



**ECOSF**  
ECO SCIENCE FOUNDATION

# The Role of Basic Sciences in Climate Mitigation

**Joint Symposium - The Role of Science Academies towards the Future of Basic Sciences.**

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**ECO SCIENCE FOUNDATION**

**Istanbul University in Istanbul, Türkiye**

**April 28-29, 2023**

# Why Science Education is a Powerful Tool to address the Climate Change?



„Education means more than acquiring knowledge. It **empowers people to develop personally** ...“ (Deutsche Welle)

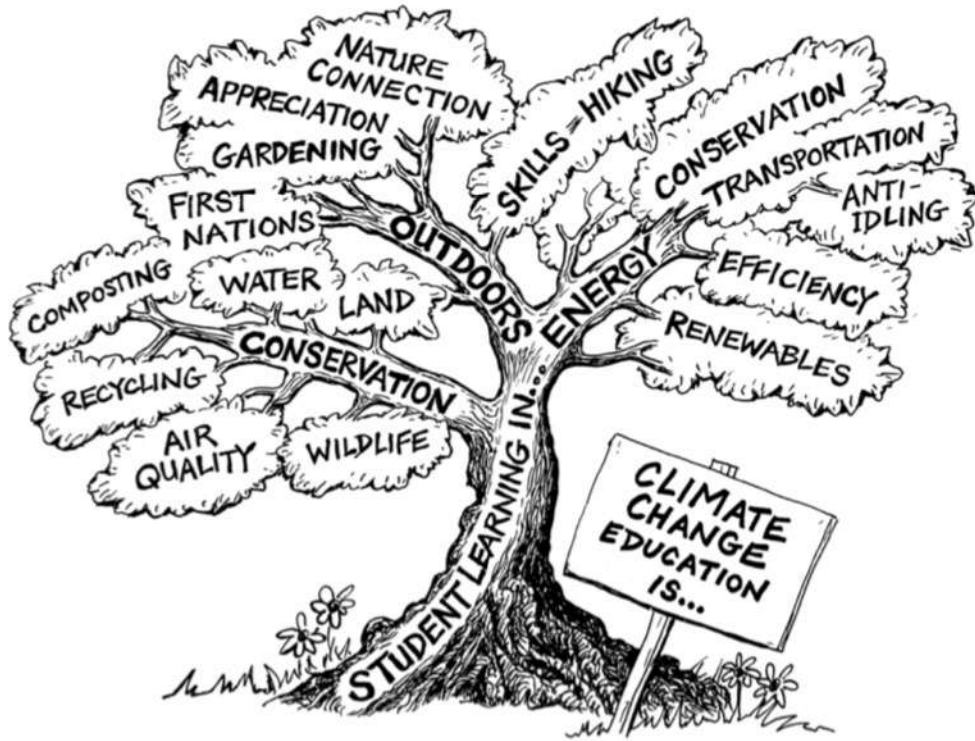
“Education is ... designed to develop and raise future leaders and indeed, **a new generation of leaders that will change the society for the better**” (Babalola).

“**Transformative power of a great education can change everything**”.  
(Nelson Mandela)

„Learning has been identified as **a critical tool for the achievement of sustainable development** as a whole, and to the UN SDG in particular” (Filoh)

Education is needed to develop “**a sense of social responsibility**, as well as strong and **transferable intellectual and practical skills** such as communication, analytical, and problem-solving skills” (Janet Eyler)

# Understanding the Climate Change



- Climate change is a global challenge caused by human activities, primarily the burning of fossil fuels and deforestation.
- Basic sciences, including physics, chemistry, and biology, provide the foundation for understanding the complex science behind climate change.
- Climate change is based on the principles of basic sciences
- **Physics:** Explain the greenhouse effect and radiative forcing, which lead to global warming.
- **Chemistry:** Describe the composition of the atmosphere, including greenhouse gases like carbon dioxide, methane, and nitrous oxide, and their role in trapping heat. Highlight the interactions between climate change and ecosystems, including heat.
- **Biology:** impacts on biodiversity, ecosystems, and natural resources.

# Educating the Young Minds About the Climate Change



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To predict what will be the most appropriate decisions in twenty years' time, when the current generation of young students will be decision-makers, is difficult.

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Education system must equip learners with the capability of understanding and decision making, based on evidence and critical thought and scientific education, rather than letting opinions or irrationality guide their choices in the future.

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Adequate teacher mobilization, science education and support and introduction of climate change education into national science curricula must be planned.



# Impact of Climate Change on Natural Systems

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Basic sciences provide insights into the impacts of climate change on natural systems, including oceans, forests, and biodiversity.

**Oceans:** the impacts of climate change on rising sea levels, ocean acidification, and the resulting impacts on marine ecosystems and coastal communities.

**Forests:** Basic science help up understand how climate change affects forests

**Ecosystem disruptions:** changes in temperature, precipitation patterns, and extreme weather events can disrupt ecosystems, leading to altered habitats, species distribution, and ecological interactions.



# Basic Sciences and Renewable Energy

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- Basic sciences are driving the development of renewable energy technologies, which play a vital role in reducing greenhouse gas emissions and mitigating climate change.
- **Solar energy:** the functioning of photovoltaic cells and solar thermal power, and their potential for clean energy generation.
- **Wind energy:** working of wind turbines and wind farms, and their contribution to sustainable energy production.
- **Hydroelectric power:** Highlight the role of dams and turbines in generating electricity from flowing water.



# Advancements in Solar Energy

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Basic sciences research has led to significant advancements in solar energy.

- **Improved efficiency of solar cells:** advancement in scientific research has resulted in more efficient solar cells, allowing for greater energy generation from sunlight.
- **Development of new materials for solar panels:** new research has led to the use of new materials, such as perovskite and thin-film solar cells, to enhance the performance of solar panels.
- **Integration of solar power in buildings and transportation:** Solar energy is being integrated into buildings, electric vehicles, and other transportation systems to reduce greenhouse gas emissions.



# Innovations in Wind Energy

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Basic sciences research has contributed to significant innovations in wind energy.

**Larger and more efficient wind turbines:** research in basic sciences has led to the development of larger and more efficient wind turbines, capable of generating more electricity from wind resources.

**Offshore wind farms:** the scientific advantages of offshore wind farms, including higher wind speeds and larger generation capacity, which have been made possible through advances in basic sciences research.

**Advancements in wind forecasting and grid integration:** Basic sciences has improved wind forecasting techniques and grid integration of wind energy, making it a more reliable and scalable renewable energy source.





# Role of Basic Sciences in Carbon Capture and Storage

Basic sciences research plays a crucial role in developing technologies for carbon capture and storage (CCS), which can help mitigate climate change.

**Carbon capture technologies:** Research enables various methods of capturing carbon dioxide (CO<sub>2</sub>) from industrial processes and power plants, including post-combustion, pre-combustion, and direct air capture, and how basic sciences research contributes to their development.

**Carbon storage technologies:** Basic science provides different methods of storing captured CO<sub>2</sub>, including geological storage, ocean storage, and mineralization, and how basic sciences research helps understand their efficacy, safety, and environmental impact.

**Potential of CCS in climate mitigation:** the potential of CCS as a viable option for reducing greenhouse gas emissions and mitigating climate change, with ongoing research to improve its efficiency and sustainability.

# Future Directions for Basic Sciences in Climate Mitigation



Basic sciences research will continue to play a critical role in addressing climate change and advancing solutions for mitigation in the future.

**Interdisciplinary approaches:** the importance of interdisciplinary collaborations between scientists from different disciplines to tackle the complex challenges of climate change, including physics, chemistry, biology, engineering, and social sciences.

**Technological advancements:** the need for continued research and innovation in basic sciences to develop new technologies and solutions for climate mitigation, including advancements in renewable energy, carbon capture and storage, and sustainable agriculture and forestry practices.

Crucial role of basic sciences in climate mitigation, and the need for continued research, innovation, and interdisciplinary collaborations to address this global challenge effectively.



# A Statement on Climate Change and Education

from the member academies of IAP for Science

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the interacademy partnership



Workshop Report

# CAPACITY BUILDING WORKSHOP FOR SCIENCE TEACHERS ON CLIMATE CHANGE EDUCATION

March 28 – April 1, 2022.  
Islamabad, Pakistan

# Capacity Building Initiatives for Science Teachers in Climate Change Education



**Teaching Module on Climate Change Education based on Inquiry Based Science Education (IBSE) pedagogy for Capacity Development of Science Teachers in Pakistan**

1st DRAFT

August 28, 2022

With Financial Support of IAP SEP.

Saba Chachar (SIBAU)  
Engr. Khalil Raza (ECOSF)  
Dr. Shaikh Tariq Mehmood (IIUI)

# Teachers Training Module on Climate Change

- Develop a teacher training module on Climate Change Education for science teachers that employs Inquiry Based Science Education (IBSE) pedagogy
- This training module aimed at delivering effective content on climate change to students of grade 5 through 10.
- an assessment or evaluation methodology for this training to measure the depth of learning with IBSE pedagogy.
- This is to demonstrate that inquiry-based approach could offer greater degree of learning and understanding of science concepts and processes in comparison to traditional science teaching methods.

# Climate Change Education Based on Inquiry Based Science Education

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- Education, especially **science education**, must play an essential role in preparing present and future generations to understand climate change and to be adequately prepared to adapt to and mitigate its impacts.
- **Inquiry Base Science Education (IBSE)** developed over the last two decades, has demonstrated an effective way to teach science at primary and secondary school levels and also to inspire higher education worldwide. It provides a firm basis to develop urgently a specific, interdisciplinary climate change education programme.

# Role of scientists and engineers in Climate Change Education

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Scientists and engineers engaged in all aspects of climate change have a critical role to play in advancing and implementing climate change education as they have the knowledge that must be embedded in curricula and conveyed to teachers.

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Cognitive scientists and education specialists also have a role to play in advancing climate change education, bringing to the table their understanding of the learning process at all ages, effective pedagogy, and the design of robust and effective teaching materials.



# Way Forward

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- Educating the present and future generations about climate change and teaching them to act with a critical mind and a hopeful heart, is essential for the future of humanity.
- Science education must meet the challenge, especially through the use of an inquiry-based and interdisciplinary pedagogy, with the global scientific community playing an essential role in its implementation and improvement.



# Thank you

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