identify the consequences of continued ozone layer depletion.

DISCUSSION

LESSON TIME:
10-15 MINS

GLOBAL COMPETENCY:
GC1 - Examine local, global and intercultural issues.

LESSON DESCRIPTION:
After you've watched Episode 2, engage your students in the class activity below.

Extra information on the ozone layer:
https://ozone.unep.org/20-questions-and-answers

LEARNER OBJECTIVES:
Reflection

Science
S1 - Explain ozone layer formation / characteristics.
S2 - Recognise the important role of ozone layer in protecting species from UV radiation.

Human Impact
H3 - Appreciate that this challenge requires international regulations and cooperation.

CLASS ACTIVITY

QUESTIONS TO ASK:

> What is the ozone layer? How is it formed? Where is it in the atmosphere?
> How does the ozone layer protect us? What does it protect us from?
> What was causing changes to the ozone layer? How did these substances change it? What was the impact on people?
> What did the heroes decide to do to stop ozone layer depletion? Were they successful?

ACTIVITY 1 - OZONE LAYER GAME

LESSON TIME:
15-35 MINS

GLOBAL COMPETENCY:
GC1 - Examine local, global and intercultural issues.

LESSON DESCRIPTION:
Using the information on ozone layer formation and depletion within the film, students will recreate these concepts by acting as UV rays and ozone layer.

CLASS ACTIVITY

Play the Ozone Layer Game - Roleplay Game

LESSON TIME:
30 MINS+

GROUP SIZE:
Any (ideally 20+ students)

LOCATION:
Outdoor open space

AGE:
7-12 Years

LEARNER OBJECTIVES:
Action

Science
S1 - Explain ozone layer formation / characteristics.
S2 - Recognise the important role of ozone layer in protecting species from UV radiation.

Human Impact
H1 - Identify the pollution that affects the ozone layer - ODS (ozone-depleting substances such as CFCs and the halons).

Long-term Progress
L1 - Identify the consequences of continued ozone layer depletion.

EQUIPMENT
Small cones or pylons (two sizes, ideally) Pinnies for ozone and CFC students (optional) Tokens (popsicle sticks, buttons, rocks)

Knowledge:
- What is ozone, how is it formed, and where is it in the atmosphere?
- How do emissions of halogen source gases lead to stratospheric ozone depletion?
- What emissions from human activities lead to ozone depletion?
- Highlight human influence on ozone, and how individual changes in behaviour can lessen impact.

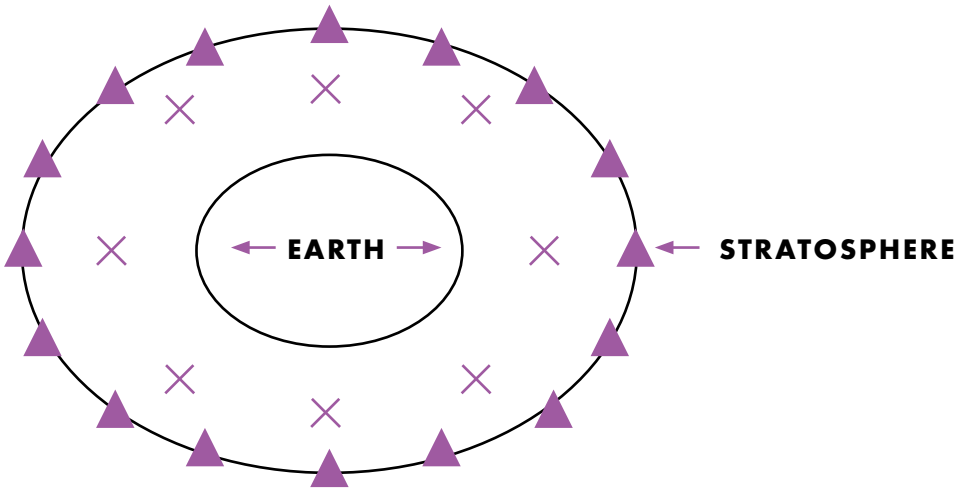
CLASS ACTIVITY (CONT.)

Active:

> Students will mimic the sun's rays by travelling into the atmosphere from the sun, and interact with the atmosphere by reflecting and refracting on earth's surface, collecting tokens from earth.
> Students must successfully pass through the stratosphere in order to make it to earth's surface. If a student is tagged by any student identified as the ozone layer, which lives in the stratosphere, they will need to return to the sun.
> Other students will portray CFCs and other halogen source gases, which can tag out the ozone layer students. Once ozone layer students are removed from the game, it will be much easier for sunray students to penetrate to earth's surface to collect tokens.

Debrief/Reflective Component:

> As more ozone became present in the stratosphere, what happened to sunrays?
> What happened to ozone once CFCs were introduced?
> Why were there differences in the number of tokens collected each round?
> What could happen to earth without the ozone present to protect us?



Setup:

1. Create a small circle with (small) cones in the middle of the playing field. Explain that this represents the earth.
2. Create a much larger circle with (large) cones, relatively even spaced from center circle. Explain that this represents the stratosphere.
3. Demonstrate to students that sunlight comes as rays of energy that are emitted from the sun (somewhere outside the stratosphere) and travel through the stratosphere toward earth.
4. The ozone layer is located in the stratosphere and absorbs a large part of the sun's biologically harmful UV radiation. Explain to students that when the ozone layer is thick enough, it allows some sunrays through to warm earth's surface (most UVa, some UVb, no UVc), which the students will role play. Begin the game with every student mimicking a sunray. They will need to run past the stratosphere, into earth's surface where they will grab a token, and then run back outside the stratosphere to deposit their token. At the end of the round, count how many tokens the students collected from earth.

CLASS ACTIVITY (CONT.)

   a. This round demonstrates that a planet with no protective layer or atmosphere would lose all of its heat, as every student should be able to 'reflect' off the earth and back to space.

5. When ready, introduce the 'ozone layer', where ozone molecules accumulate in the stratosphere. Oxygen molecules are broken down by solar ultraviolet radiation to produce two single oxygen atoms. These highly reactive oxygen atoms combine with an oxygen molecule to produce ozone (O_3).
   a. Extension activity: Play a round of the game away from the circle set up. Group students into pairs of two (to present an oxygen molecule). One student will roleplay as solar UV radiation, and must tag as many oxygen molecules as possible. Once an oxygen molecule is tagged, the students must separate and attempt to find a free oxygen molecule to bind to, forming O_3. Once students have formed a chain of three, they must freeze and act as a barrier to the sun UV radiation student, preventing them from tagging other oxygen molecules.
6. Have students identified as the ozone layer spread out throughout the stratosphere. These students must remain within the stratosphere, and their goal is to tag/block any UV rays heading to earth. Once tagged, UV rays must head back into space, returning their token to earth if necessary, and sit out or be invited back to play after a countdown. After a set amount of time, end the round and count how many tokens students were able to collect from earth.
   a. There should be fewer tokens collected, representing the ozone layer's role in protecting earth from harmful UV radiation.
7. Introduce a new player to the game, ODSs (ozone-depleting substances – a common example is CFCs or chlorofluorocarbons). These are manufactured halogen source gases that bring chlorine and bromine atoms to the stratosphere, where they destroy ozone in chemical reactions.
   a. Extension activity: Play a round of the game away from the circle set up, and play a similar tag game as previously, where oxygen molecules are tagged by UV radiation, becoming free oxygen atoms that bind to other oxygen molecules to become ozone. This time, there will be CFCs or ODSs students that can 1) repair free oxygen atoms into oxygen molecules (tag and hold hands with an oxygen atom, once two are tagged, these oxygen atoms are now an oxygen molecule that cannot block UV rays and can be tagged by UV rays once more) or 2) break apart an ozone molecule by removing one oxygen atom.
   b. Extension idea: Introduce to students the concept that colder temperatures in polar regions (specifically Antarctica, as the Arctic doesn't get quite cold enough) can lead to the formation of clouds (polar stratospheric clouds) which speeds up the above reactions, leading to rapid ozone loss. This is why ozone becomes thinner in Antarctica.
8. Students identified as 'ODSs or CFCs' have the ability to run from earth and tag ozone layer students. These students are then out of the game and must leave the stratosphere. At the end of the allotted time, count how many tokens students were able to retrieve from earth.
   a. This number will be higher than the last round, showcasing that CFCs/ODSs breaking down ozone allows more harmful UV rays to penetrate to earth.

WORKSHEET - PAMPHLET

LESSON TIME:
30-50 MINS

GLOBAL COMPETENCY:
GC2 - Understand and appreciate the perspectives and world views of others.

LESSON DESCRIPTION:
Have students design a pamphlet based on what they know about the ozone layer and CFCs. Note that the heroes dropped their pamphlet in the past, and noticed changes to the billboards - clearly the pamphlet had been read, but there was no difference in the state of 2084.

- What information should students include to make sure change is made?
- What issues and solutions would you highlight?
- Do you think this would work?
- Why didn't earth go back to normal after the original pamphlet was received?
- Include: what motivates you to make a change? What about your parents, friends, grandparents, etc.? Consider these factors in pamphlet design.

LEARNER OBJECTIVES:
Combined

Human Impact
H3 - Appreciate that this challenge requires international regulations and cooperation.
H4 - Appreciate that individual personal behaviours and consumer choices have an impact on the ozone layer.

Long-term Progress
L3 - Acknowledge that continued progress on the ozone layer requires a broad base of awareness and support.

POSSIBLE KEY AUDIENCE FOR THE PAMPHLETS THAT STUDENTS NEED TO CONSIDER:
Those that would use CFC products (hairspray/aerosol sprays, refrigerators, automobiles, air-conditioners, cleaning agents, foaming agents, etc.)

ARE THERE ALTERNATIVE PRODUCTS THEY COULD USE? HOW WILL WE MOTIVATE THEM TO CHANGE THEIR BEHAVIOUR?

REVIEW

LESSON TIME:
50-55 MINS

GLOBAL COMPETENCY:
GC3 - Engage in open, appropriate and effective interactions.

LESSON DESCRIPTION:
Pair and share or small group discussion to share what their pamphlets look like, and why they think it will work.

- Do they like anything from anyone else's work?
- What changes should be made to your own design?
- What would you do if you received a pamphlet from the future?

LEARNER OBJECTIVES:
Reflection

Human Impact
H3 - Appreciate that this challenge requires international regulations and cooperation.

H4 - Appreciate that individual personal behaviours and consumer choices have an impact on the ozone layer.

Long-term Progress
L3 - Acknowledge that continued progress on the ozone layer requires a broad base of awareness and support.

CLASS ACTIVITY

DISCUSSION POINTS:
- Do they like anything from anyone else's work?
- What changes would you make to your own design?
- What would you do if you received a pamphlet from the future?

CLOSE - LINK LESSON 3

LESSON TIME:
55-60 MINS

GLOBAL COMPETENCY:
N/A

LESSON DESCRIPTION:
We now know and understand the cause of ozone layer depletion, but the first plan of action did not work.

LEARNER OBJECTIVES:
Reflection

DISCUSSION POINTS:

> What do you think the heroes will do in the next episode?
> Do you think they will be successful in their mission? Why or why not?

LESSON RESOURCES

Click on the links below to download the lesson resources:

> Reset Earth Character Profiles
> Lesson 2 Worksheet (colour)
> Lesson 2 Worksheet (print friendly)
> Reset Earth Story Book Chapter 2
> UNEP Q&A
> National Geographic Climate 101: Ozone Layer Depletion Video
> Hair Spray Connection Article

PREPARATION

> Access To Reset Earth Episode 2
> Lesson 2 Worksheet
> Access To Outdoor Space Or Large Indoor Space (For Running)
> Materials: Pylons (Or Rope, Hose, Etc.) For Boundaries, Tokens (Coins, Rocks, Popsicle Sticks, Etc.)

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