

**ICSE Academy
EUROPEAN WORKSHOP SERIES
Spring 2024**

**Cluster 1: Tools and approaches to deal with
sustainability issues in STEM education**

Date	Topic
Cluster 1: Tools and approaches to deal with sustainability issues in STEM education	
March 5 * 16:00 – 18:00	Local introduction to the workshop series
March 12 16:00 – 18:00	1. Sustainability and socio-scientific issues in STEM education
March 19 16:00 – 18:00	2. Inquiry-based STEM learning
April 9 16:00 – 18:00	3. Argumentation and decision making in STEM education
Cluster 2: Diversity and inclusion in STEM	
April 16 16:00 – 18:00	1. Introduction to diversity and inclusion in STEM education
April 23 16:00 – 18:00	2. Analysing and designing STEM tasks for diversity and inclusion
April 30 16:00 – 18:00	3. Analysing inclusive classroom practices (based upon try-outs)

Climate change, energy and materials crisis, sustainable development

Current societal challenges:

Key role of Science & Technology

Need for

Highly qualified
Scientist and STEM professionals

Respond to

STEM-literate citizens
to make informed decisions

Cluster 1 ICSE Academy
Responding to societal needs

Sustainability & Socio-
Scientific Issues

As powerful learning contexts to
achieve the intended goals

Inquiry-Based Learning

To foster inquiry minds and skills
To collect evidence

Argumentation

As an approach to promote
critical thinking and informed decision-making

Argumentation and decision making in STEM education

April 8, 2024

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OUTLINE, SESSION 3

- Brainstorming for photosynthesis
- Plenary introduction to argumentation and its importance in science
- Group work: Creating a simple argument
- Plenary sharing

- BREAK

- Plenary introduction to argumentation and decision-making in STEM education
- Group work: Creating a complex argument
- Plenary sharing
- Reminder of homework (assignment)

Teaching is a complex and challenging occupation in which teachers need to manage various activities and simultaneously achieve goals in interactions with their students (Hall & Smotrova, 2013).



Image source: Freepik

The reflection from classroom

Teacher Claim:

Green leafy plants photosynthesize under sunlight.

Student inquiry:

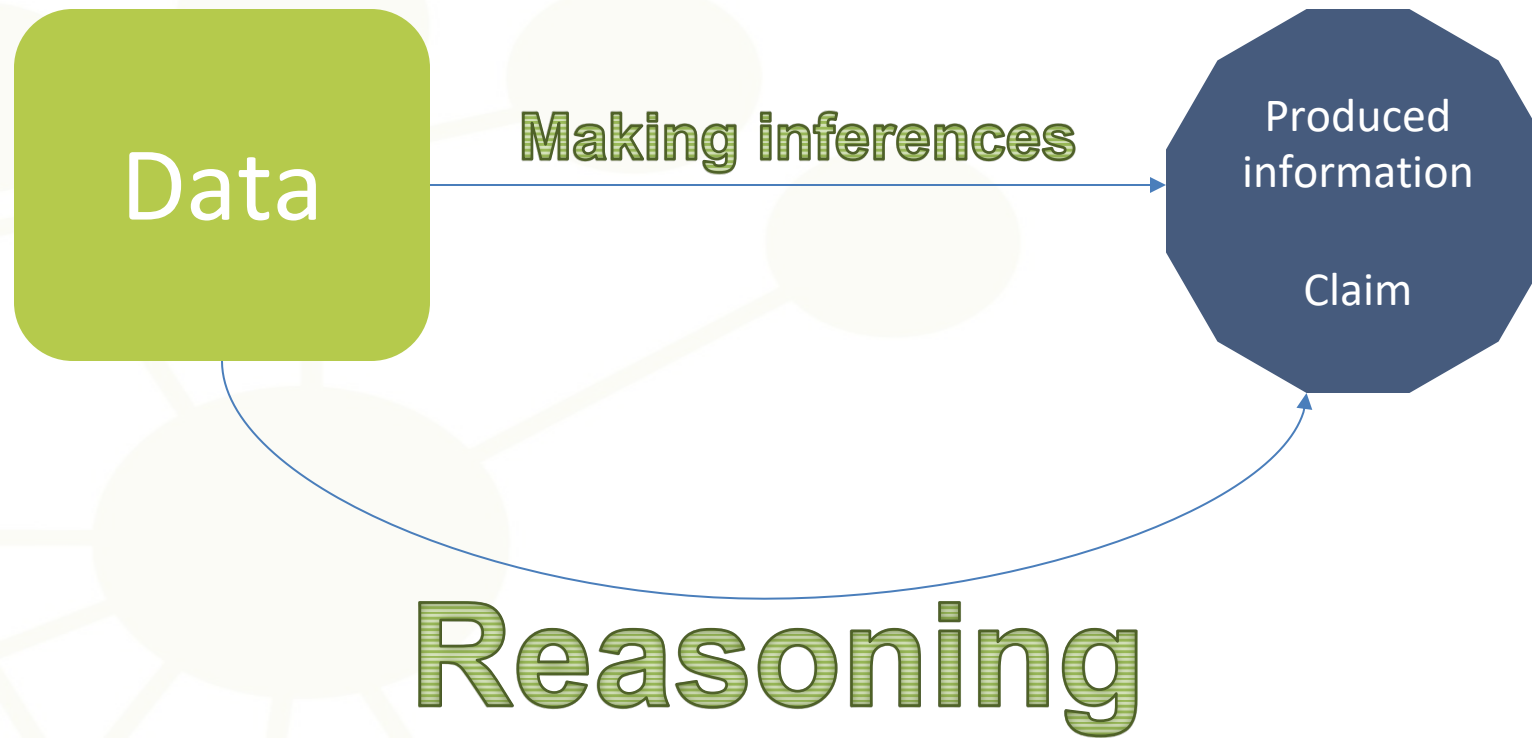
How do we know this information?

How do we confirm the information is true?

How do you convince the student?



Image source: Freepik



What are Argument and Argumentation?

An argument is a reason or reasons why an idea or action should be supported by an individual.

(Cambridge Online Dictionary, 2024a).

Argumentation is a set of arguments used to explain something or to convince people of something.

(Cambridge Online Dictionary, 2024b).

An argument is a claim and its justification.

Argumentation is a process in which claims are supported by data and justifications are given.

Toulmin, 2003

Components of an Argument

Data: These are the facts that those involved in the argument appeal to in support of their claim.

Claim: This is the conclusion whose merits are to be established.

Warrants: These are the reasons (rules, principles, etc.) that are proposed to justify the connections between the data and the knowledge claim, or conclusion.

Backing: These are basic assumptions, usually taken to be commonly agreed that provide the justification for particular warrants.

Qualifiers: These specify the conditions under which the claim can be taken as true; they represent limitations on the claim.

Rebuttals: These specify the conditions when the claim will not be true.

(Driver, Newton, & Osborne, 2000, p.293).

Successful implementation



Image source: Freepik

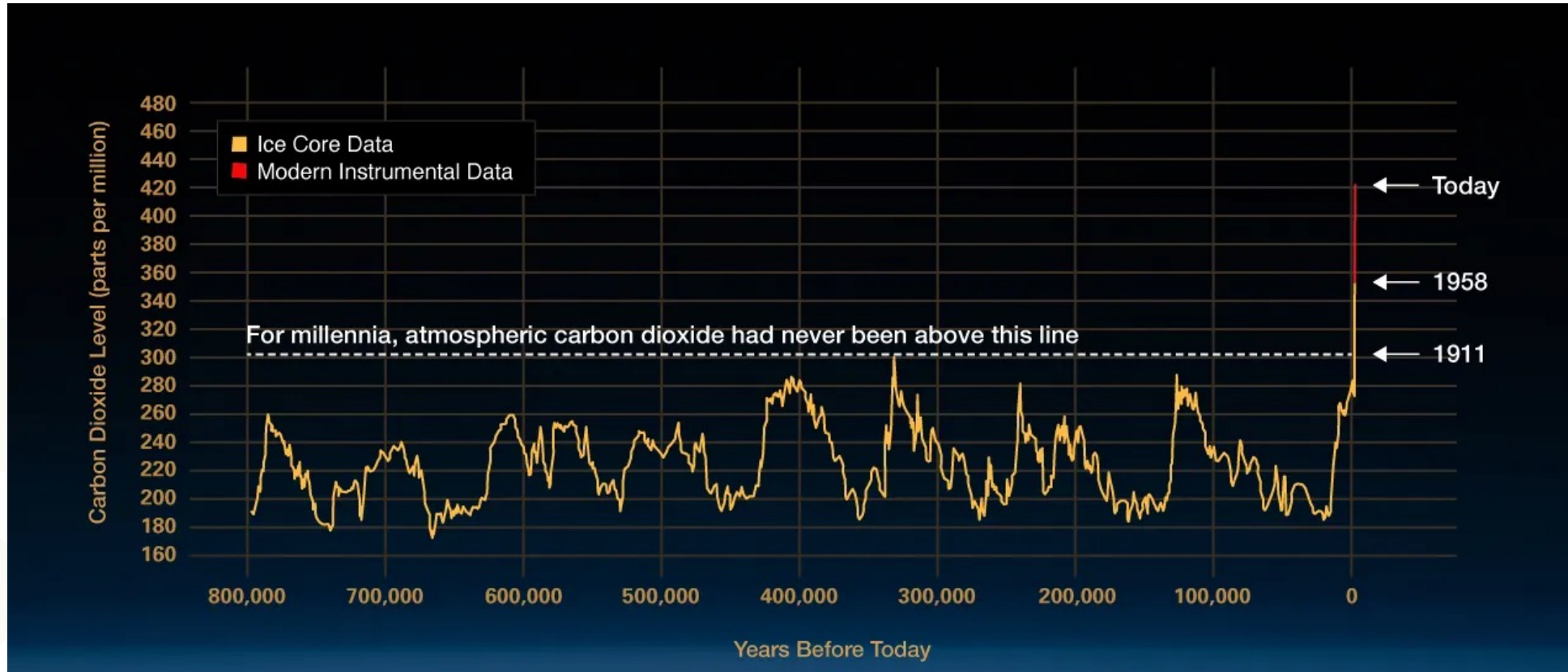
Argumentation requires to understand the students' ideas and respond to unexpected events in the classroom (Zohar, 2007).

Many teachers face challenges in creating and supporting the dialogic culture or argumentation, even if they use a curriculum that promotes in-class interaction (Alozie et al., 2010), and they find it difficult to produce appropriate questions to support students (McNeill & Knight, 2013).

Contributions

- students' science learning by playing an essential role in the development of both thinking processes and scientific reasoning (Chin & Osborne, 2010a)
- conceptual understanding (Chin & Osborne, 2010b; von Aufschnaiter et al., 2008)
- cognitive and metacognitive processes (Cavagnetto, 2010).
- talking and writing about science (Norris & Phillips, 2003)

Creating a simple argument



<https://shorturl.at/fhBDE>

**You might try to
create your
argument using
Microsoft
Copilot**

<https://science.nasa.gov/climate-change/evidence/>

Look at the Graph and create a simple argument containing claim, data, and warrant in cooperation on Padlet.

10"
break



Plenary sharing

What is the
argument of
your group?



Image source: Freepik

Argumentation and decision-making in STEM education

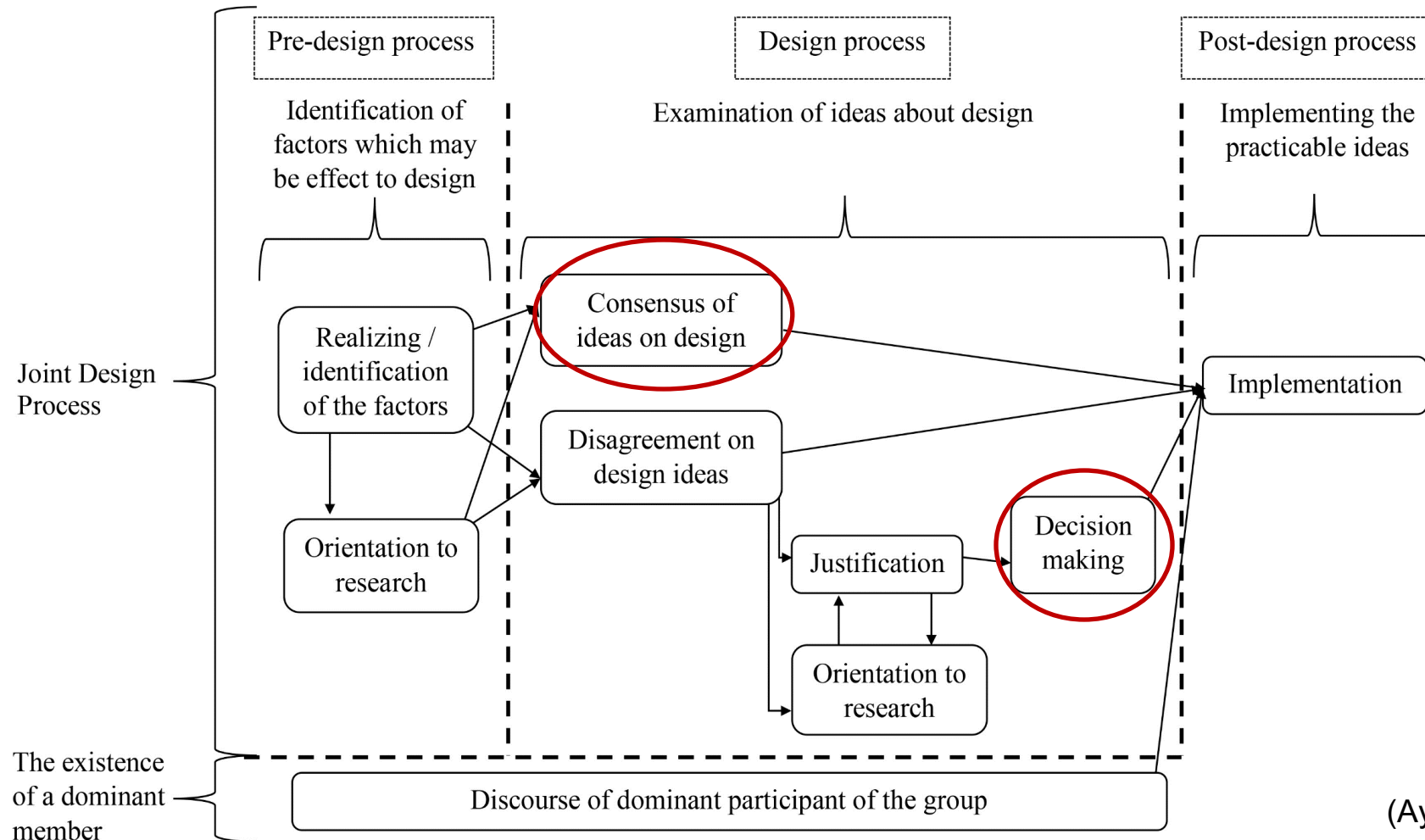
Think about the recent activity



Image source: Freepik

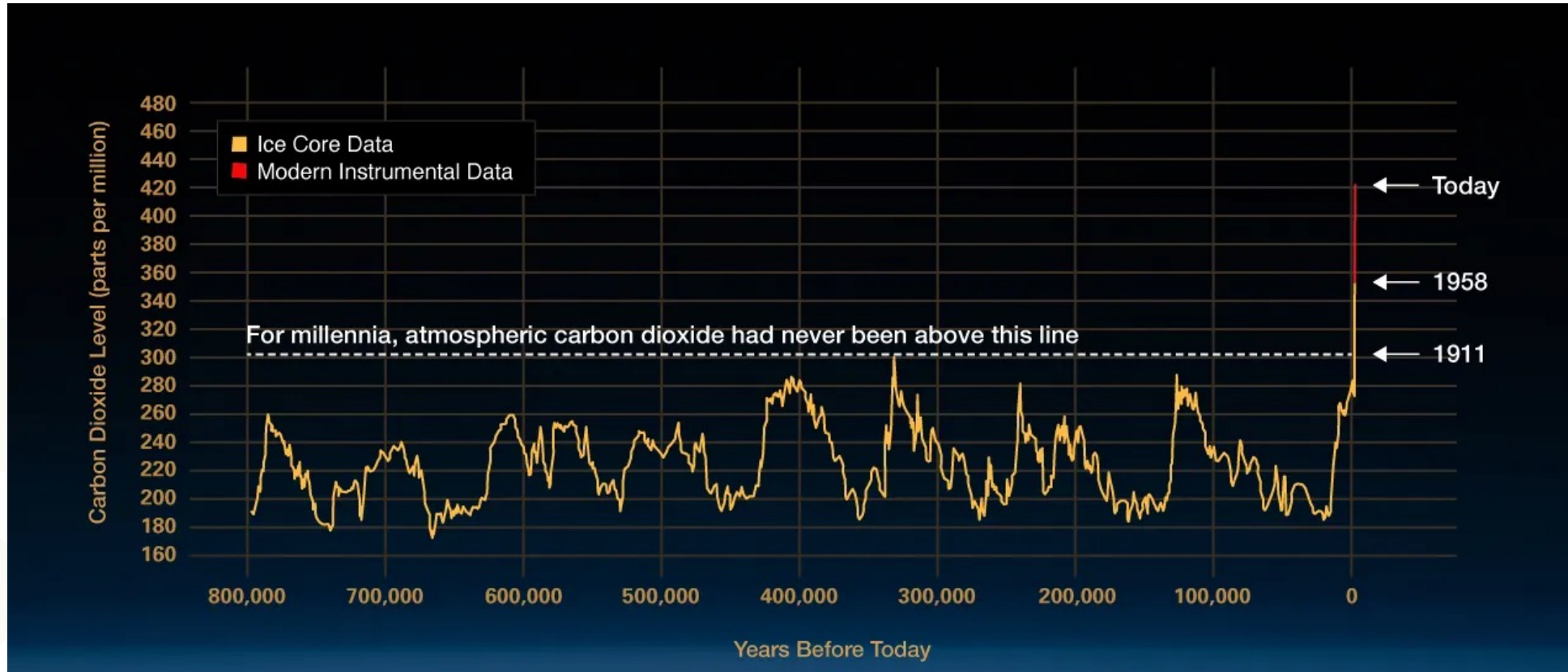
In which stages and for what did you have to decide?

STEM Activity Process



(Aydin-Gunbatar and Sardag, 2022)

Creating a complex argument



<https://science.nasa.gov/climate-change/evidence/>

Task 2: Modify the simple argument into a complex argument. To do this, add a backing, a qualifier and rebuttal(s).



<https://shorturl.at/fhBDE>

**You might try to
create your
argument using
Microsoft
Copilot**

Plenary sharing

What is the
qualifier, backing
and rebuttal of your
group?



Image source: Freepik

Considering the graph of the change in the level of carbon dioxide in the atmosphere according to put forward by NASA	Qualifier
It is seen that there are increases in the level of carbon dioxide between 800,000-780,000, 640,000-600,000, 540,000-510,000 and 450,000-400,000 years, which can be considered as a jump of about 100ppm.	Data
Therefore, by looking at these increases, it reveals that the increase in the level of carbon dioxide does not occur only as a result of human activities.	Claim
Because the emergence of humanity is later than the specified dates, there must be other factors that can change the level of carbon.	Warrant
Looking at the history of the world, some natural events that have taken place support the increase in the level of carbon dioxide. Volcanic eruptions, for example Yellowstone volcanic eruption before 640,000 years ago, can be given as examples of these events.	Backing
Although there are people who think that the increase in carbon dioxide in the atmosphere is caused by human activities, the increases that occurred in the periods when there was no humanity unjustified the thought of these people. If the increases had started with humanity, the opinion of the people could have been in question. But such a situation does not exist. Therefore, the increase in carbon dioxide does not occur only as a result of human activities.	Rebuttal

Argument generated by AI

Claim: Human activities are the primary cause of the unprecedented rise in atmospheric CO2 levels since the Industrial Revolution.

Data: The graph shows a significant increase in atmospheric CO2 levels from the year 1911 onwards, reaching levels that are unmatched in the last 800,000 years.

Warrants: These warrants support the claim by linking the data to the claim.

1. The correlation between the start of the Industrial Revolution and the increase in CO2 levels suggests a causative relationship, as this period marks a substantial increase in the burning of fossil fuels for energy.

2. Scientific research indicates that the combustion of fossil fuels releases a large amount of CO2, which is a greenhouse gas that contributes to global warming.

Backing: The backing provides additional support to the warrants.

1. Ice core data provides a historical record of atmospheric gases, and it shows that the natural range of CO2 levels has been exceeded dramatically in recent times.

2. Reports from reputable scientific organizations, like the Intergovernmental Panel on Climate Change (IPCC), confirm that the rise in CO2 levels since the Industrial Revolution is largely due to human activities.

Qualifier: The qualifier indicates the strength of the claim, considering possible exceptions.

• While the claim is supported by strong evidence, it is also acknowledged that natural processes can influence CO2 levels, although the current increase is too rapid to be attributed solely to natural causes.

Rebuttal: The rebuttal acknowledges potential counter-arguments and provides responses to them.

• One might argue that CO2 levels have fluctuated over the past 800,000 years due to natural cycles. However, the rate and magnitude of the increase in CO2 levels in the modern era do not correlate with known natural cycles. Instead, they align closely with the timeline of human industrial activity. (OpenAI, 2024)

Reminder

Prepare an outline for a STEM lesson for your local curricula. Chose a topic that you would feel comfortable implementing with your students. The lesson should use an SSI as a context, and focus on argumentation and Inquiry based learning (IBL). In the outline include the following information: level of students, duration of the lesson, participants' prior knowledge, methods to be applied, content, assessment methods, STEM theme, learning objectives, and description of the learning activities.

Please submit your assignment for cluster 1 in .pdf or .doc

References

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Thank you for your participation

For further information please feel free to contact

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