

Lesson Plan: Hydrocarbons and climate change

Teacher-submitted lesson plan, contributed by Dr. Sharda Pasricha, Associate Professor, Sri Venkateswara College (Delhi University)

As a **high school Chemistry teacher**, this set of computer-based tools will help you to introduce the topics of **hydrocarbons** in **fossil fuels**, **carbon dioxide release** by fossil fuel combustion and the effect of **high atmospheric carbon dioxide** on **climate change**.

This lesson plan helps students to learn about hydrocarbons, different types of hydrocarbons, and how the products of their combustion reactions can potentially lead to climate change. Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in **Chemistry**.

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

- Q1. What are hydrocarbons?
- Q2. What types of hydrocarbons are found in commonly used fossil fuels?
- Q3. Discuss whether methane is a cleaner combustion fuel than methanol/ethane.
- Q4. Explain how the burning of fossil fuels is a potential contributor to climate change.

About the Lesson Plan

Grade Level: High School

Discipline: Chemistry, Environmental Sciences

Topic(s) in Discipline: Fossil Fuels, Hydrocarbons, Combustion Reactions, Carbon dioxide and Global Warming

Climate Topic: Climate and the Atmosphere; Climate and the Anthroposphere; Energy sources and Climate Change

Location: Global

Access: Online, Offline

Language(s): English

Approximate Time Required: 45-60 minutes

1 Contents

1. Video Micro-lecture (4 minutes)

A short video that introduces the topic of fossil fuels, how they are formed, and how the combustion/burning of fossil fuels may lead to an increase in atmospheric carbon dioxide and potentially contribute to global warming.

<https://www.calacademy.org/educators/whats-the-deal-with-fossil-fuels>

2. Reading (15 minutes)

A reading that describes hydrocarbons as primary components of fossil fuels, types of hydrocarbons and their structures, and the products of combustion of different hydrocarbons.

https://energyeducation.ca/encyclopedia/Hydrocarbon_combustion

3. Classroom/Laboratory Activity (40 minutes)

A classroom/laboratory activity that demonstrates the thermal properties of CO₂, its role as a greenhouse gas, and how increased CO₂ concentrations due to combustion of different hydrocarbons in fossil fuels may contribute to global warming.

www.rsc.org/Education/Teachers/Resources/jesei/co2green/home.htm

4. Suggested questions/assignments for learning evaluation

- Q1. What are hydrocarbons?
- Q2. What types of hydrocarbons are found in commonly used fossil fuels?
- Q3. Discuss whether methane is a cleaner combustion fuel than methanol/ethane.
- Q4. Explain how the burning of fossil fuels is a potential contributor to climate change.

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 topic through a video micro-lecture

Introduce the topic of fossil fuels to your students by using the video micro-lecture “What’s the deal With Fossil Fuels?” developed by California Academy of Sciences and available at <https://www.calacademy.org/educators/whats-the-deal-with-fossil-fuels>. You may use this teaching tool to discuss common fossil fuels and their formation, and renewable and non-renewable sources of energy. Emphasize how carbon dioxide released from fossil fuel combustion may lead to global warming.

2. Discuss the topic further by using an online reading

Now explore the topic in greater detail through this reading titled “Hydrocarbon Combustion” from University of Calgary, available at https://energyeducation.ca/encyclopedia/Hydrocarbon_combustion.

Use this teaching tool to demonstrate the products of the combustion of different hydrocarbons and to show the potential costs and benefits of using different fossil fuels. You may demonstrate this by having your students note how much CO₂ per molecule is released due to the combustion of different fossil fuels.

3. Conduct a hands-on classroom/laboratory activity

Now help your students investigate the thermal properties of CO₂, its role as a greenhouse gas, and how increased CO₂ concentrations due to combustion of different hydrocarbons in fossil fuels may contribute to global warming. Use the classroom/laboratory activity titled “The carbon dioxide greenhouse - is it effective?” developed by the Royal Society of Chemistry and available at www.rsc.org/Education/Teachers/Resources/jesei/co2green/home.htm, and proceed with the lab activity as instructed. While conducting the classroom/laboratory activity, have your students observe the effect of applying heat and light energy on carbon dioxide and air. Ask your students if their observations of the thermal properties of CO₂ and air allow them to better understand the relationship between increased atmospheric CO₂ due to combustion of fossil fuels and an increase in Earth’s surface temperature since the industrial revolution. You may further discuss impacts of climate change on local and global scales and on different sectors.

4. Questions/Assignments

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

- Q1. What are hydrocarbons?
- Q2. What types of hydrocarbons are found in commonly used fossil fuels?
- Q3. Discuss whether methane is a cleaner combustion fuel than methanol/ethane.
- Q4. Explain how the burning of fossil fuels is a potential contributor to climate change.

3 Learning Outcomes

The tools in this lesson plan will enable students to:

- Learn that fossil fuels are primarily composed of hydrocarbons.
- Compare the products of combustion of various hydrocarbons.
- Explore the thermal properties of carbon dioxide and air.
- Interpret how the combustion of fossil fuels may release greenhouse gases such as CO₂ in the atmosphere and may potentially contribute to global warming.

4 Additional Resources

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

Reading, “Greenhouse Gases”, from the American Chemical Society:

<https://www.acs.org/content/acs/en/climatescience/greenhousegases.html>

Reading, “Hydrocarbons”, from BC campus Open Education:

<https://opentextbc.ca/chemistry/chapter/20-1-hydrocarbons/>

Reading, “Energy From Fossil Fuels”, from Western Oregon University, USA:

https://www.wou.edu/las/phisci/GS361/Energy_From_Fossil_Fuels.htm

Simulation , “Climate Bathtub Simulation”, by Dr. Sterman from [System Dynamics Group at MIT](#) , USA, to understand what will happen if atmospheric carbon dioxide concentrations are allowed to increase or decrease beyond current levels:

<https://www.climateinteractive.org/tools/climate-bathtub-simulation/>

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. Video, “What’s the Deal with Fossil Fuels?”:

[California Academy of Sciences, USA](#)

2. Reading, “Hydrocarbon Combustion”:

[Energy Education, University of Calgary, Canada](#)

3. Lab Activity, “The carbon dioxide greenhouse - is it effective?”:

[Royal Society of Chemistry, London](#)

Additional Resources

- American Chemical Society; <https://www.acs.org/content/acs/en/about.html>
- Opentext, BC campus Open Education: <https://opentextbc.ca/>
- Western Oregon University: <https://www.wou.edu/>
- Climate Interactive, Schlumberger Ltd.: <https://www.climateinteractive.org/tools/climate-bathtub-simulation/>

Images (Suggestions)

Figure1: Fossil fuel Greenhouse Emissions

Source: <https://www.climateemergencyinstitute.com/greenhousegases.html>

Figure 2: Carbon dioxide from Fossil Fuel Combustion

Source: www.carbonaction.co.uk/index.php/blog/view/carbon-dioxide-from-fossil-fuel-combustion/