

Lesson Plan: The COVID-19 Pandemic: Climate Change and the Risk of Virus Spillover

As an **Undergraduate Biological Sciences** or **Environmental Sciences** teacher, you can use this lesson plan to teach your students about **zoonosis**, the increased risk of inter-species **virus spillover** due to climate change, **infectious diseases such as COVID-19** and their **modes of transmission**.

In this lesson plan, students will be taught how the occurrence of newly emerging infectious diseases like COVID-19 with **zoonotic (vertebrate animal to human) transmission** are rising due to the closer interactions of humans and wild animals that result in an increased exposure to animal viruses. Greater **human-animal conflicts** are largely due to environmental changes such as **habitat degradation** and **biodiversity loss** caused by anthropogenic activities. Through this lesson plan your students will learn that human activities induced climate change in turn causes **biodiversity disturbances** and could be responsible for the increased risk of **animal virus spillover** into human populations.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in **Biological Sciences** and **Environmental Sciences**.

Use this lesson plan to help your students find answers to:

1. What is the zoonotic transmission of a disease? Give examples.
2. Why is there an increased incidence of newly emerging viruses in recent times?
3. How could climate change increase the risk of inter-species virus spillover in the future?
4. How has climate change affected the occurrence of vector-borne and infectious diseases?

About the Lesson Plan

Grade Level: Undergraduate

Discipline: Biological Sciences, Environmental Sciences

Topic(s) in Discipline: Infectious Diseases, Disease Transmission, Zoonosis, Virus Spillover, Biodiversity Disturbance, Animal-Borne Diseases

Climate Topic: Climate and the Biosphere, Climate and the Anthroposphere

Location: Global

Access: Online, Offline

Language(s): English

Approximate Time Required: 120 min

1 Contents

1. Reading (20 min)

A reading to introduce the role of climate in the occurrence of infectious diseases.

This can be accessed at:

<https://www.who.int/globalchange/climate/en/chapter6.pdf>

2. Reading (20 min)

A reading to explain how climate change related species range shifts and biodiversity disturbances could raise the risk of pandemics.

This can be accessed at:

<https://www.carbonbrief.org/q-and-a-could-climate-change-and-biodiversity-loss-raise-the-risk-of-pandemics>

3. Reading (20 min)

A research article that describes how changing habitats for mammalian populations can increase the risk of inter-species virus spillover.

This can be accessed at:

<https://royalsocietypublishing.org/doi/10.1098/rspb.2019.2736>

4. Classroom/Laboratory Activity (50 min)

A classroom/laboratory activity to extend understanding of range shifts due to climate variables, for a species of choice.

This can be accessed at:

<https://gubeshub.org/publications/1106/about?v=1>

5. Suggested questions/assignments for learning evaluation

- What is the zoonotic transmission of a disease? Give examples.
- Why is there an increased incidence of newly emerging viruses in recent times?
- How could climate change increase the risk of inter-species virus spillover in the future?
- How has climate change affected the occurrence of vector-borne and infectious diseases?

2 Step-by-step User Guide

Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

1. Introduce the role of climate in the occurrence of infectious diseases

Use the reading, 'Climate Change and Infectious Diseases' by the World Health Organization, to explain the association of infectious diseases with climatic conditions. Use the text to describe the various modes of transmission of viral diseases in humans, in animals, and between animals and humans. Explain what zoonotic transmission is, in the context of the SARS-CoV-2. Refer to table 6.1 in the text to discuss examples of how environmental changes have affected the occurrence of various infectious diseases in humans in the past. Finally, use the text to emphasize how different methods of predictive modelling have shown that climate change could result in changes in infectious disease transmission patterns.

This can be accessed at:

<https://www.who.int/globalchange/climate/en/chapter6.pdf>

2. Discuss how climate change related species range shifts and biodiversity disturbances could raise the risk of pandemics

Use the reading, 'Q & A: Could climate change and biodiversity loss raise the risk of pandemics?' by Daisy Dunne for Carbon Brief, to explain to your students how climate change induced biodiversity disturbances could influence the risk of diseases being transmitted from animals to humans. Use the reading to describe how and why a pandemic could develop when climate change affects the biogeographical distribution of species. Explain how rising temperatures and changing precipitation patterns have resulted in some species seeking newer areas. Emphasize on how such movements could increase the contact between animals and humans, and the viruses harbored by them. Highlight how these interactions are exacerbated by human land-use changes such as deforestation and habitat degradation leading to habitat loss. Finally, discuss how all these factors can be responsible for the increased risk of animal-borne diseases crossing over into humans.

This can be accessed at:

<https://www.carbonbrief.org/q-and-a-could-climate-change-and-biodiversity-loss-raise-the-risk-of-pandemics>

3. Describe how changing habitats for mammalian populations can increase the risk of inter-species virus spillover

Use the research article, 'Global shifts in mammalian population trends reveal key predictors of virus spillover risk' by Christine K. Johnson et al., to explain why zoonotic viruses transmission risk has risen with some animals having shifted their ranges and adapted to more human-dominated landscapes. Discuss the anthropogenic activities that have resulted in greater animal-human interactions and facilitated zoonotic disease transmission.

This can be accessed at:

<https://royalsocietypublishing.org/doi/10.1098/rspb.2019.2736>

4. Extend understanding of range shifts due to climate variables, for a species of choice

Use this classroom/laboratory activity, 'Species Range Over Space and Time' by Debra Linton, Anna Monfils, Libby Ellwood, Molly Phillips on Qubes, to enable students to analyze data for a chosen species from natural history collections for its range shift due to rising temperatures. Follow the instructions given to complete the activity. This tool will enable students to understand the effect of global temperatures on species' distributions by analyzing a large dataset. Use the questions given in the accompanying activity sheet to initiate discussions about the impact of species range shifts on changing biotic interactions and their influence on human well-being. Discuss students' findings in the context of the raised risk of climate-induced virus spillover and possibility of pandemics.

This can be accessed at:

<https://qubeshub.org/publications/1106/about?v=1>

5. Questions/Assignments

Use the tools and the concepts learned so far to discuss and determine answers to the following questions:

- What is the zoonotic transmission of a disease? Give examples.
- Why is there an increased incidence of newly emerging viruses in recent times?
- How could climate change increase the risk of inter-species virus spillover in the future?
- How has climate change affected the occurrence of vector-borne and infectious diseases?

3 Learning Outcomes

The tools in this lesson plan will enable students to:

- learn about the influence of environmental disruptions and climate change on the occurrence of infectious diseases

- describe the role of biodiversity loss and habitat degradation on altering species distribution
- explain the possibility of zoonotic virus transmission due to species range shifts leading to increased human-animal interactions
- discuss the impact of climate change on habitat loss, altered biotic interactions and therefore, the higher risk of inter-species virus spillover

4 Additional Resources

If you or your students would like to explore the topic further, these additional resources will be useful.

1. Video Conversation and associated Reading

A video conversation, 'Covid-19: Of virulent viruses and reservoir hosts' between two UC Berkeley researchers, Britt Glaunsinger and Cara Brook, about virology, the origin of the novel coronavirus, and the prospects for a vaccine.

This can be accessed at:

<https://news.berkeley.edu/2020/06/12/of-virulent-viruses-and-reservoir-hosts/>

2. Video

A short video, 'Pandemics, Nature and Us' by Sir David Attenborough for BBC Earth.

This can be accessed at:

<https://www.facebook.com/118883634811868/videos/370795280754577>

3. Reading

A conversation, 'Coronavirus, Climate Change, and the Environment' on COVID-19 with Dr. Aaron Bernstein, Director of Harvard Chan C-CHANGE.

This can be accessed at:

<https://www.hsph.harvard.edu/c-change/subtopics/coronavirus-and-climate-change/#:~:text=Many%20of%20the%20root%20causes,or%20people%20and%20share%20germs.>

5 Credits/Copyrights

All the teaching tools in our collated list are owned by the corresponding creators/authors/organizations as listed on their websites. Please view the individual copyright and ownership details for each tool by following the individual links provided. We have selected and analyzed the tools that align with the overall objective of our project and have provided the corresponding links. We do not claim ownership of or responsibility/liability for any of the listed tools.

1. Reading; 'Climate Change and Infectious Diseases'

By the [World Health Organization \(WHO\)](#)

2. Reading, 'Q & A: Could climate change and biodiversity loss raise the risk of pandemics?'

By Daisy Dunne for [Carbon Brief](#)

3. Reading; 'Global shifts in mammalian population trends reveal key predictors of virus spillover risk'

Christine K. Johnson, Peta L. Hitchens, Pranav S. Pandit, Julie Rushmore, Tierra Smiley Evans, Cristin C. W. Young and Megan M. Doyle.
[Proceedings of the Royal Society B: Biological Sciences](#). Volume 287, Issue 1924. Published:08 April 2020

4. Classroom/laboratory activity; 'Species Range Over Space and Time'

By Debra Linton, Anna Monfils, Libby Ellwood, Molly Phillips on [Qubes](#)

5. Additional Resources

[Berkeley News](#), University of California, Berkeley

Sir David Attenborough, [BBC Earth](#)

[Dr. Aaron Bernstein](#), Director of Harvard Chan C-CHANGE