



Climate Change Educators Handbook

A classroom supplement created by the
SeasonWatch Climate Change Educator Network

*Draft for review

Climate Change Educators Handbook



A classroom supplement created by the
SeasonWatch Climate Change Educator Network

*Draft for review

SeasonWatch Climate Change Educator Network

Authors

Annamma T. Baby, Aravind Kudla, Arvind Patole, Benoy Joseph, Geetha Ramaswami, Hussein E, Mrinal Shah, Prabhakaran P.V , Rajashree, Rekha Edappal, Savithri P.R, Suhirtha Muhil M , Sujatha M Kongad

Contributors

Akhter Hussain, Muhammed Nizar, Rajangam P, Ramjee Nagarajan, Sayee Giridhari, Swati Sidhu

Advisors

Anjali Noronha, Mythreyi Kumaraswamy, Nirmal Govindarajulu, Priyanka Prakash, Roshni Ravi, Thejaswi Shivanand, Vena Kapoor

Supported by

Azim Premji University Research Fund
Wipro Foundation

Design & Layout

Suhirtha Muhil M

Illustrations

Canva AI

Cover Photograph

Gyrocarpus americanus, by Suhirtha Muhil M



CC BY-NC 4.0 DEED

Attribution-NonCommercial 4.0 International

Citation: The Climate Change Educators Handbook, 2024. *The SeasonWatch Climate Change Educator Network*

CONTENTS

<i>Introduction</i>	i
<i>Going Outdoors</i>	1
BIODIVERSITY	2
<i>Flowering, pollination and climate change</i>	4
<i>Birds of every season</i>	9
<i>Nesting behaviour of birds</i>	13
<i>Visitors to a tree</i>	16
<i>Invasive plants</i>	19
<i>Butterflies migration-Flight of Tigers and crows</i>	25
<i>Dragonflies-Spotting the wanderer</i>	30
<i>A monsoon feast-Termite swarms</i>	34
WEATHER	37
<i>Documenting your local climate</i>	39
<i>Monitoring everyday weather</i>	44
<i>Extreme weather events</i>	49
<i>Tracking rising temperature</i>	54
WATER	58
<i>Mapping surface water bodies</i>	60
<i>Seasonality of water bodies</i>	63
<i>Traditional water management</i>	71
FOOD & CLIMATE CHANGE	74
<i>Forgotten foods</i>	76
<i>Old is gold cooking challenge</i>	79
<i>Resilient foods, making choices</i>	81
<i>Carbon coast of food transportation</i>	85

SOIL AND LAND

Mapping geographies

Soils around you

Soil and Vegetation

Measuring soil organic content

Soil erosion

88

90

94

101

104

106





Introduction

Rising global temperatures, shifts in weather patterns, and more frequent and severe weather events are becoming the norm. Now, more than ever, we are beginning to experience the impacts of climate change first-hand and gaining a deeper understanding of its effects on human livelihoods, biodiversity, and the environment. Climate change education plays a crucial role in equipping children to tackle the challenges posed by this phenomenon. However, information about climate change often feels distant in environmental science textbooks, providing little opportunity for children to relate it to their own lives. Examples of climate change in textbooks often focus on far-away occurrences like melting polar ice sheets or receding glaciers, which seem disconnected from the everyday experiences of the majority of the Indian school-going children.

To address this gap in curricula, we at SeasonWatch (www.seasonwatch.in) set out to understand how educators perceive climate change and whether they found it necessary to communicate the same to their students. To this end we conducted a teachers' survey in 2021. Almost all of the 191 survey respondents acknowledged the effects of climate change on the environment and also shared their own lived experiences of climatic change. Many of the teachers felt that their students, though aware of climate change as a phenomenon, were unable to relate to such a large-scale process in their own immediate surroundings. We then collaborated with a volunteer group of teachers to develop a resource that emphasizes locally relevant examples of climate change. This resource aims to integrate local examples into existing school curricula, ensuring that students can relate to and understand the impacts of climate change in their own communities. We believe that a deep understanding of one's own environment, with a connectivity to biodiversity, local landscape, and culture will bring about a sense of ownership, awareness, resilience, and action. We hope this resource book will enable teachers to talk about climate change to students by observing and documenting the changes that are taking place around them.



How to use this resource?

This resource is primarily intended for high school and higher secondary school teachers. Teachers can review the activity list and select those applicable to their school or related to upcoming curriculum chapters. Since some activities are seasonal, planning should align with the academic calendar. This resource can also be utilized by educators from alternative schools, parents involved in homeschooling, as well as nature educators. This resource contains a set of activities under different themes – Weather, Biodiversity, Water, Food, and Soil.

Each activity includes the following sections –

Overview: A brief introduction to the concept understood through the activity .

Age Group: The appropriate age group or class for which the activity is designed.

Period of Activity: Many activities can be conducted throughout the year, while some are seasonal, occurring in specific months (e.g., Observing butterfly and dragonfly migration). This section suggests a suitable time in the year to conduct the activity

Learning Objective: The expected learning of a child at the end of the activity.

Detailed Activity: Step-by-step instructions for conducting the activity with students.

Curricular Links: Suggestions for chapters/topics in school curricula during which this activity can be conducted as supplementary learning.

Discussion: Guides/prompts/questions for teachers to discuss in class post-activity. Typically the relationship of a local phenomenon with climate change will emerge at the end of discussions based on these prompts. .

Local/Cultural References: References to local culture to make the activity more locally contextualised and relatable for students.

Resources: Additional information or links for teachers to explore, self-learn, or share with students

Addressing climate anxiety

We all remember the anxiety we went through as individuals and as a society during the COVID-19 pandemic. Climate change, too, is a very large, intangible issue, that is a pressing reality, without immediate, or easy solutions. This has been known to cause anxiety to people, especially young children. While it is important and necessary to address climate change and its effects, it is equally important to consider the mental well-being of the child learning about climate change.

Information on climate change can evoke a sense of fear, grief, and anxiety among children who have experienced natural disasters in the past. Research has shown that students who have had no experience of natural calamities also develop climate anxiety with increasing media coverage on climate change. Since climate change is a future-oriented anxiety, people tend to adapt and adjust to the changing environment. However, when individuals are unable to adapt and are in a constant state of worry, it affects their mental well-being. Some individuals are likely to experience more fear and anxiety than others due to their lived experiences.

Teachers should ensure that climate change-related topics are conveyed in a sensitive manner, ensuring that:

- Facts and information are age-appropriate.
- They avoid being overly pessimistic about the future and instead provide hope
- They validate students' emotional state by inquiring about their feelings and addressing them together in the class.

It is important to keep in mind both individual well-being and the efforts we engage in to mitigate climate change for societal well-being.





Connect to nature

- Go outdoors on a clear day when it is pleasant to sit in the shade of a tree
- Close your eyes and breathe deeply, count to 10
- With your eyes closed, recall a vivid memory connected to nature from your childhood
- Remember with your senses – what colours, smells, textures, tastes, or sounds of nature made that memory special
- Write this memory down, or make a drawing about it, or share it with another person, or simply relive it at that moment!
- Notice what you feel when you think about these memories

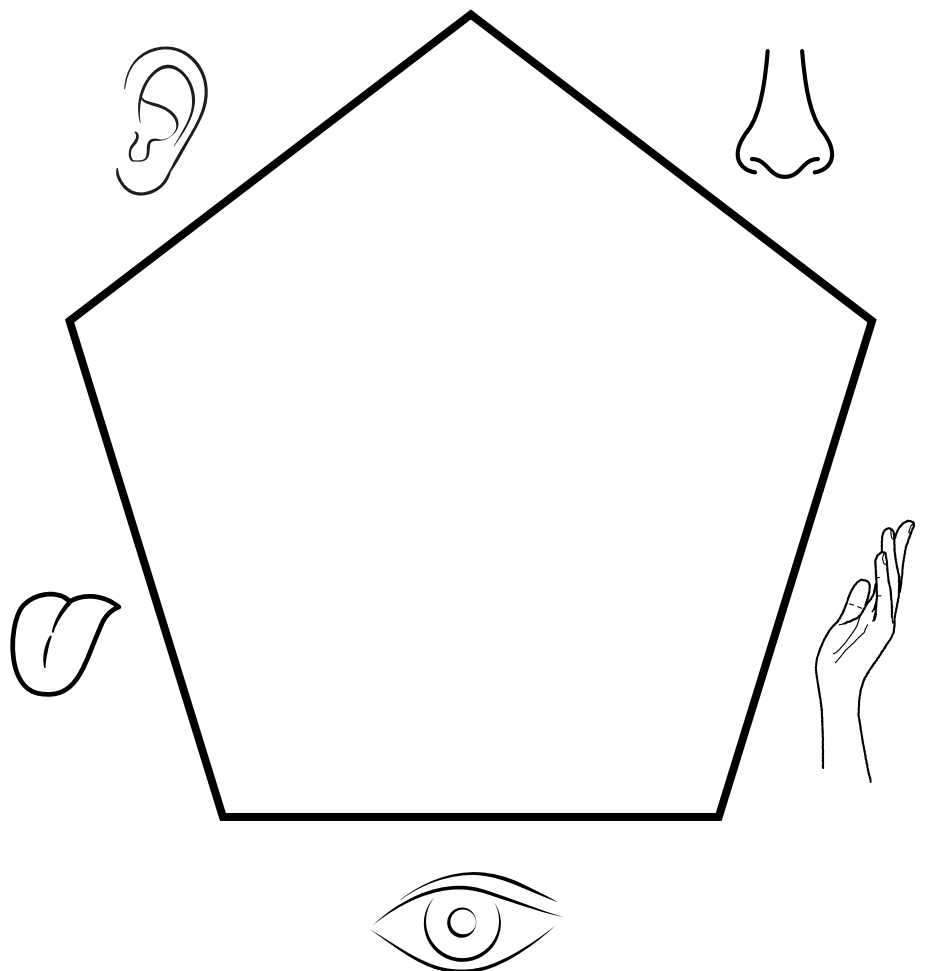
Going outdoors

Overview

if you are unfamiliar with going outdoors and exploring the natural world, your first experience taking children out can be overwhelming. Try beginning your explorations with the two sensory activities given here, either by yourself or with your students. These activities help to orient our senses to our environment, and have no bigger learning goal other than to experience nature fully!

Make a sensory map of your surroundings

Go outdoors on a pleasant day, and walk for 10 minutes in your surroundings where it is safe. Observe the world with all your senses – sight, sound, smell, taste, touch. In the map below, write or draw the things that stimulated each sense on your walk



Biodiversity



Climate change is widely recognized for its impact on different aspects of life, with a common focus on the effects of extreme weather events on human communities. However, climate change's ramifications extend far beyond immediate weather events, from altering ocean currents to disrupting wildlife habitats; its influence reverberates throughout natural systems, necessitating comprehensive understanding. Climate change affects biodiversity by altering habitats and ecosystems, leading to shifts in species distribution and abundance. It increases the frequency and intensity of extreme weather events, disrupting ecological balance and threatening vulnerable species with extinction. Changing temperature and precipitation patterns further stress ecosystems, affecting species' reproductive cycles and food availability. Some activities listed in this section are annual seasonal events, while others are simple observations that can be made daily. Engaging in these activities can empower teachers to explore the interconnectedness of biodiversity with the surrounding physical environment, students gain insight into the impacts of climate change on various species and their ecosystems. These activities offer opportunities to integrate with the curriculum in diverse ways, providing hands-on experiences that simplify complex concepts for students to comprehend effectively.

Flowering, pollination & climate change

Insects are great pollinators! Nearly one third of the world's plants are pollinated by insects, and of these, bees are especially important. Changing climate is affecting the flowering patterns of many trees, leading to a timing mismatch between insects and flowers. For example, if a tree that usually flowers in April blooms earlier in March, the bees that come for nectar in April will go hungry. How do you think this may affect in the food chain? There may be a decline in insect populations, and eventually low food production for people, because many crop plants that we consume are also pollinated by insects. When some insects pollinate only very specific species, these changes may be especially damaging to plants, pollinators, and people.

This activity teaches students about how inter-connected plants and insects are, and how important that is for us humans. This activity can be conducted alongside curriculum topics on pollination, pollinators, reproduction in plants, seasonality, and the food chain (see Curricular Links for specific chapters). Students will learn to observe, document, and interpret ecological and natural phenomena.



Flowering, pollination & climate change



Class/Grade

6-12

Activity

Outdoor -3 days (10 min a day)

Indoor (1 class hour for discussion)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

Pen/Pencil, a notebook, a stopwatch

Curricular links

NCERT

- Class 12 Biology , Chapter 2 Sexual reproduction in flowering plants
- Class 12 Biology, Chapter 9 Strategies for enhancement in food production

Overview

Students will examine a flower or inflorescence and observe the pollinators that interact with them. They will note the characteristics of these pollinators, including their shape, size, and species. Through discussion, students will explore the significance of pollinators and the vital role of pollination in ecosystems. Additionally, they will engage in discussion concerning honey gathering.

Learning Objective:

Observe and document the organisms that visit a flower and understand their role in pollination, food chain, and human livelihoods; infer impacts of climate change on pollination ecology through discussion

Detailed Activity:

- Begin with a discussion about the importance of insects in pollination
- Ask students to observe a flowering tree/plant in their school or home. Students should select a flower on the plant, making sure the flower observed is close to their height or at a lower level, for ease of observation.
- Students should select a flower that is about to open, [notice when the flower opens].
- Once open, the flower should be observed for ten minutes everyday for three consecutive days
- Share the following observation sheet with students to record details about their plant
- Ask students to answer Q 1-5, then create a minute-by-minute activity log for insects on their flower as given in Q6, then answer the next set of questions

Observation sheet

Date:.....

Day(1/2/3).....

Start Time:.....

End time:

Weather: Sunny/rainy/cloudy/windy

1.Name of tree/plant

2.Colour of flower petals.....

3. Can you see the pollen grains in the flower (tick yes or no)? Yes.....No.....

4.What colour is the pollen grain?.....

5.Does your flower have a smell? Describe it

.....
.....

6.List down all the insects that visit the flower at the time of observation (Bees, wasps, ants, butterflies, moths, other insects? Note it down in this activity log below (the first row is filled in as an example) -

SNo.	Time	Activity
1	10:00	2 bees hovering, 7 ants seen, one of bee sitting on flower
2	10:01	
3	10:02	
4	10:03	
5	10:04	
6	10:05	
7	10:06	
8	10:07	
9	10:08	
10	10:09	

After filling this log, answer the following questions -

1.Did you see bees carrying pollen grains (tick yes or no) ? Yes.....No.....

2.Do all insects that visit the plant carry pollen grains (tick yes or no)? Yes.....No.....

3.On which part of the bees/insects are the pollen grains
seen?.....

4.Do you think the bees also visited adjacent flowers (tick yes or no)? Yes.....No.....

5.Did you see any other animals feeding on the flowers (tick yes or no)? Yes.....No.....

6.Could you identify any of the insect species ? Write their names
here.....

7.Could you identify any of the bee species ? Write their names
here.....

8. Draw a picture of the flower you observed and visitors to the flower, in the page behind this sheet

Resources

Click the links to open the resource below

- [Types of honey bees in India:](#)
- [Bee flora and pollination of crops](#)

Discussion

Here are some questions you could ask students during the discussion:

- How is pollination important in the food chain? What would happen to food production if insects were not there for pollination?
- What if there were no flowering trees/plants in your area?
- What does pollen contain and why do bees need them?
- What is nectar?
- What qualities do bees have that make them good pollinators? (E.g body covered with hair, body size and proboscis length, does not injure plants, can easily carry nectar and pollen)
- What will happen to pollinators if plants and trees start flowering at unusual times? Do you know if this is happening in your locality?
- How does unseasonal rain affect flowering in trees? Do you know if this is happening in your locality?
- How does increasing temperature due to climate change affect bee colonies and other insects?
- Are bee populations declining? What can we do to revive bee populations?

Other activities to do

Watch these short movies on wild honey gathering. Discuss the risks involved for people who depend on wild honey collection for their livelihood, and the dependence on seasonal flowering trees for the honey bee populations.

- [Short film: Wild Honey harvesting in Sirumalai,](#)
- [Honey hunters vs bees vs tigers,](#)

Local & Cultural references

April and May are months when honey is collected from the forests in Southern India, when is honey gathered in your area?

How do you use honey in your food? And on what occasions?



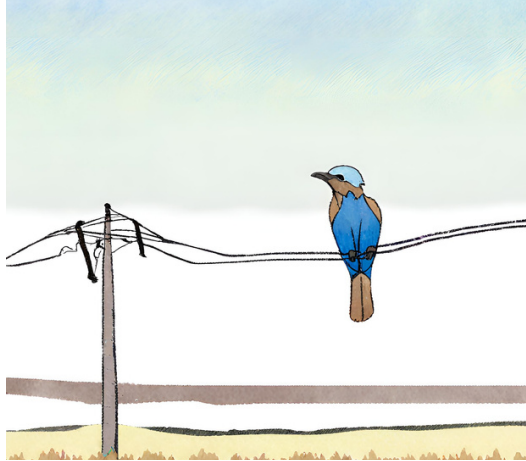
Birds and climate change

Birds are constantly adapting to the changing climate. Every aspect of a bird's life is dependent on the timing, seasonality and availability of food: from migrating and breeding, to nesting and egg-laying. Changing weather patterns the world over are altering these bird behaviours. Migration of birds from colder temperate regions to tropical regions in winter is a well known phenomenon and each species follows a regular path to arrive at warmer breeding or feeding sites. In recent years, scientists have found that birds' migratory pathways are shifting due to changes in temperature along the route, or due to loss of suitable habitats. Birds also discontinue their journey, or stop abruptly if they find unfavourable conditions along their migration route - affecting their breeding, and eventually their populations. Biological events such as flowering, insect emergence, and prey availability that are affected by climate change also have an impact on bird populations.

The activities listed below will help students understand bird migration, seasonality, natural resources and habitats, and the interdependence of species within ecosystems. Students will learn to observe birds and environmental issues affecting them.



Birds of all seasons



Class/Grade

6-12

Activity

Outdoor (once a week)

Indoor (1 class hour for discussion)

Period of Activity

Can be a year round activity

Place

Any part of the country

Materials Needed

Field guides, pencil/pen, notebook, binoculars (if available)

Curricular links

NCERT

- Class 12 Biology , Chapter 2 Sexual reproduction in flowering plants
- Class 12 Biology, Chapter 9 Strategies for enhancement in food production

Overview

Students will observe and document the bird communities around the school campus over a period of time. They will monitor and record bird behaviours, and discuss the importance of migration for specific bird species, and examine the potential impacts of climate change on this phenomenon.

Learning Objective:

Observe and document local bird communities and their seasonal behaviour

Detailed Activity:

- Introduce students to some common birds of your region. This can be done with the aid of a bird pocket guide (e.g. Early Bird regional pocket guides: <https://www.early-bird.in/>)
- Go birding with your students for a few sessions within your school campus, and familiarise them with common local birds
- Select a few spots within your school campus where it is convenient to observe birds.
- Divide the class into four or five groups.
- Each group should visit selected spots every week for 20-30 mins, and make a note of the different birds that are present/visit this location. Encourage students to draw the bird if you are not able to identify it, and note down its colour, size and shape and get it identified by an expert at a later stage. Identification of birds is not necessary, but it can help understand species-specific behaviours better.
- Ask students to note the behaviour of the birds- are they calling, eating, preying on other animals, trying to build a nest etc. If possible, record bird calls. If not, ask students to remember and recall any bird calls they hear during the activity during the post-activity discussion session.

- Ask students to fill the observation sheet below every week between June (monsoon) and March (spring/summer). The first row is filled as an example. Add as many more rows as required for every week, or copy this format onto a notebook with a fresh page every week.
- OPTIONAL: You can choose to register on the citizen science portal of eBird (ebird.org/home) to upload bird observation data. eBird also hosts an interactive visualization page (see link below) through which migration and seasonality can be easily tracked .

Observation			
Date: _____		Day: _____	Time: _____
Week: 1			
Weather _____			
S.No	Bird species	Numbers	Behaviours
1	Jungle crow	2	Building nest, feeding chicks

*Make observations for as many week as possible

Discussion

Here are some questions you can ask students during the discussion:

- Are some bird species seen throughout the year? What are these species?
- What birds are seen only during a particular season?
- From the list of birds that visited the school, were any of them migratory? (Make use of the explore page in eBird, to look at the seasonality of birds visiting your area)
- How do seasons occur?
- Why do you think birds migrate? How do birds migrate? Do they travel in one go or make stops? How do they remember their migratory pathways?
- What factors affect the birds making a safe journey during migration. Birds forage a lot during the migratory season, what happens if they do not find enough food?
- How does the timing of seasons affect the food availability for birds? What will happen if the seasons change and become longer/shorter/more unpredictable?

Resources

Click the links to open the resource below

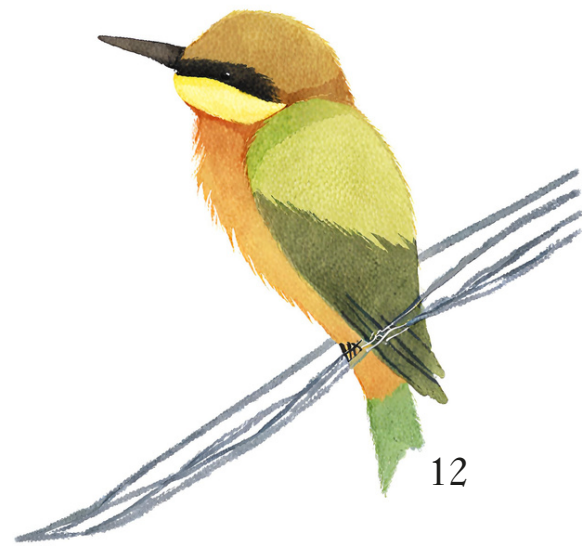
- [Early Bird](#) contains wonderful resources to introduce children to birds including pocket guides, games, posters, interactive multimedia and activities
- [Climate change and bird migration](#)

Local & Cultural references

Bird Migration in Ancient Tamil Verses

[M. Amirthalingam's research on Birds in Tamil literature.](#)

Do you know of any poems or folk songs that talk about birds?



Nesting behaviour of birds

Overview

In this exercise, students will observe a bird's nesting site, its geographical location, the materials utilised for nest construction, the timing involved in nest building, and the seasonal aspects of nesting behaviour. Through group discussion, students will gain insight into the potential impacts of climate change on bird nesting behaviours.

Learning Objective:

Observe the different materials, locations and seasonality of bird nests

Detailed Activity:

Activity 1

- Begin by giving students examples of different kinds of bird nests. Freely available images can be downloaded from the internet and shown to students.
- On a weekend, ask students to list down the nests they observe around their home. Nests could be in tree tops, under window slabs, in a shrub, hanging on the twigs, a folded leaf or even on the ground depending on the species.
- Ask students to use a paper/notebook to mark the locations of bird nests that they spot and create a map of nest locations around their homes.
- From a safe distance, ask them to observe and note the type of materials used in the making of the nest (twigs, leaf, straw, sponge like soft materials) and fill the observation sheet below. The first row is filled in as an example



Class/Grade

6-8

Activity

Outdoor (on a weekend)

Indoor (1 class hour for discussion)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

Field guides, pencil/pen, notebook, binoculars (if available)

Notes to teachers

Some birds might perceive our presence near the nest as a threat, and could abandon or relocate their nesting site. Therefore, it's advised for students to avoid approaching close to the nests and to keep a safe distance from nesting areas.

Curricular links

NCERT

- Class 7, Social studies –Our home, social studies

Observation sheet

Date: _____ Day: _____ Time: _____ Weather: _____

SNo	Nest	Twigs	Leaves	Straw	Man-made materials	others
1	Crow nest	yes	no	no	Cloth, wire, aluminium hanger	Fluffy seeds

Resources

Click the links to open the resource below

- [How birds defend their nests](#)
- [Nest building in a changing climate](#)

Activity 2

- If your students find a bird actively building a nest in their locality, (eg tailor bird, woodpeckers, coppersmith barbets, bulbuls etc), they can be encouraged to monitor bird behaviour whenever possible. Especially, observation on how long it takes to build the nest, whether it is done in pairs or by the male/female bird individually, where the birds are sourcing the raw material etc.

Discussion

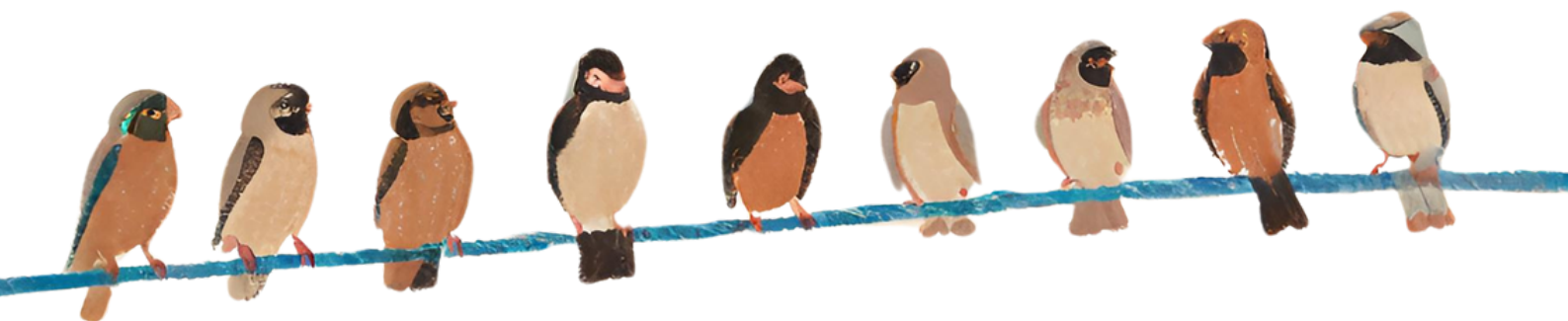
Here are some questions you can ask students during the discussion:

- Why do different birds have different ways of building nests?
- How do birds collect different materials for the nest?
- What techniques do birds use to protect their nests from predators?
- What factors could affect bird nests and successful fledging?

- What happens when there is unseasonal weather like extremely heavy rainfall or wind and how does it affect the nests or bird chicks?
- What will happen if the timing of nesting does not match with the availability of food (like insects, fruits and nectar)?
- What can cause lots of birds to nest in a small area? How will it affect the birds?

Local & Cultural references

Read about Nyishi tribe and their quest to save the hornbills





Trees through the seasons

Trees play a crucial role in the ecosystem, with their most captivating feature being their transformation throughout the seasons. While some trees undergo seasonal changes, others, like evergreen trees, maintain their appearance year-round. The study of the seasonal cycle of change in trees, including leaf flushing, flowering, and fruiting, is known as phenology.

Understanding the impact of climate change on tree phenology is vital, as it can have impacts on other organisms. Changes in tree phenology can disrupt affect organisms like pollinators, whose life cycles depend on the timing of tree flowering. What animals visit a tree in any season will depend on what services a tree is providing animals at that time. One can expect different kinds of animal visitors to a tree in different seasons.

The following activity can supplementing curricular teaching on parts of a plant, plant animal interaction, habitats, food web and seasonality. This outdoor learning activity will enable children to connect with the nature around them and make make scientific enquiry about climate change



Visitors to a tree

Overview

Students will engage in observing trees and the organisms that frequent them. Students will try to observe how certain organisms rely on specific phenological aspects of a tree and understand plant-animal interaction

Learning Objective:

Documenting seasonal changes in trees and the seasonal relationship between trees and other organisms

Detailed Activity:

- Select one or more trees from the SeasonWatch list of species that are found in your school campus. Register the tree(s) with SeasonWatch. Assign 2-5 students to monitor each tree.
- Ask students to visit their tree every week and make observations on leaf, flower, fruit quantity on trees using the SeasonWatch app or observation sheets. As and when possible, the data on the observation sheets should be uploaded on the project website
- In a separate notebook, ask students to note down the date, and make a list of all animals that they can see on the tree (this includes insects, birds, reptiles, and mammals). These observations should be made on the same day as the tree observations.
- Against each animal, ask students to note what the animal was doing – perching, running up and down, building a nest etc. Cattle or goats grazing under the tree or feeding on the fruits from the tree can also be recorded. Ask students to pay special attention to the relationship between animal behaviour and tree phases – leaves, flowers, and fruits, and record these.

Class/Grade

6-9

Activity

Outdoor (20 min-once a week)

Indoor (1 class hour for discussion)

Period of Activity

Can be a year round activity

Place

Any part of the country

Materials Needed

A smart phone with the SeasonWatch app or an observation sheet, note book, pen or pencils, binoculars (if available)

Notes to teachers

Introduce the class to SeasonWatch and talk about the importance of observing seasonal variations in trees.

Curricular links

NCERT

- Class 12 Biology, Chapter 9 Strategies for enhancement in food production



Resources

Click the links to open the resource below

- seasonwatch.in
- [Why trees are essential for Animal habitats](#)

- If possible, animals can be identified with the help of an expert or field guides, but this is not important. Ask students to give their own names for the animals they observe.
- At the end of 1 year, ask the groups to make a presentation (a video, journal, play, essay) on their tree specifically highlighting seasonal changes on the tree and in the animals that use the tree. Conduct a Q/A session with discussion suggestions given below

Discussion

Here are some questions you could ask students during the discussion:

- Which animals visited your tree and why do you think they had to visit the tree?
- Are leaves of trees important for animals? how does seasonal falling of leaves affect animals?
- How does a tree benefit from its visitors?
- What will happen to leaves, flowers and fruits on a tree if the summer season becomes hotter or less rain falls during the monsoon?
- During the flowering season, if there is unseasonal that affects the fruiting of the tree leading to low yields, how will it affect the animal visitors to your tree?
- If the tree lacks the necessary resources (fruits/flowers/leaves), do visiting animals have alternative options?
- Do you think animals will fight for food and space when there are only a few good trees in a given area?

Local & Cultural references

Jackfruit is a large edible fruit that is used in sweet dishes when it is ripe in south India, while it is used only in the unripe form in pickles or cooked like a vegetable in north India.

Can you think of any tree that has a special place in your culture?

Invasive Plants

An invasive species is a non-native organism (plant, animal, or microorganism) that has been introduced to an ecosystem, typically by human activities, and has the potential to cause harm to the environment, economy, or human health. These species often outcompete native species for resources, disrupt ecological balance, and can lead to significant ecological and economic damage. Some of the most common invasive species on the planet belong to the plant kingdom, and it is very likely that there are multiple invasive plants in your school and locality, especially in urban areas.

Climate change is likely to exacerbate the impacts of invasive plants on native species and ecosystems. With warming temperatures, some invasive species will be able to spread to newer regions which were previously too cold for them. Some invasive plants benefit from warmer temperatures and grow more vigorously, outcompeting native vegetation that are less tolerant to changing temperatures. Invasive plants can have significant economic and ecological costs, including reduced agricultural productivity, degraded ecosystem services, and loss of biodiversity.

Teachers can use this activity to supplement curricular topics on habitat loss, climate change, seed dispersal, farming practices, interdependence of species.. Students will learn to recognise invasive plants and identify problems associated with invasive species.





Invasive plants

Overview

In this activity, students will learn to identify invasive plants from their surroundings. They will observe and document the characteristics of both invasive and native plants and discuss the implications climate change may have on the further spread of invasive species

Learning Objective:

Identify and document invasive plant species in your locality and learn their impact on local biodiversity and climate change.

Detailed Activity:

- Explore information regarding invasive plants present in your region using the provided link (<http://nbaindia.org/uploaded/pdf/laslist.pdf>). You can also look at the book 'Guests who never left' which describes some common invasive plants of Peninsular India. Try identifying specific invasive plants located near your school premises and designate a plot for conducting taking students outside the activity.
- Choose a site close to your school, maybe an empty plot or a stretch of area next to the road, that has overgrown vegetation and contains some invasive plants. This will be where you take your students for field observation of invasive plants
- In the class, introduce students to invasive plants—explaining their origin and why they are labelled 'invasive'.
- Show the students photographs of invasive plants found in your locality (the species provided in the list below are likely to be found in nearly all habitats). Find out if they are familiar with any of the plants/can identify them/ know where they grow and know their local names.

Class/Grade

6-12

Activity

Outdoor (Half a day)
Indoor (2 class hours for discussion)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

Note book, A4 size sheet,
pen/pencil , colours

Curricular links

NCERT

- Class 12, Biology-
Chapter 15 Biodiversity
and Conservation
 - Class 12, Ecology-
Chapter 10 Organisms
and Population
- Resources

©Juan Carlos Fonseca Mata



Lantana camara

©ShahadatHossain



Chromolaena odorata

©Jegadeeswaran Natarajan



Parthenium hysterophorus

©Renjusplace



Mikania micrantha (wet-region invasive)

©Juan Carlos Fonseca Mata



Water Hyacinth

©Selva Ganesh



Prosopis juliflora

©Dhinesh Valke



Ageratina adenophora

©Dhinesh Valke



Senna tora

©Vinayaraj



Xanthium strumarium

- Take your students to the study plot and show them the different plants growing there. Together try to distinguish between the invasive plants and other native plants. If unable to identify certain plants, collect samples or take photographs for later identification with the assistance of a plant enthusiast. It is not mandatory to identify every plant, the aim of this exercise is to illustrate to students the widespread distribution of invasive plants in our landscape.
- Count the number of invasive plants in each plot, if difficult, assess the spread of each type of invasive plant (as percentage) on the study plot and note it in the observation table.
- Observe the characteristics of the plants, such as leaf type, presence of thorns, whether they are creepers or shrubs. Note the kind of flowers, fruits, and seeds produced by these plants, and look for undergrowth below these plants.
- Ask students to create a map showing the location and size of invasive plants in the plot, similar to the example provided below
- After returning to class, facilitate a discussion among students about invasive plants.

Observation sheet

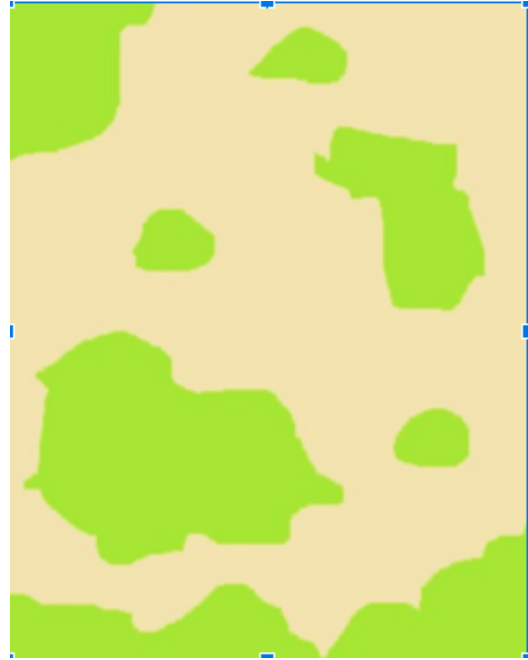
Date: - _____

S.No	Species	No of plants/Perc entage	Characteristics
1	Prosopis juliflora	30	Thorny, seed pods - yellow in colour
2.	Parthenium	50	Flowers are white, star shaped, no thorns , grows in open areas
3	Other plants	20	

Note any other observation: _____



Invasive species along a stream bed



An example of mapping invasive species in your locality. Green patches are invasive species in the plot

Discussion

Here are some questions you could ask students during the discussion:

- In the plot you observed, how many different invasive plant species did you observe?
- Did you observe any bird/insect/animal visiting or feeding from the invasive plant?
- What percentage of the plot was occupied by invasive plants?
- If they are not native, how did invasive species arrive in the country?
- How are they able to spread so wide to almost all kinds of habitats?
- Why do you think they are able to survive in new environments?
- When one plant species dominates a space and suppresses the growth of other local vegetation, in what way will it affect local biodiversity? - (Talk about how butterflies and moths depend on specific host plants to lay their eggs, and the leaves of the host plants are larval food)
- When some invasive species are able to survive in high temperatures, what do you think global temperature rise could contribute to the spread of invasive species? How will it affect local biodiversity and landscapes in the future?
- What can we do to mitigate the spread of invasive plant species?

Resources

Click the links to open the resource below

- [What are invasive plants](#)
- [Invasive Alien species of India](#)
- [Invasive species, A handbook](#)
- [Guests who never left](#)
- [Invasive species are blooming in India despite climate change](#)
- [Invasive pest fact sheet- Parthenium hysterophorus](#)
- [Invasive pest fact sheet: Lantana camera](#)
- [Invasive plant species threaten 66% of India's natural systems](#)

Local & Cultural references

Click on the link below to know more

In the lean months of the south west monsoon (June–August) in Kerala, the intense downpour kept people indoors and farming activities remained dormant. During this period, meals were simple, with fresh greens from the surroundings and native snails collected from paddy fields were cooked and eaten as a delicacy. Now the fields are infested with the African giant snails (Achatina achatina) which have taken over the land, these snails are not consumable and moreover do not have natural predators. They easily multiply and proliferate during monsoon, leaving a trail of destruction on crops and other native plants

The News Minute, 16 Nov, 2021, [Spotting Giant African Snails everywhere in Chennai post rains? Here's why](#)





Butterfly migration

The migration of milkweed butterflies in Peninsular India, though less studied than the Monarch butterflies of North America, is a fascinating annual event involving around 10 species (mostly Dark Blue tiger and Common crow butterflies). It occurs after monsoonal rains (September-October), with Danaid butterflies moving from the eastern ghats and the plains, towards the western ghats. The reason for this migration remains unclear but is a remarkable spectacle. Climate change threatens this phenomenon by disrupting the timing of seasonal events, potentially affecting the synchronized interaction between plants and butterfly that are crucial for migration.

Teachers can make use of this activity to address topics in their curriculum such as animal movement and migration, life cycle of butterflies and plant- animal interaction. Through this activity students will be able to learn to identify butterflies, make systematic observations and have an outdoor learning experience.

The flight of Tigers and Crows

Overview

In this activity, students will observe the seasonal migration patterns of Danainae butterflies and explore the factors influencing their movement, as well as discuss factors potentially impacting their population.

Learning Objective:

To observe the seasonal migration movement of the Danainae butterflies in Southern India.

Detailed Activity:

- Commence by introducing children to butterfly migration, elucidating the migratory phenomenon of the Monarch butterfly journeying from Canada to Mexico.
- Engage students by questioning whether they have witnessed significant butterfly movements at any juncture.
- Familiarize students with the Danaine butterfly migration in Southern India and exhibit images of the six major species involved in the migration.
- Given the challenge of identifying the six major species in flight, students can categorize them into three groups, which should be recorded on an observation sheet (see next page)
- Designate three locations within the school campus where butterfly movement can be readily observed. Divide students into three groups, assigning each group to a different location.
- Accompany students during the initial observation days. Utilize a compass to ascertain the direction of butterfly movement. Note that in the plains of Tamil Nadu, butterflies are likely to move westward, but this may vary within the Western Ghats region.

Class/Grade

6-12

Activity

Outdoor (3 months)

Indoor (1 class hour)

Period of Activity

September-November

Place

Peninsular India

Materials Needed

Notebook-pen, stop-watch/timer, compass

Curricular links

NCERT

- Class 10, Science, Chapter 15 'Our environment'
- Class 12, Geography, Chapter 2- 'Migration'



Dark blue tiger
Tirumala septentrionis



Blue tiger
Tirumala limniace



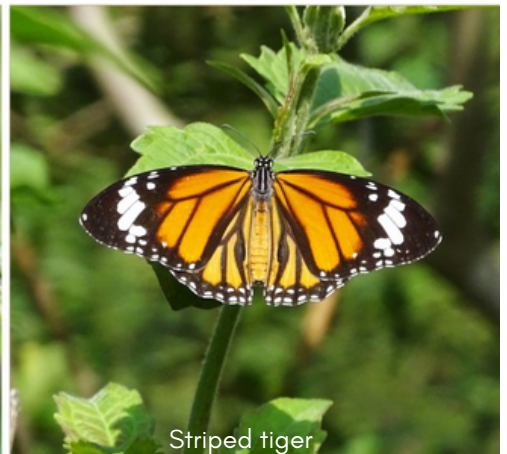
Common crow
Euploea core



Banded crow
Euploea sylvester



Plain tiger
Danaus chrysippus






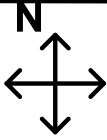
Striped tiger
Danaus genutia

Butterfly species involved in migration (Plate by Vinayan *et al*, 2023)

Observation sheet

Date _____

Time _____

S.No				 Directions
	Blue tiger + Dark blue tiger	(common crow + banded crow)	(Plain + striped tiger)	←.....

Resources

Click the links to open the resource below

- [Watch-How to use a compass?](#)
- More activities on butterflies and climate change are available here: Climate, Biodiversity and People curriculum by Palluyir trust. [Butterfly and climate change module](#)
- [Scientist crack secrets of internal compass of monarch butterflies](#)
- [Butterflies of India: ifoundbutterflies.org](#)

Background information

- Vinayan, P.A., Yathumon, M.A., Sujin, N.S. et al. Pattern and drivers of danaine butterfly migration in Southern India: implications for conservation. J Insect Conserv 27, 505-516 (2023). <https://doi.org/10.1007/s10841-023-00473-z>
- Times of India article, May 27, 2022 [Swarm Song](#)

- Monitor butterfly activity within designated areas measuring 3 x 10 meters, akin to a small 10-meter-long bridge. Encourage students to count the number of butterflies passing through this designated section
- Students can observe flying butterflies during morning break (10-11 am), afternoon break (12-2 pm), and possibly during the evening break (3-5 pm), each session lasting approximately 10-15 minutes.
- Each group will, a) Count and classify butterflies within the designated groups (Blue Tigers, Crows, Danus group (Plain tiger +Stripped tiger)) within the observation plot, b)record the direction of movement.
- At the conclusion of the migratory season, compile the gathered information and transform it into a graph. Plot a graph with the x axis denoting the days of observation and y axis denoting the total number of butterflies observed everyday. Analyze which week had the peak movement of butterflies.

Discussion

Here are some questions you could ask students during the discussion:

- From your observation, at what time of the day did you observe the highest level of activity?
- Among the three groups you observed, which group had the highest number of individuals during the migration?
- Did the butterflies fly close to the ground or high up in the air?
- Did you notice any other butterfly species other than the 6 species?
- Did you observe butterflies perching and feeding on plants?
- What could be the factors that drive butterfly migration?
- What role do plants play in the life cycle and survival of these butterflies?
- What is a host-plant?

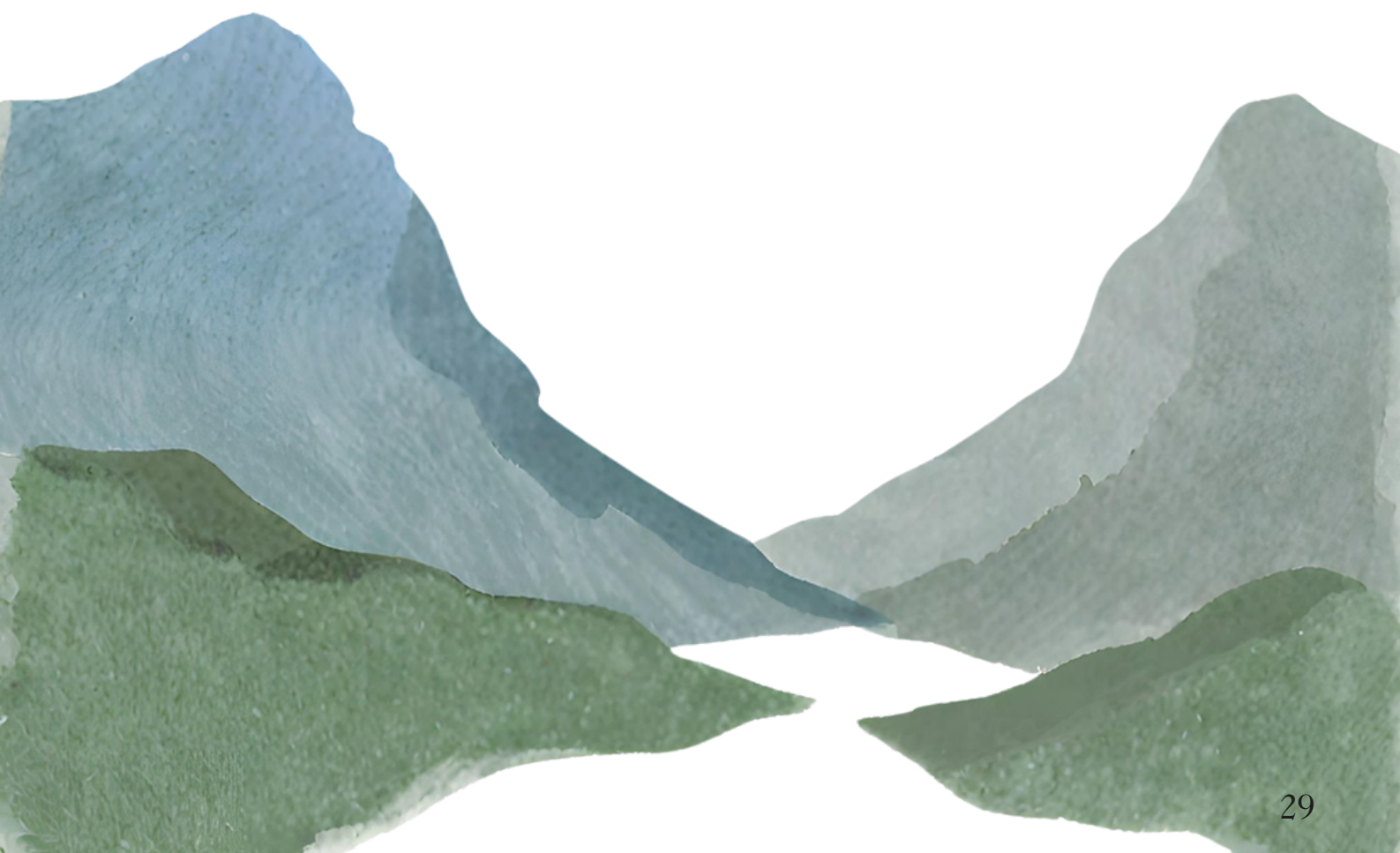
- How might delays in rainfall impact butterflies' ability to locate suitable host plants for egg laying?
- Do you believe invasive plants like *Lantana camara*, which produce abundant flowers, are beneficial for butterflies?
- What measures can be taken to preserve host plants and thereby butterflies?

Local & Cultural references

*In June 1897, in Mumbai, E.H. Aitken observed numerous *Euplaea core* (Common crow butterflies) migrating steadily northwards. Upon questioning the locals, who had witnessed this event previously, they mentioned that rain (SW monsoon) would arrive three days after the butterflies.*

-- Aitken EH (1897) *The migration of butterflies*. *J Bombay Nat Hist Soc* 11:336-337

Find out if locals in your area observed similar movement of butterflies?



Dragonflies and Climate change

Dragonflies are amphibious insects, that need both aquatic and terrestrial ecosystems for their survival hence they are known to be very sensitive to environmental changes and serve as indicators of the health of the habitat. Various species of dragonflies have specific habitat requirements; some prefer forest streams, some rivers, others prefer ponds, lakes, or stagnant road-side pools or even water in a tree hole. Ecologists have found that any changes to these aquatic landscapes can affect dragonfly populations. Climate change is also known to affect dragonfly population by the change in seasonal rain patterns that these dragonflies so depend on. One such seasonal event that occurs every year post south-west monsoon is the emergence of the Wandering glider (*Pantala flavescens*) dragonfly in large numbers and their movement. Not surprisingly, dragonflies are culturally known to be the harbingers of the monsoon. Scientists believe this dragonfly undertakes the longest non-stop migratory route of any insect, from the Indian sub-continent towards the East coast of Africa.

Observing dragonfly swarms offers teachers an opportunity to integrate curricular topics such as predator-prey interactions, food chains, wetland ecosystems, and the impact of pollution on insect populations. Engaging in this outdoor learning experience allows students not only to collect data but also to witness this annual phenomenon, which might otherwise go unnoticed.



Spot the wanderer



Class/Grade

8–10

Activity

Outdoor (2 months)

Indoor (1 class hour for discussion)

Period of Activity

August–November

Place

Any part of the country

Materials Needed

Notebook and Pen

Curricular links

NCERT

- Class 10, Science, Chapter 15 Our environment
- NCERT Class 12, Geography, Chapter 2–‘Migration’

Resources

Click the links to open the resource below

- [How the globe skimmer migrates across the Indian ocean](#)
- [Kerala: Tracking the migratory dragonflies](#)
- [Watch: An epic migration driven by water](#)

Background

The migratory phenomenon of *Pantala flavescens* (Wandering glider) from India to East Africa is a remarkable journey spanning thousands of kilometers. These dragonflies undertake this epic migration, crossing oceans and continents, in search of suitable breeding grounds. Their migration is one of the longest non-stop journeys undertaken by any insect species. Scientists speculate that favorable winds aid their journey, allowing them to cover vast distances.

Overview

In this outdoor activity, students will learn to identify *Pantala flavescens* dragonflies and observe their swarming behavior. They'll record observations of habitat preferences, such as perching locations and water bodies, noting behaviors like rapid flight movements and territorial interactions. Through hands-on observation and data collection, they'll gain insights into the migratory phenomenon of *Pantala flavescens*.

Learning Objective:

Document and observe the seasonal swarm and behaviour of a non-charismatic animal Wandering glider (*Pantala flavescens*) dragonfly and understanding and its role in the ecosystem through discussion

Detailed Activity:

- Begin this activity prior to the onset of the south-west monsoon, emphasizing the seasonal aspect of the dragonfly's life cycle, which is reliant on water availability.
- Introduce students to the identification of the dragonfly species *Pantala flavescens* (commonly called Wandering glider). Show students pictures of the dragonfly and inquire if they have spotted this dragonfly at any point of time before.

- Discuss the amphibious nature of dragonflies, highlighting that eggs and larvae inhabit water while adults exist as terrestrial organisms. Talk about the behavior of these dragonflies which appear in swarms in large numbers in the months from August–November.

Observations

- Ask students to observe individual dragonflies or swarms– count the number of individuals(if possible), recording their locations (e.g., tree tops, ground level) at any time of day and record them in a notebook.
- Encourage students to commence observations from August (or upon the appearance of Pantala dragonflies in their region).
- Instruct students to document behavioral observations such as rapid flight movements, feeding, egg-laying, perching on electric lines and territorial behaviors (fighting with other dragonflies to maintain its territory).
- Ask students to notice how these dragonflies prey on mosquitoes in the early morning and evenings using rapid flight movements. Also ask students to note down if they observe any birds or animals that predate dragonflies during this period.
- Encourage students to estimate the height of the swarm from the ground (e.g., 2–5 m, 5–10 m, or higher).
- Make a note of the weather conditions– such as sunny, cloudy, overcast, rainy on every observation day.
- Allow students to continue observing dragonfly swarms until the end of November or until they perceive a significant reduction in swarm counts.

Consolidation and interpretation

- Instruct students to consolidate their observations
- Collaborate with students to identify the week(s) exhibiting peak swarm abundance.
- Encourage students to come and talk about some of the behavior of the wandering gliders that they observed in this period in the classroom.

Wandering glider dragonfly swarm observed in Karaivetti Bird Sanctuary, Ariyalur district, Tamil Nadu on November 4th, 2014.
Photo by P.Jeganathan



Discussion

Here are some questions you could ask students during the discussion:

- What was the largest swarm count you observed?
- Where did you most often find dragonfly swarms?
- Did you notice them preying on other insects?
- Did you notice dragonflies flying close to the ground or very high in the air?
- How are they able to stay in flight for a long time?
- What caused such a huge number of dragonflies to emerge?
- Where are the dragonflies migrating? How do you think they will be able to travel so far?
- If the monsoonal rains were poor, how do you think it will affect the wandering gliders?
- How do dragonflies control mosquitoes? What will happen to humans if all dragonflies disappear?
- Discuss how dragonflies are sensitive to temperature and water quality, indicating the overall health of the habitat

Local & Cultural references

In Tamil Nadu, there's a popular saying that goes 'Thattan thala paranthal thappathu mazhai', meaning when a dragonfly flies close to the ground, then rain is imminent'

Are there any folk songs, proverbs or cultural references for dragonflies you know of from your region ?



Termite swarms

Have you noticed clouds of winged insects emerging from the ground just before it starts raining? These are a swarming, social, colony-building insects called termites. The emergence of termite swarms varies depending on factors like climate, species, and local environmental conditions. Different termite species show variations in emergence based on their biology and ecology. In many areas, swarms coincide with warmer temperatures and increased daylight. In tropical regions with wet and dry seasons, swarms may coincide with the onset of rains (that creates optimal soil moisture conditions), boosting termite activity and colony expansion. Urban areas may experience indoor swarms year-round due to controlled temperatures, while outdoor swarms follow natural seasonal patterns. Termites are ectothermic organisms - their activity and development are influenced by the external temperature. Climate change, and rise in global mean temperatures can potentially alter the timing of their emergence. Given their crucial role in ecosystem processes like decomposition and nutrient cycling, climate-induced changes in termite behavior can disrupt ecosystem functions, impacting plant communities, soil health, and ecosystem services.



A monsoon feast

Overview

In this activity students observe a termite swarm, noting the diversity of birds, bats, and other animals attracted to it. Through careful observation, they note feeding behaviors, interspecies interactions, and the understand the impact of rainfall on termite emergence. This hands-on experience enhances their understanding of species interactions and underscores the need for specific environmental cues for termite emergence.

Learning Objective:

To list down the species that feed on termites when they emerge as a swarm and Observe the feeding behavior of each species

Detailed Activity:

- Commence the session by discussing with students the role of termites in ecosystems and their significance, especially in light of environmental changes.
- Instruct students to locate a newly formed termite swarm and guide them to sit at a safe distance to observe the ground.
- Ask students to note down the different types and number of birds, bats, reptiles or other animals that come close to the swarm emergence sight .
- Prompt students to observe whether the birds gather termites from the ground or in flight. Students are not required to identify birds by their names, they can note down the features of the bird, its colours and size in their notebook.

Class/Grade

6-9

Activity

Outdoor &
Indoor (1 class hours)

Period of Activity

During/After the rains

Place

Any part of the country

Materials Needed

Pen/pencil and note book

Notes to teachers

Introduce students to this activity before the rainy season, encourage them to make observations, whenever this event occurs.

Curricular links

NCERT

- Class 10, Science, Chapter 15
Our environment
- NCERT Class 12, Geography,
Chapter 2- 'Migration'

Resources

Click the links to open the resource below

- [An observation of fauna feeding on termite alates in the tropical rainforest](#)

- Direct students to observe the behavior of each species during the swarm, particularly noting any competition or conflicts among the birds and other animals that arise.
- Ask students to make note of the weather conditions that existed before and after the swarms
- Ask them to note how long the feeding frenzy lasted and list down the species observed.

Discussion

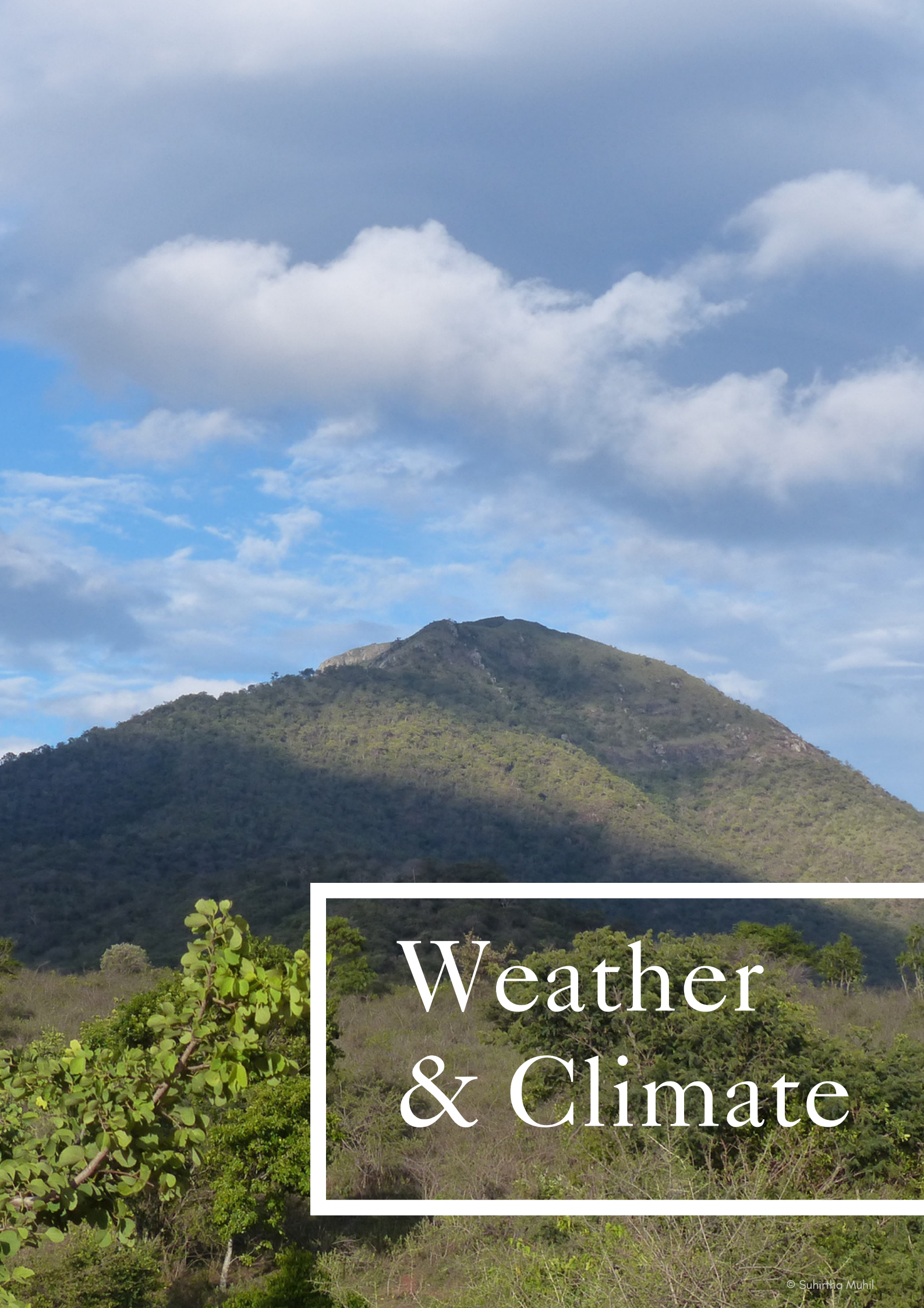
Here are some questions you could ask students during the discussion:

- When and which season have you mostly seen termites swarms?
- What are alates?
- How does the emergence of alates during high humid weather or after the rains help termites? (helps in colonisation, termite reproduction and colony formation)
- Discuss the life cycle of termites and if all types of termites within a colony swarm?
- Inquire to students why do some frugivore/granivorous birds also consume termites occasionally?
- Termites are most active in hot and humid weather. With rising temperature what do you think would happen to termite colonies?
- Do you think unseasonal rains can affect termite nestings?
- How could spread of termites affect human settlements?

Local & Cultural references

Click on the links to know more

Read about: [Goa's monsoon tales of mushrooms on termite hills](#)



Weather & Climate

Weather plays a crucial role in our daily existence. Every aspect of life, from agricultural practices, to migratory patterns of birds, to the seasonal blooming of trees, all life forms are intricately linked to the fluctuations in weather. However, climate change has disrupted many of these familiar patterns that humans and other organisms have relied upon for centuries. Unprecedented levels of rainfall and temperature extremes have become increasingly common occurrences.

Understanding the local weather patterns is essential, not only for human activities but also for the diverse biodiversity that depends on these patterns for survival. Moreover, cultural festivals and traditions often revolve around seasonal changes, further emphasizing the significance of this natural rhythm.

Teaching about weather, seasons, and extreme weather events benefits educators by providing real-world examples that enhance classroom learning. It fosters student engagement through hands-on activities, and encourages interdisciplinary learning across subjects like science, geography, and mathematics.



Documenting your local climate

Background

Climate is the long-term weather pattern of a region. Depending on where you are in India, you may experience different weather at the same time of the year (north Indians may call March 'spring time', while south Indians will call it 'summer').

Sometimes within a geographical region too, a particular location may have a different weather pattern than its surrounding areas which could be due to the elevation, local vegetation, and geography to name a few. Understanding your locality's climate will also help us understand how living beings cope with the changing environment. This activity helps document what elders in the community understand about local climate through their own observation

Overview

Students will record the local climate of their area by interviewing community elders, observe and explore how the microclimate impacts the region's biodiversity, culture, and overall climate.

Learning Objective:

Document the microclimate of your area, its effect on local biodiversity and significance in local traditions and customs through investigation

Detailed Activity:

- Divide the class into five groups.
- Give one chart paper to each group. This will be a 'Seasonality Chart' Ask each group to draw a line with different months of the year marked on it (see image below).
- Ask students to note down what their perception of seasons is across different months. E.g., monsoon in July, summer in May etc. (see image by the end of the activity).

Class/Grade

6-11

Activity

Outdoor &
Indoor (1 class hours)

Period of Activity

A Rainy day

Place

Any part of the country

Materials Needed

Chart, pencils, colour pens
and pencils, scissors, glue,
cellotape, papers/notebooks

Notes to teachers

The calendar created for this activity can be re-used and linked with other activities in this handbook

Curricular links

NCERT

- Class 7, Science, Chapter 16- 'Water a precious resource'
- Class 9, Social Science, Chapter 3- 'Drainage'
- Class 10- Geography contemporary India- 'Water resources'

- Together with students, create a list of 10 questions that can be asked to local elders which can help understand the local climate (see sample interview).
- Ask each group to pose these questions to a total of 1-3 elders (grandparents, parents, neighbours) outside of school hours within a two week time frame
- Each group can now collate and depict the answers to their questions as illustrations, poems, anecdotes, or stories on their seasonality chart.
- Ideally the timing of seasonal patterns like onset of rain, pre-monsoon showers, windy months, fruiting/flowering in plants, seasonal festivals and cultural practices, local farming practices, should emerge as observations on the chart
- Once the chart is complete, spend one class hour discussing the seasonality charts (reference questions provided below)
- Display the seasonality chart prominently on the classroom bulletin board and motivate students to continuously contribute by noting observations and marking each seasonal occurrence that corresponds with the events depicted on the chart.
- By the end of the year, summarise the major points from the seasonality charts
- Together list down the biodiversity they think is dependent on the a particular season and habitat, based on their survey of elders
- List down human livelihoods that are season-dependent

Some sample questions to ask elders

- How long have you lived here?
- How many seasons are there in a year in your village/town/city?
- List down the period in a year when it rains?
- The general direction of clouds when it rains?
- Is the timing of rains/summer/spring this year different from what you remember from your childhood?
- What cultural or religious festivals coincide with rain/summer/spring?
- Why do we celebrate these festivals at this time?
- What are some special foods in any particular season?
- Do you think these food habits have changed now, and how?
- How do you know that the season has changed?
- What changes do you see in trees with the seasons?
- What changes do you see in birds with the seasons?
- Do different animals behave differently in different seasons?

Resources

Click the links to open the resource below

- [For a similar activity on understanding ground water and water usage please look at this article by Kavita Krishna](#)
 - [Nature classroom's water module](#)
 - [Some traditional water management practices in India:](#)
 - [How a 15th century water system in Bidar could quench its thirst during drought.](#)
- Were there any traditional methods or techniques employed in your region for water conservation?
 - Have you encountered situations resembling drought? If so, how did you navigate through those challenging circumstances?
 - In your experience, what were the primary areas of water usage within the community?
 - How was water utilized for agricultural irrigation, including the utilization of wells, canals, or rainfall?
 - Have you observed changes in local weather patterns and rainfall over the years?
 - What are the merits and drawbacks you perceive with the present water management practices?
 - Which practices from traditional water management systems do you believe should be upheld or reintroduced?

Discussion

Here are some questions you could ask students during the discussion:

- From your conversation with elders, do you think water was available in your town/village/city throughout the year? Were there periods of scarcity?
- Are there still any water management practices mentioned by the elders that you still follow?
- In your opinion, what are some pressing climate-related threats to water resources in your area?
- How might the strain in water resources affect the communities around?
- What are some of the traditional water management practices that can be implemented today to mitigate climate change related pressure on water resources?
- What additional daily practices can contribute to the conservation of water resources?

Local & Cultural references

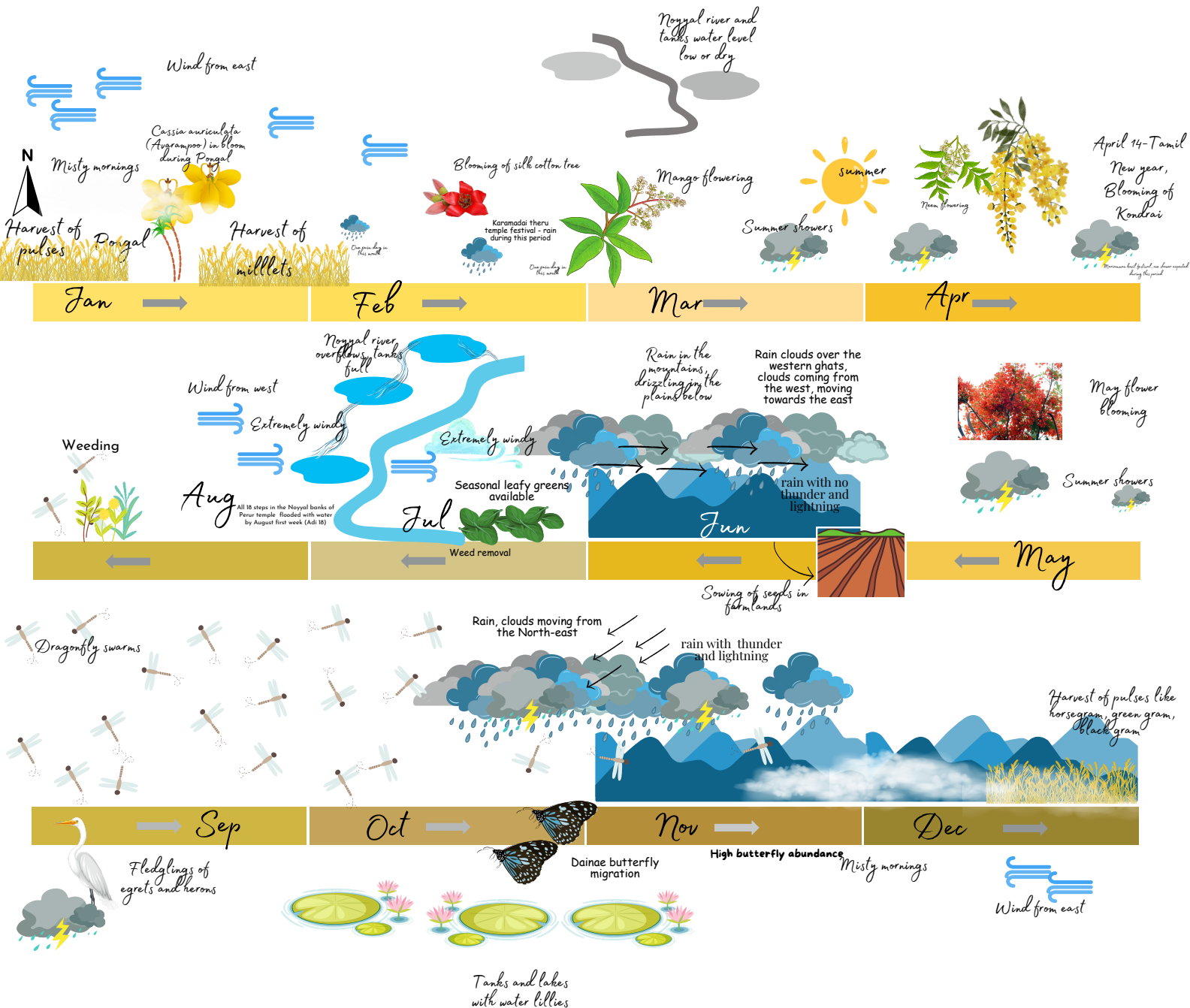
Click on the links to know more

- *There is name for a peculiar kind of thunder that occurs in the month of July in Kerala, called the 'Koon idi' or 'Kumi idi', meaning the thunder which causes mushrooms to sprout. Read more about it [here](#)*
- *Check out these [Ovi songs from Maharashtra](#) that celebrate the Pre-monsoon showers.*

Do you have any songs or quotes that capture the essence of the seasons in your area?



Sample recording of local climate and its associated seasonal events from the westernmost part of Coimbatore
(by interviewing community members and making your own observations)





Monitoring Daily Weather

Background

Weather monitoring plays a crucial role in our daily lives and in understanding long-term climate patterns. It provides valuable data that helps us predict short-term weather conditions and track long-term climate changes. Having a weather monitoring station within your location is essential because it provides localized and accurate data, we can better understand weather patterns and make informed decisions (e.g in agriculture, construction), and even mitigate the impacts of extreme weather events (disaster preparedness). Through this activity students will have hands-on experience in using equipments and collecting data. This activity also integrates topics from science, maths, geography and technology.

Overview

In this activity, students will engage in daily weather monitoring, documenting temperature, rainfall, humidity, cloud cover, and wind speed. Through analysis of the collected data, they will gain insights into seasonal weather fluctuations

Learning Objective:

Observe and comprehend seasonal variations in weather parameters

Detailed Activity:

Begin by discussing the importance of weather monitoring and how it helps us predict weather in the immediate future, as well as climate change far into the future. Talk to students about the nearest weather monitoring station in your region and the importance of having one within your location.

Class/Grade

7-11

Activity

Outdoor (15 min/day)

Indoor (2 class hours)

Period of Activity

Can be a year round activity

Place

Any part of the country

Materials Needed

Room thermometer,
Hygrometer, Rain gauge,
Anemometer, Wind Vane,
Types of cloud chart and
Oktas scale (Details on
materials and links for DIY
given inside)

Curricular links

NCERT

- Class 11, Geography Chapter 10, Atmospheric circulations and weather systems
- Class 11, Practicals in Geography, Weather Instruments, maps and charts



1. Understanding weather parameters

Introduce students to various weather parameters. Explain their measurement techniques, and its units of measurement to the class.

- Temperature (Min/Max)- °C, °F
- Relative humidity- (Explain the difference between absolute humidity (g/m³) and relative humidity(%))
- Cloud cover (Oktas measuring scale) and types of cloud
- Rainfall (mm/cm/inches)
- Wind speed (km/hr) - how to build an anemometer and calculate the wind speed and wind direction (by using a wind vane or other techniques)

2. Divide the class into five groups. Assign each group one of the following weather parameters to monitor. Rotate groups periodically to monitor different parameters throughout the observation period. Students are expected to collect data daily, excluding weekends and holidays.

3. Data collections

- Temperature: Utilize a wall thermometer or digital thermometer positioned within the school, away from direct sunlight or sources of heat and accessible for students to take regular readings. Demonstrate to students how to interpret the displayed temperature. Instruct them to record both the minimum and maximum temperatures consistently at 8:30 am and 2:00 pm daily.
- Relative humidity: Utilize a hygrometer from the science lab or a digital hygrometer accompanying a digital thermometer. Instruct students to record relative humidity at 8:30 am and 2:00 pm consistently each day. Explain the inverse relationship between relative humidity and temperature: as temperature rises, relative humidity decreases, and vice versa.

Resources

Click the links to open the resource below

- [Oktas cloud cover scale](#)
- [Ten main types of cloud chart](#)
- Watch and learn about [Ten main types of cloud chart](#)
- [Make your own rain gauge](#)
- [Watch: How to make your own anemometer](#)
- [Watch: How to make a wind vane](#)
- [Watch: How to make a wind vane](#)
- [How to identify wind directions](#)
- [A wonderful interactive portal for visualizing weather and other climatic information:](#)
- [These school children in India are learning to read the weather](#)

- Cloud cover : Encourage students to observe the clouds consistently at the same time every day, perhaps during their lunch break or interval, to monitor both cloud cover and cloud type. Provide them with printouts of the [oktas scale](#) and [types of clouds chart](#).
- Rainfall : [Make your own rain gauge](#) along with the students. Choose a place that is suitable for placing the rain gauge in the school. It should be placed in an open area away from obstacles such as buildings or trees that could block rain. Make sure it doesn't tip over or be blown over by the wind. Measurements must be taken every next day following rain at 8:30 am. Using a ruler students should measure the depth of water and note it down. Students should empty the rain gauge after every measurement and keep it ready for the next rainfall.
- Windspeed: Together with the students build an [anemometer](#). Once ready, trial it out outdoors, count the number of rotations of the cups per minute using a stopwatch. Once back in class, calculate the wind speed using the formula

$$\text{Wind speed} = \frac{\text{Circumference of the cup (cm)}}{\text{X rotations per minute}}$$

For example an anemometer with cups of radius 5 cm, rotates 30 time within a minute. Let's calculate the wind speed.

$$\text{Circumference of the cup (cm)} \times \text{rotations per minute}$$

$$2 \pi r \times 30$$

$$= 2 (3.14) \times 5 \times 30 = 942 \text{ cm/minute}$$

$$[1 \text{ km} = 100000 \text{ cm}], [1 \text{ hr} = 60 \text{ min}]$$

$$942 / 100000 = 0.009 \text{ km/minute}$$

Converting minutes to hour

$$0.009 \times 60 = 0.54 \text{ km/hr}$$

$$\text{Wind speed} = 0.54 \text{ km/hr}$$

- Wind direction : Along with the students, build a wind vane to identify the direction of wind, you can show some other techniques to identify the wind direction to the students. If using a wind vane, try it out in an open spot in your school grounds where wind is not obstructed. Ensure correct orientation by marking the ground with a north-facing indicator, guiding students to position the wind vane accordingly.

4. Monitor the weather across the months.

5. Data analyses

Along with the students, put together the collated data and observe any emerging trends and patterns from the weather data collected

Temperature

- Using a graph sheet plot daily minimum and maximum temperatures across the year to identify seasonal trends(x axis – dates, y axis– temperature) , Calculate average temperatures for each month and compare them over the observation period.

Relative humidity (RH)

- Similarly graph daily relative humidity readings to observe fluctuations over time.
- Analyze correlations between relative humidity and temperature variations by comparing the graphs of the minimum, maximum temperature graphs and the RH graph

Cloud cover and types

- Record daily cloud cover observations and categorize them based on the Oktas scale.
- Determine the frequency of different cloud types and their impact on weather conditions.

Rainfall

- Summarize daily rainfall measurements to identify rainy periods or dry spells. Calculate monthly or seasonal rainfall averages to assess precipitation patterns.

Wind Speed and Direction:

- Graph wind speed data to visualize variations in wind intensity.
- Analyze wind direction data to identify prevailing wind patterns and changes over time.

6. Visualize long term weather patterns in your region (or close to your region) using this https://cdsp.imdpune.gov.in/home_riturang_sn.php. Find out if it matches with what you have observed in your city/town/village over the one year period.

Discussion

Here are some questions you could ask students during the discussion:

- What are the seasons you experience in your town/village?
- Which period is the most windy period in your town?
- How often do you see cumulonimbus clouds in your town?
- How long does the rainy season last in your town/city/village?
- Which month recorded the highest maximum temperature ?
- Do you notice a fluctuation in weather patterns across the months? Why do you think they change? Why do seasons change?
- During this period have you noticed how changing seasons affect life cycles of plants and animals?
- What was the most challenging part of doing this activity?
- Did you record temperature/rainfall patterns that were known to be abnormally high or low according to your teachers or elders in your community?
- How can a change in the seasonal cycle, such as unanticipated torrential rain or exceptionally high temperatures, affect your local area?

Local & Cultural references

In Kerala, there's a popular saying: "Atham Karuthal, Onam velukkum," which means "If it rains on Atham day, Onam day will be bright and clear." Atham typically occurs in mid-August, ten days prior to Onam.

Do you have similar quotes on seasons and months in your place?





Extreme weather events and anomalies

Background

Extreme weather events and weather anomalies are a meteorological phenomenon that deviates significantly from the typical weather patterns in a particular region. Examples of these events include unusually high or low temperatures, intense rainfall, flooding, drought, heat waves, strong winds and more. Although extreme weather events have happened all through earth's history, climate change exacerbates and increases the frequency, intensity, and duration of extreme weather events. Through this activity students will learn what kind of extreme weather events are likely to occur in a region and underscore the importance of data in offering insights into climate trends, enabling informed interpretations, and guiding decision-making processes.

Overview

In this activity students will explore freely available long-term data and data-visualizations to understand local extreme weather patterns

Learning Objective:

Exploring extreme weather events and unusual weather patterns in a given area

Detailed Activity:

- Before the class activity, please take some time to explore the data visualization pages linked below.
- Begin the discussion by explaining to students the concepts of extreme weather event and weather anomalies

Class/Grade

9-12

Activity

Indoor (2 class hours)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

a computer, internet connection, projector in the classroom (if available)

Curricular links

NCERT

- Class 11, Geography Chapter 10, Atmospheric circulations and weather systems

Resources

Click the links to open the resource below

- Climate data portal service:
<https://cdsp.imdpune.gov.in/>
- Across India, minimum temperature are rising far more than maximum

Glossary

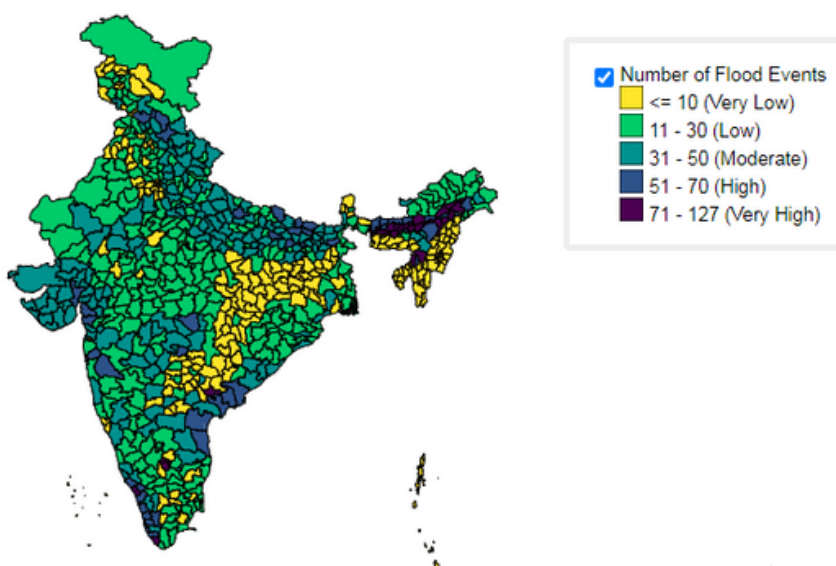
Extreme weather events refer to severe and uncommon weather phenomena that significantly deviate from the average weather conditions in a particular area. These events include cyclones, thunderstorms, heatwaves, droughts, and cold waves.

A **weather anomaly** measures how different the current weather pattern is compared to the average pattern over many years. It helps in identifying unusual weather patterns over long time scales, usually decades.

Climate hazard vulnerability

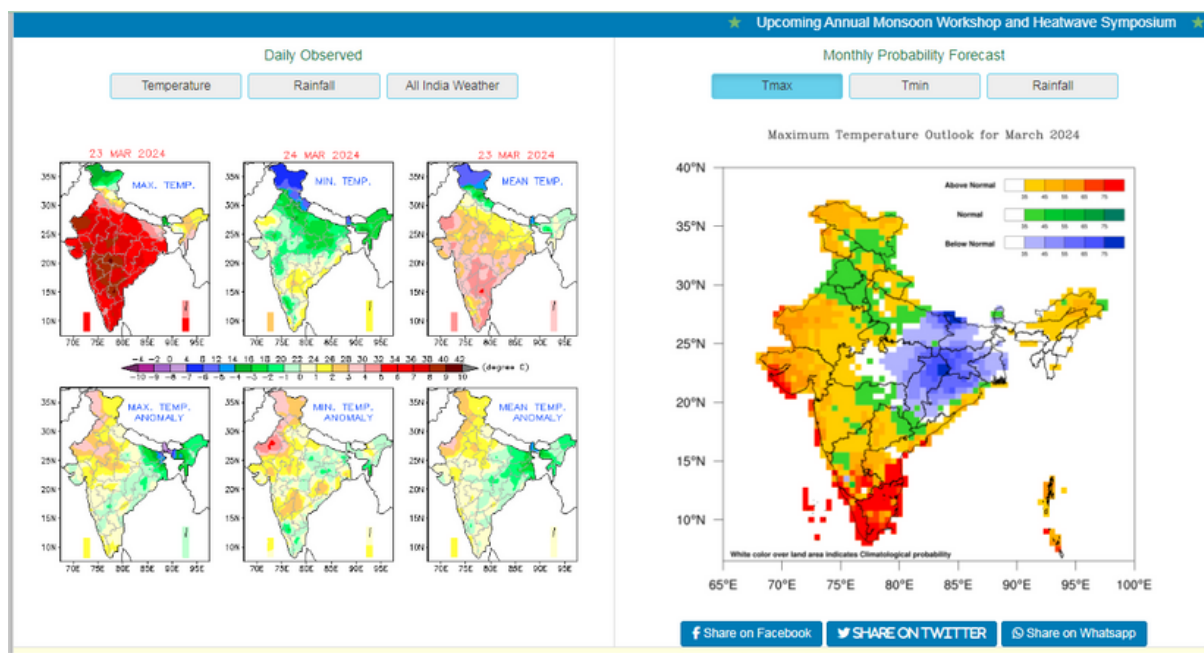
- Visit the climate hazard vulnerability atlas (<https://imdpune.gov.in/hazardatlas/index.html>) and project the interactive screen in your classroom
- Select the weather events given in the page (like Cyclone, thunderstorm, heat wave, drought, cold wave)
- From the India map, find out what is the severity zone of your district
- Use the side tab to visualize annual or monthly weather events
- From the visualisation, infer what extreme weather event is likely to occur in your area district.
- Inquire to students if they have experienced any such event in recent times.

**Total Number of Flood Events
During the Period from 1969 to 2019**



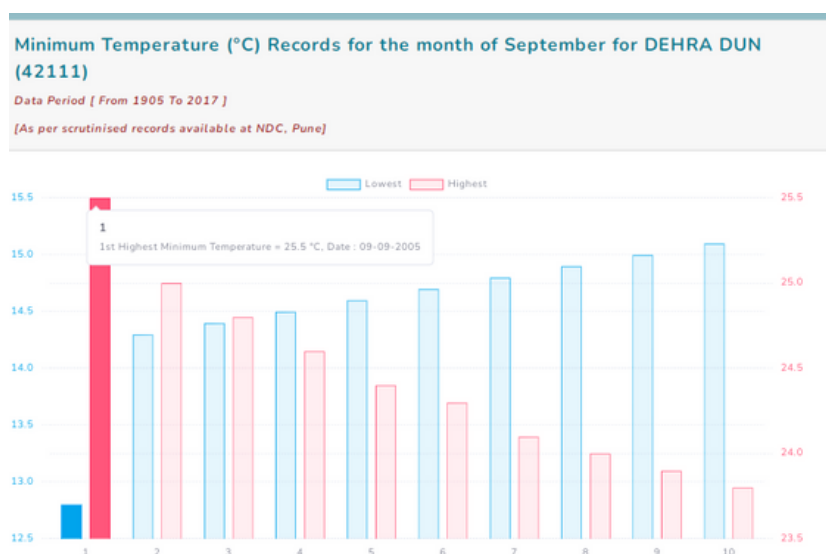
Weather anomalies:

- You can look at monthly anomalies of temperature and rainfall from this all India chart (<https://www.imdpune.gov.in/index.php>).
- Identify the specific area (region/district) on the all India map that students need to focus on.
- Using the colour scale provided in the chart, inquire students if their region falls in the normal, above normal or below normal category of weather anomaly.



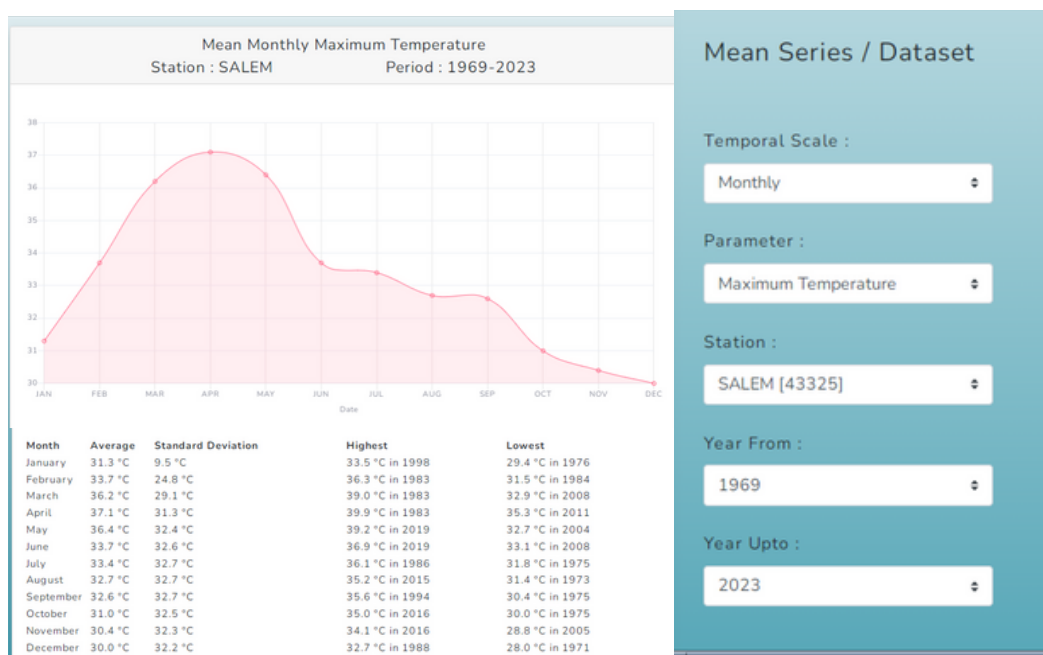
Extreme weather events

- Visualize the ten extreme rainfall and temperature events that have occurred on a particular month over the years in your region, by selecting the district and month on this page. https://cdsp.imdpune.gov.in/home_lab_2.php#extremes



- Additionally, observe the general trend of temperature and rainfall in your region since records are available. You can look at the highest and lowest monthly recordings for each parameter throughout the years.

https://cdsp.imdpune.gov.in/home_riturang_sn.php#snormals



Discussion

Here are some questions you could ask students during the discussion:

- What kinds of extreme weather events is your area prone to according to the climate hazard vulnerability atlas? Have you faced any such extreme event lately?
- Does the highest record of maximum temperature fall in the recent couple of years?
- Does the highest record of minimum temperature in your region fall in recent years?
- Looking at the weather anomaly chart, is rainfall above or below normal this year in your region?
- What causes an extreme weather event?
- How do you think we should be prepared to face such events?
- What type of precautions are taken by your state to prepare for extreme weather events?
- Are extreme weather events preventable? What do you think can reduce the frequency of such events?

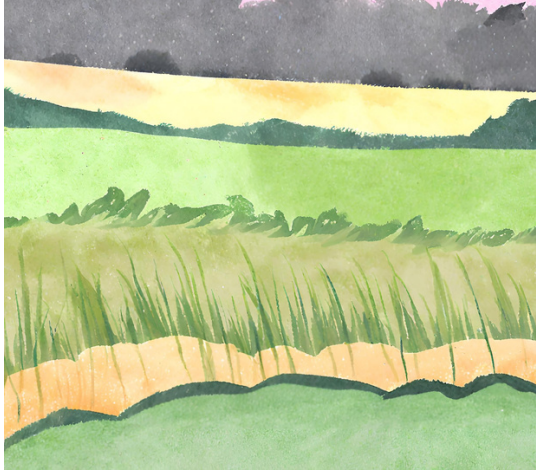
Local & Cultural references

Click on the links to know more

Read

- *How extreme heat affected this farming community in Bihar in 2023.*
Extreme weather plays havoc with Magahi paan
- *How torrential rain affected this region in Madhya Pradesh* *Our village was under water for three days*





Tracking rising temperature

Overview

Students will utilize an open-access weather dataset to generate a graphical representation illustrating the increase in average temperatures across India in comparison to historical averages.

Learning Objective:

Observing and recognising a trend in rising average temperature across India

Detailed Activity:

- Visit the data.gov.in portal to obtain the mean temperature data of the country for the years 1901-2021. Similarly there are datasets with minimum, maximum temperatures along with seasonal and annual data
- Follow the step by step process given in the next page for downloading data
- Explore this page before introducing to students.
- In the class, provide each student with a graph sheet
- Begin by explaining to the students the concept of maximum and minimum temperature

Class/Grade

8-12

Activity

Indoor (2 class hours)

Period of Activity

Anytime of the year

Place

Any part of the country

Materials Needed

Graph sheet, scale and pencil

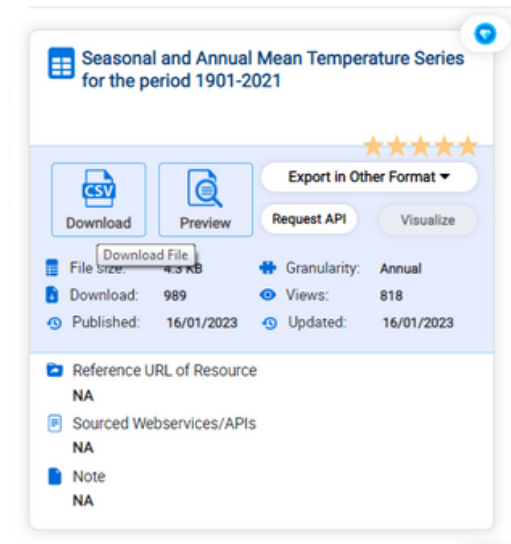
Curricular links

NCERT

- Class 11, Geography Chapter 10, Atmospheric circulations and weather systems

Maximum temperature refers to the highest temperature recorded within a specific period, while **minimum temperature** refers to the lowest temperature recorded within the same period. The **mean annual temperature** can be defined as the approximate average/mean of the maximum and minimum temperatures of the hottest and the coldest months of the year

- Visit the data.gov.in website, to download the all India mean temperature data, click on this link
- From the many data sets , scroll down and select the 'Seasonal and annual mean temperature series'.
- Click 'download CSV file'



Download Purpose

Kindly state your purpose of downloading this resource.

Usage Type *

☐ Commercial ☒ Non Commercial

Purpose *

☒ Academia ☐ R&D
☐ Business ☐ Journalistic
☐ Govt Use ☐ Other

Name E-mail Address

Which code is in this image? *

The fields marked with * are mandatory

Download

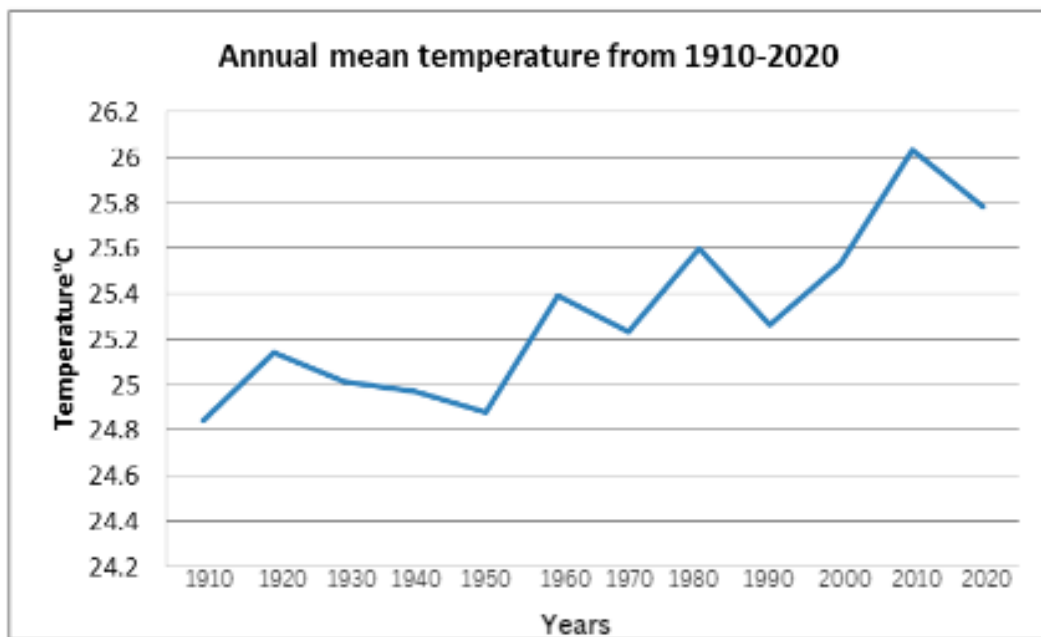
- Provide your necessary credential as shown in the image on the left and download the file.
- You should be able to get an excel sheet as shown in the image below, with annual and seasonal mean temperature data from 1901-2021

TEMP_ANNUAL_SEASONAL_MEAN (3) - Microsoft Excel (Product Ac									
File Home Insert Page Layout Formulas Data Review View Add-Ins									
Clipboard Font Alignment Number Conditional Formatting									
A1 YEAR									
	A	B	C	D	E	F	G	H	I
1	YEAR	ANNUAL	JAN-FEB	MAR-MAY	JUN-SEP	OCT-DEC			
2	1901	25.42	20.11	27.64	28.16	23.1			
3	1902	25.42	20.88	27.96	27.98	22.51			
4	1903	25.01	19.99	27.02	28	22.33			
5	1904	24.93	19.76	27.23	27.57	22.56			
6	1905	24.84	18.36	26.38	28.2	23.13			
7	1906	25.18	19.75	27.39	27.78	23.11			
8	1907	25.02	20.51	26.53	27.74	22.88			
9	1908	25	20.12	27.53	27.65	22.21			
10	1909	24.96	20.08	27.14	27.32	22.9			
11	1910	24.84	20.24	27.29	27.44	22.01			
12	1911	25.08	20.34	26.95	27.83	22.72			
13	1912	25.2	20.89	27.31	27.88	22.39			
14	1913	24.95	20.28	27.01	27.57	22.5			
15	1914	25.07	20.51	26.92	27.71	22.75			
16	1915	25.44	20.09	27.45	28.33	23.14			
17	1916	25.08	20.2	27.86	27.5	22.34			
18	1917	24.54	20.16	26.16	27.3	22.14			
19	1918	24.96	19.75	26.82	27.78	22.81			
20	1919	25.15	20.48	27.33	27.7	22.71			
21	1920	25.14	20.24	26.91	27.8	23.09			
22	1921	25.45	20.87	28.46	27.69	22.5			
23	1922	25.18	20.53	27.88	27.6	22.33			

- Choose ten values from the Excel sheet distributed evenly across each decade
- Make use of these data points to plot the graph in the class
- Inform students that you are going to plot temperatures from several decades in a graph sheet.
- Begin by explaining to the students the concept of maximum and minimum temperature.

Plotting Data Points

- Ask students to draw an X-axis and Y-axis on their graph sheet.
- The X-axis should represent the years (1910, 1920, 1930, ..., 2020).
- The Y-axis should represent the temperature, ranging from 26°C to 32°C
- Ask students to plot each data point corresponding to the year on their graph sheet.
- The plotted graph should show a trend in temperature rise as shown below



Interpreting Temperature Trends:

- Ask students to observe and interpret the graph
- Inquire about the year from which they have observed a steady rise in temperature.

Resources

Click the links to open the resource below

- [The 1.5C threshold explained](#)
- <https://data.gov.in/catalog/all-india-seasonal-and-annual-temperature-series>

Discussion

Here are some questions you could ask students during the discussion:

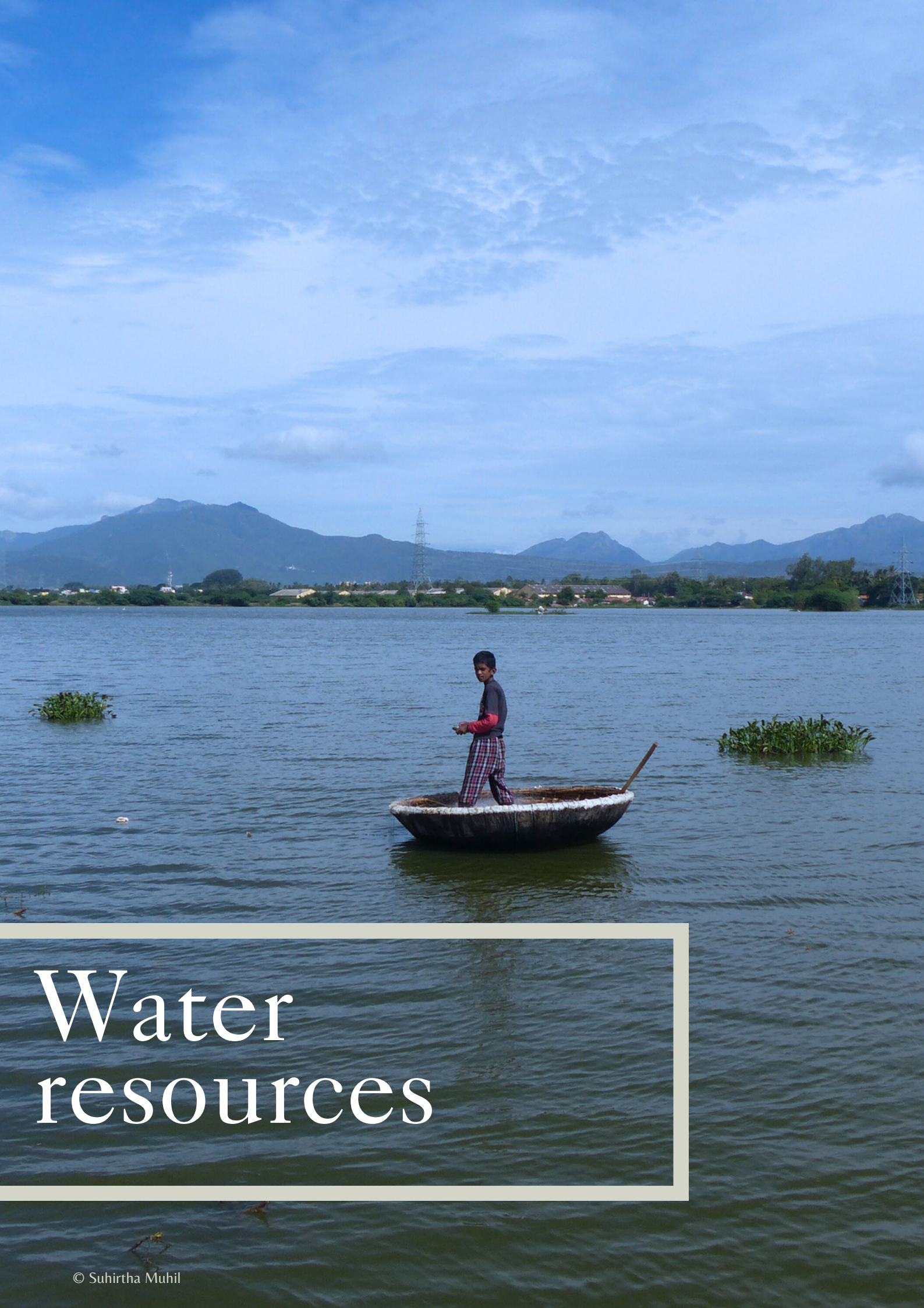
- From the graph you can observe that the temperature has risen 1 degree celsius. Why is it a cause of concern?
- How can 1 or 1.5 degree celsius affect human population and biodiversity?
- What could be the primary factors contributing to the increase in temperature?
- Have you noticed any increase in temperature compared to when you were younger?
- What are the individual and collective measures required to mitigate greenhouse gas emissions?

Local & Cultural references

Click on the links to know more

The Cassia fistula flowers are an integral component of Vishu celebrations in Kerala, which occur in mid-April. Historically, these trees have had their peak blooming period around the Vishu festival for centuries. Nowadays, the flowering of these trees tends to occur earlier, with some trees blooming throughout the year. Scientist attribute this to changing climate. Similar instances of change in Mango flowering and Cherry flower flowering in Japan have been attributed to climate change

- [The Case of the Confusing Kanikonna Trees](#)
- [Where have all the Vishu Kanikonna's gone?](#)



Water resources

Water and climate change are inherently interconnected. The impacts of climate change on water resources manifest through events like floods, droughts, torrential rains, storms, and the melting of glaciers. These changes significantly influence water cycles and disrupt access to water resources. Both surface water and groundwater play pivotal roles for living organisms, and also forming integral components of the hydrological cycle. Unfortunately, both surface water and groundwater resources face overexploitation, pollution-induced contamination, depletion from excessive pumping, and susceptibility to other impacts of climate change. Traditional water management practices, often aimed at conserving and utilising water optimally, can provide valuable lessons for addressing contemporary water challenges.

Teachers can leverage these activities to enhance understanding of spatial distribution of water through mapping, explore various types of local water bodies, explore biodiversity and insect life cycles, and examine weather and water management practices. This outdoor learning experience enables students to engage actively with a contemporary environmental issue by observing, monitoring, and working collaboratively in groups, especially through interviewing adults, offering them a holistic understanding of the intricate relationship between water and climate change.



Mapping water bodies

Overview

Students will identify water bodies in their surroundings, analyze their features, record the environment, and produce labeled maps. They will also participate in conversations with the teacher regarding the possible impacts of climate change on these water bodies.

Learning Objective

Learn to identify, observe and create a map of water bodies in their neighborhood

Detailed Activity

1. Introduction to water bodies

- Ask students about the various types of water bodies they have encountered.
- Use the blackboard to categorize them. For example: River, lakes, streams, ponds will fall under surface water bodies; Farm wells and water from underground borewells will fall under ground water.
- Introduce the concept of how surface water bodies and groundwater are interlinked. Explain how the surface waterbody replenishes underground aquifers. And underground aquifers sometimes feed into surface water bodies.

2. Documenting personal experience

- Prompt students to reflect on their own experiences with water bodies
- Ask them if they have encountered any water bodies during their daily commute to school or around their neighborhood.
- Document students' responses on the blackboard.

Class/Grade

6-10

Activity

Outdoor &
Indoor (2 class hours)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

Chart/ paper, color
pens/pencils/watercolors

Notes to teachers

Students should be cautioned against approaching water bodies without the presence of adult supervision.

Curricular links

NCERT

- Class 7, Science, Chapter 16- 'Water a precious resource'
- Class 9, Social Science, Chapter 3- 'Drainage'
- Class 10- Geography contemporary India- 'Water resources'



- Encourage them to describe the routes to nearby water bodies, roads, structures, or common landmarks (such as the lake near the city center, the river beneath the XYZ bridge, the pond by the school, the lake close to the town bus stop, the substantial well on a farm).
- Utilize the students' inputs to sketch a map of the local water bodies on the blackboard.
- Remember to include legends and symbols where needed and provide instructions on the map.

3. Individual mapping exercise

- Ask students to participate in a similar mapping exercise individually. Using a chart or A4 sheet task them with creating a visual representation of the water bodies they have encountered close to their home
- Give students a few days to prepare their maps and get them ready.
- Following completion, let students present their maps, with relevant information about the waterbody. Each student should explain their map, highlighting the water bodies they have marked and providing any relevant information about the legends and symbols in their map.

Discussion

Here are some questions you can ask students during the discussion:

- How will severe drought affect the water bodies near you?
- If there is a sudden spurt of very heavy rainfall, will the water bodies near your area be able to hold the water? Can soil and vegetation absorb such a copious amount of water (More on soil erosion activity)
- When water is not absorbed by vegetation and soil, it leads to pollutants to be carried into water bodies. Inquire what kind of pollutants from the soil can be carried off through soil runoff (fertilizers, pesticides etc)

Resources

Click the links to open the resource below

- [How climate change impacts water access](#)
- Watch this [short film](#) on the Mekong river and the accumulative effects of climate change and hydropower dams on the river and the communities dependent on them:
- Make use of Google earth, to showcase different landforms and water bodies:
<https://www.google.com/earth/>.

Glossary

- **Surface water** refers to any water found on the Earth's surface, such as rivers, lakes, streams, ponds, and oceans.
- **Groundwater** is water located under the Earth's surface in soil, sand, and rocks, filling pores and crevices to form aquifers.
- **Aquifers** are underground layers of permeable rock, sediment, or soil that hold and transmit groundwater. They serve as natural reservoirs that store and supply groundwater to wells, springs, rivers, and other surface water bodies.

- How is it going to affect us? (polluted waterways) How will it affect farmers/fishermen in your area?
- How lack of rainfall or increased rainfall can alter the quality of surface water and ground water?
- Is groundwater an everlasting source of water?
- What happens when the salt water from the sea enters groundwater aquifers?

Local & Cultural references

In Tamil Nadu, over the centuries water bodies have been classified into 46 different types according to their usage and characteristics. Here are a few examples 'Kaataru'- meaning forest stream where flash floods can occur, 'Odai' - a stream that arises from a spring, 'Oorani' a pond/lake that is used only for drinking purposes, and 'Eri' or 'Kamvai' which means a large tank used for irrigation. Do you have any local names for water bodies like the ones above in your region?

Make a note of different local names that are related to water bodies



Seasonality of waterbodies

Overview

Students will investigate how water bodies experience seasonal fluctuations based on water availability. Throughout this dynamic period, biodiversity in these water bodies changes in response to the availability of water. Students will observe and track weather, water levels, aquatic vegetation, bird populations, and other insect activity at various times of the year.

Learning Objective

Observe seasonal shifts in waterbodies and its associated biodiversity

Detailed Activity

1. Select a waterbody in close proximity to your school, that is safe and accessible for frequent observations. This could encompass various types of waterbodies such as streams, rivulets, rivers, ponds, lakes, or even wells. Most inland water bodies are seasonal (with a period of high and lows), yet some wetlands are perineal. You can choose waterbodies that are convenient to monitor.
2. Inform the class about the monthly field trips, dividing them into four to five groups. Each group will be tasked with monitoring different parameters during the visits. These parameters may include weather and water level, bird life, insects and other animals, and vegetation.
3. Conduct visits to the chosen site once a month, with students spending a minimum of 30 to 45 minutes at the water body between 8:00 am and 4:00 pm.
4. Opt for either stationary observations from a fixed location near the water body or employ a transect method, establishing a small stretch of line spanning a few meters (approximately 200–500m) along the water's edge.

Class/Grade

8–12

Activity

Outdoor (30 min once a month)
Indoor– 1 class hour

Period of Activity

Can be a year round activity

Place

Any part of the country

Materials Needed

Field guides, pencil/pen, notebook, binoculars (if available), printed observation sheets, room thermometer

Notes to teachers

- For field visits obtain necessary permissions from parents and local authorities
- Students should be cautioned against approaching waterbodies without adult supervision

5. Monitoring Weather and Water Levels:

- Assign a group to document field weather conditions such as sunny, cloudy, overcast, or windy and temperature. Temperature can be measured using a weather app or you can use a room thermometer from your school's science lab.
- Assist students in identifying a permanent structure near the water body for assessing water levels. For instance, if monitoring a lake- identify a tree, rock, or edge of the road as reference points. Describe the water level in relation to these markers, like "water level is three meters below the road" or "water level covering the base of the tree with only 10 meters of the tree visible on top." For streams or rivers, estimate the width and flow of water (See observation sheet provided at the end of this activity)

6. Bird and other animals Observation:

Task one group of students with observing birds and documenting their behavior. While precise species identification is not necessary, students should note the bird characteristics such as color, size, and behavior. Record whether the bird was solitary or in a group, its position near the water body. Make a note of any other animals you observe (See observation sheet provided at the end of this activity)

7. Insect Monitoring:

Another group of students can monitor the presence of aquatic insects like dragonflies, damselflies near the water body and water striders and water beetles inside the water body noting their colors and behavior observed. Additionally also make note of butterflies, grasshoppers, bees close to the waterbody if any. (See observation sheet at the end of this activity)

8. Vegetation

Allocate a separate group to assess the proportion of shrubs, grasses, and trees bordering the water body. Record the percentage of floating aquatic vegetation and document any flowering plants, including drawings and descriptions of observed flowers. If there are trees closeby, you can monitor the seasonality of trees through SeasonWatch.

9. Fishes

If there is a fishing community near your water body, find out from them what kind of fishes grow in the waters. Find out if they are exotic or native variety of fishes? What methods are used for fishing? Do they have lean months during fish breeding season?

10. Looking at data

Once the data is collated, assist the students in identifying patterns between different parameters and seasonal fluctuations. For example, you can examine if the water level has remained constant throughout the observation period, did you notice a corresponding change in biodiversity?

Curricular links

NCERT

- Class 7, Science, Chapter 16- 'Water a precious resource'
- Class 9, Social Science, Chapter 3- 'Drainage'
- Class 10- Geography contemporary India- 'Water resources'
- Class 10- Science, Chapter 15- Our Environment
- Class 12, Biology, Ecology, Chapter 14- Ecosystem

Resources

Click the links to open the resource below

- [Wetlands and climate change](#)
- [What are wetlands and why are they so critical to life on earth](#)
- [Ephemeral ponds and wetlands](#)

Mini Activity (for class 5-7)

Ask students to observe a small puddle in the school grounds after a bout of rain. Mark the edge of the puddle with chalk powder, visit the puddle after 2 hours and observe if the puddle has receded further and mark the edge with chalk powder again. Discuss where the water goes?

Discussion

Here are some questions you could ask students during the discussion:

- Have you determined whether the water body you've been monitoring is influenced by seasonal fluctuations or maintains a constant flow throughout the year?
- Across your observations, have you detected any noticeable shifts in biodiversity corresponding to different times of the year?
- If the waterbody unexpectedly dries up, when it is expected to be abundant with water, what repercussions might this have on aquatic life and surrounding biodiversity?
- In what ways could unanticipated rainfall disrupt the usual ecological balance and biodiversity of the area?
- In what ways could unanticipated rainfall disrupt the usual ecological balance and biodiversity of the area?
- What impacts would the local communities experience if the water bodies undergo changes that deviate from their expected seasonal patterns? How will it affect their livelihoods?
- How can we take action to reduce the harmful effects of climate change on waterbodies and the ecosystems they support?

Local & Cultural references

A small river known as Noyyal meanders through the city of Coimbatore. Despite much of Coimbatore being situated in a rain shadow region, this river receives replenishment during the southwest monsoon from the mountains of the Western Ghats, filling its streams, tanks, and river. Consequently, by the end of June, these water bodies flourish with vitality despite the scarcity of rainfall. In August, the locals commemorate the 'Aadi Perukku' festival, a celebration marked by the overflowing waters of the Noyyal's banks, where locals worship their ancestors near the river bank.. As November draws to a close, the water gradually recedes, and by March, the tanks and streams run dry, only to commence the cycle anew by June.

Are there any waterbodies associated with festivities or cultural significance in your region?

Weather and Water monitoring observation sheet

Date_____

Time_____





Weather

- Temperature_____ (note from room temperature/ weather app)
- Is it ☐ Sunny ☐ Partially cloudy ☐ Cloudy ☐ Overcast
- Did it rain in the last week ____ Yes/No. If yes, was it ☐ Heavy
☐ Moderate
☐ Scanty





Water

- Water level_____ (rough estimate of depth from the nearest reference point)
- Flow speed of stream/river_____(Rapid/fast/slow/still)
- Percentage of rock or boulders you see exposed in the water body _____

Observation sheet for aquatic insects

Tick if you find these aquatic insects during your visit. Add any additional characteristics or behaviour that you observe	Dragonfly (near water and vegetations close by)	Damselfly (near water and vegetations close by)	Water strider (in water)	Water beetles (in water)
Date				
--/--/--				
--/--/--				
--/--/--				
--/--/--				
--/--/--				
--/--/--				
--/--/--				
--/--/--				
--/--/--				
--/--/--				
--/--/--				

Observation sheet for terrestrial insects

Tick if you find these aquatic insects during your visit. Add any additional characteristics or behaviour that you observe	Butterfly	Grasshopper	Cricket	Bees	Other
Date					
--/--/--					
--/--/--					
--/--/--					
--/--/--					
--/--/--					
--/--/--					
--/--/--					
--/--/--					
--/--/--					
--/--/--					

Observation sheet for birds

Date _____

Time _____

Bird (draw the bird if unable to identify)	Behaviour	Location at the site



Traditional water management systems

Overview

In this activity, students will interview elders on traditional water management practices. This activity can provide valuable insights on past traditional practices and present challenges and lessons on local ecological history.

Learning Objective:

Documenting and understanding traditional water management practices that were used in the past

Detailed Activity

The set of questions provided below can serve as a starting point but feel free to tailor them to the specific context and culture of the elders students may speak with.

- From where did you obtain your drinking water?
- Prior to the availability of household water pipes, how and from where did you procure water?
- What significance did natural water sources such as streams, rivers, and lakes hold in water management strategies?
- In instances where water was abundant only during specific seasons, what methods did you employ to conserve water for the remainder of the year when resources were scarce?
- Describe the techniques utilized for rainwater collection, including the design of rooftops and housing structures for this purpose.
- Where did you store collected water, and what types of vessels, containers, or tanks were commonly used for storage?

Class/Grade

6-9

Activity

Outdoor + 1 class hour discussion

Period of Activity

Can be a year round activity

Place

Any part of the country

Materials Needed

Pen and notepad for survey

Notes to teachers

Advise students to approach the interviews with sensitivity and consideration, acknowledging the experiences of the individuals they interview.

Curricular links

NCERT

- Class 7, Science, Chapter 16- 'Water a precious resource'
- Class 9, Social Science, Chapter 3- 'Drainage'

Resources

Click the links to open the resource below

- [For a similar activity on understanding ground water and water usage please look at this article by Kavita Krishna](#)
- [Nature classroom's water module](#)
- [Some traditional water management practices in India:](#)
- [How a 15th century water system in Bidar could quench its thirst during drought.](#)

- Were there any traditional methods or techniques employed in your region for water conservation?
- Have you encountered situations resembling drought? If so, how did you navigate through those challenging circumstances?
- In your experience, what were the primary areas of water usage within the community?
- How was water utilized for agricultural irrigation, including the utilization of wells, canals, or rainfall?
- Have you observed changes in local weather patterns and rainfall over the years?
- What are the merits and drawbacks you perceive with the present water management practices?
- Which practices from traditional water management systems do you believe should be upheld or reintroduced?

Discussion

Here are some questions you could ask students during the discussion:

- From your conversation with elders, do you think water was available in your town/village/city throughout the year? Were there periods of scarcity?
- Are there still any water management practices mentioned by the elders that you still follow?
- In your opinion, what are some pressing climate-related threats to water resources in your area?
- How might the strain in water resources affect the communities around?
- What are some of the traditional water management practices that can be implemented today to mitigate climate change related pressure on water resources?
- What additional daily practices can contribute to the conservation of water resources?

Local & Cultural references

In Kadaladi, a small town in the Ramanathapuram district of Tamil Nadu water has always been a luxury and people have always depended on storing and conserving water. This region predominantly receives rain from the North-East Monsoon (Oct-Nov), alternative sources like underground water have been rendered impractical due to the proximity of the sea and its high salt content.

Up until 30-40 years ago, many of the houses in this region had their houses built in a way that conserved water from rainfall. Roof tops were cleaned regularly and rainwater from the roof tops were channeled to a room, that was a few meters deep than the rest of the house (called pallam). Also, rainwater that did not pass through any surface was directly collected in bronze containers. If they passed through any surface, they had to be filtered through a piece of white cloth and kept under the sun. Remarkably, the collected rainwater could last for 6-7 months, remaining clean and potable throughout this period.

Today this region reels under immense water shortage, can practicing this time tested water conservation method be of help now?

Watch : <https://www.thehindu.com/news/national/tamil-nadu/watch-in-this-tamil-nadu-village-fetching-water-is-a-daily-struggle/article67379096.ece>





Food & Climate change

The accessibility of food from distant corners of the world has significantly increased in most Indian cities, introducing fruits and vegetables that were once unfamiliar into our daily diets. While our dietary habits have evolved over time to incorporate diverse food sources, this transformation has come at an environmental cost. Nevertheless, within our traditional food practices, there exist numerous resilient options that can serve as sustainable choices during uncertain times of climate change. Teachers can be aided in their classroom teaching through these activities by talking about agricultural practices, food choices, plant growth, native varieties and fossil fuels. When students learn about traditional food practices, teachers can provide valuable insights to students about the origins of their food, fostering an understanding of the community's culinary heritage. This approach not only enhances awareness about sustainable food choices but also encourages a connection to local traditions and agriculture, making students more conscious consumers in the face of environmental challenges.



Forgotten foods

Class/Grade

6-9

Activity

Indoor (2 class hours)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

Notebooks, pencil/pen

Curricular links

NCERT

- Class 6, Science, chapter 2 - 'Components of food'
- Class 9, Economics, Chapter 4- 'Food security in India'
- Class 9, Agriculture, Chapter 15- 'Improvement in food resources'

Overview

In this activity, students conduct interviews with individuals from various age groups to document some lesser known foods and explore how food habits have evolved over time. Together with their teacher, students will analyze whether certain food practices could offer a more sustainable approach amidst the challenges of climate change.

Learning Objective:

Document lesser known foods and understand that food and food habits of humans change over time

Detailed Activity:

- Ask students to collect information on the food items that are no longer eaten in your household/community by interviewing at least 3 adults at home or nearby with the questionnaire given in the next page
- Once the students return with the survey, allow students to discuss among themselves, especially what they feel has changed in the present day. Group the students based on the age of the interviewees (e.g. 30-40, 40-50, 50 and above), ask them to discuss their findings. Encourage them to identify any similarities in food preferences both among and within the different age groups.
- Together with the students, review the article provided in the resource section that can highlight some key points for discussing the results of the survey

Questionnaire

Date:_____ Time: _____ Location: _____

Name of adult:_____

- Which year were you born?
 - What food do you eat everyday - name 5-10 dishes that you regularly eat?
 - List down food items/dishes that you ate as a child/young person but are no longer available or cooked in households
- _____
- Why do you think these food items are no longer cooked/available?
 - Which of the listed food items are seasonal? What were the seasons in which you ate these dishes?
 - Do you think it was easier to grow/collect/procure these foods before? Yes/No
 - What are the local names for the plant/fish/animal varieties that were consumed earlier but are not available now?
 - Which of the dishes listed under question 3 were prepared during cultural festivals or celebrations? Note the name and timing of these festivals if possible.
 - Did unusual weather/climate affect the availability of some foods? What alternatives were consumed when these foods were missing?
 - What do you think about the nutritional quality of your present diet?
 - Would you like to switch back to eating some of your old favourite foods more regularly?

Discussion

Here are some questions you can ask students during the discussion:

- Have a discussion with students on why some food items/varieties are no longer available?
- Discuss what could be the factors for their unavailability like- Unfavourable weather conditions, change in cropping patterns, green revolution, invasive species, change in living lifestyle etc.
- Discuss the diversity of food items, specific to your locality. Discuss how some foods are available based on the landscape and favorable climatic conditions of a particular place.
- Ask students if they think previous food habits were more resilient and adaptable to extreme weather conditions
- Could some of these dishes be a more reliable source of food in a changing climate?

Resources

Click the links to open the resource below

- [A village nurtures traditional food systems in response to climate change](#)
- [Climate change impacts Assam's cuisine and culture](#)
- [Songs of survival: The cultural memory that kept millets alive](#)

Local & Cultural references

Click the links to open the resource below

Have you heard of tubers that are the size of an average man?

Read about some of the traditional tubers that were part of our diet . [Nature's Hidden treasure](#), Deccan Herald, Jan 2019



Old is gold, cooking challenge

Overview

Students will learn to cook a traditional recipe by gathering information about the recipe, its ingredients and cooking method. They will then discuss the cooking process and the factors that contribute to the limited consumption of these foods in the present.

Learning Objective:

Learning to prepare a traditional recipe and gaining insights into the reasons for its limited consumption in modern times.

Detailed Activity:

- Ask students to find out an old recipe from adults at home that has fallen out of regular consumption. Alternatively, if no such recipe is available, students can craft their own dish utilizing traditional, locally-sourced, and fresh ingredients.
- Request that students prepare the dish with assistance from someone at home and bring it to class.
- Exhibit all food dishes prepared by the students
- Each student can talk about the dish prepared, its nutritional value, where the recipe comes from and any associated history or cultural significance.
- Once the presentations are over, invite the students to share the yummy food with their class and enjoy all dishes

Class/Grade

6-8

Activity

Indoor (Home activity +1 class hour discussion)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

Notebooks, pencil/pen

Notes to teachers

Advise children to get the help of an adult at home before preparing a dish in the kitchen

Curricular links

NCERT

- Class 6, Science, chapter 2 - 'Components of food'



Discussion

Here are some questions you can ask students during the discussion:

- Discuss the experience and preparation that went into cooking these dishes
- How long does the dish take to cook?
- How much water is consumed in making the food?
- What components of the recipe are seasonal?
- Can the seasonal ingredients be cultivated/foraged/harvested/caught from the backyard?
- As human use of spaces changes or as landscape altered, what will happen to these ingredients?

Local & Cultural references

Click the links to open the resource below

*Baromashi- Bengali-
Aaj amader aaj amader/
Shapla phool bhaja/
Roshun diye moja.../
Ilsha maachh phalsha diye/
Methi diye bhejechhi*

Translation : waterlily cooked with garlic; hilsa combined with tart, fleshy sherbet berries and fried with fragrant fenugreek.

(source:

<https://scroll.in/magazine/1058684/bengali-food-is-baked-into-the-lilt-of-its-folk-music>)



Resilient foods- Making choices

Overview

Students will experiment with three species of crops (2 millets and a cereal) to assess their ability to withstand water stress. This activity will enable students to grasp how less water-demanding crops could serve as a solution in a shifting climate.

Learning Objective:

Understanding which crops can withstand water scarcity through experimentation . Documenting variation in water-requirement of different crop plants through experimentation, and inferring crop resilience to extreme climate events such as drought through discussion

Detailed Activity:

- Begin by discussing the importance of water in crop growth and how water requirement varies in different crops.
- Arrange the pots in three rows, each row containing three pots, making a total of 9 pots.
- Prepare the soil, making sure it is aerated and not hard. In the first row of the pots plant 50 seeds of a millet of your choice in every pot (eg Sorghum), mark it as A1,A2,A3.
- Plant 50 seeds of the second species of millet (e.g Finger millet) in every pot of the second row mark the pots as (B1,B2,B3)
- In the third row, plant 50 seeds of seeds of a cereal crop in all three pots mark the pots as C1,C2,C3
- Once all the seeds are planted, add equal amounts of water to all the pots using the measuring jar or a mug which has measurements.

Class/Grade

7-9

Activity

Outdoor (3 months)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

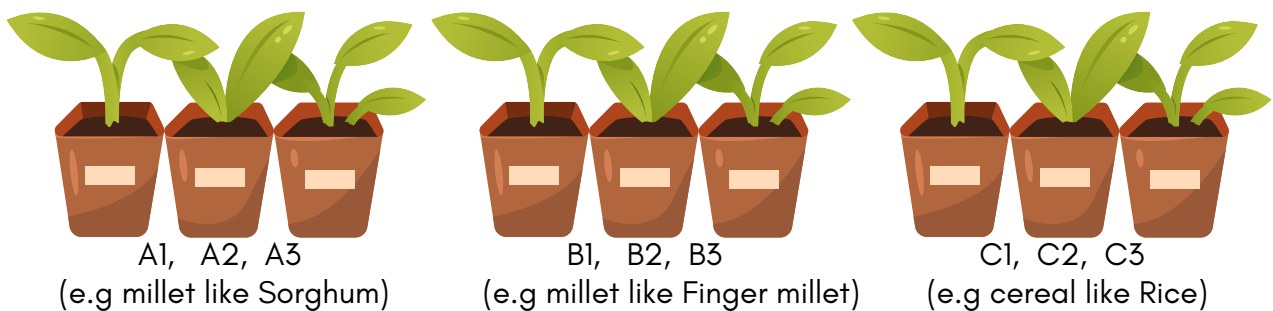
9 earthen pots with soil (taken from the same source, well-aerated),
Seeds of 2 types of millet grown locally, and seeds of a cereal crop like wheat/rice/corn,
Measuring jar/mug

Curricular links

NCERT

- Class 11- Biology, Chapter 7 Structural organization in plants and animals'
- Class 11- Biology, Chapter 15- Plant Growth and Development Class 11- Biology- Chapter 11- Plant Physiology

- Make sure all the pots are placed at a spot where there is adequate sunlight but are not exposed to rainfall (this is to ensure each pot receives only certain amount of water)
- To the pots A1,B1,C1, after first day of watering, water the plants every 5 days
- To the pots A2,B2,C2, after first day of watering, water the plants only every 10 days
- To the pots A3,B3,C3,..., water the plants only every 15 days
- Observe the number of plants that germinate in every pot, and measure the height of each plant every 5 days. Note down the measurements of each potted plant.
- Observe the potted plants for a period of three months from the day of sowing.



A1	B1	C1	Water every 5 days after first watering
A2	B2	C2	Water every 10 days after first watering
A3	B3	C3	Water every 15 days after first watering

Experimental set up of potted plants

Resources

Click the links to open the resource below

- [Six reasons to bring millets to the market](#)
- [The story of millets](#)
- [Sorghum, the right choice- Growth and development](#)

Discussion

Here are some questions you can ask students during the discussion:

- On pots that were watered once in 5 days, which exhibited good plant growth?
- On pots that were watered once in 10 days, which had exhibited plant growth?
- On pots that were watered once in 15 days, which had exhibited plant growth?
- Of the three species in the experiment, which species do you think were able to grow when watered once in 15 days?
- Why do certain crops need more water while others do not?.
- Imagine an extreme weather event like drought, how is it likely to affect your plants in different pots? Which species will likely be able to survive?
- How extreme weather events like drought can pose a threat to some of our major cereal crops like rice/wheat.
- How will drought affect crops in agricultural fields? Imagine the water requirement for such a large area
- Are there any local crop varieties in your region that are adapted to local weather and soil conditions?
- If more water can help plants grow? How events like flooding affect plants?
- If you live near a coastal region, have you heard about saltwater intrusion, how can it affect plant growth?
- How extreme weather events drive fluctuation in the market price of food?



Local & Cultural references

Click the links to open the resource below

Read about some conservation efforts to conserve local food varieties

- *Grains of Life: How Chotanagpur's Adivasis Are Reviving Native Varieties of Rice*, The Wire March, 2024
- *Thirunelly's seed festival celebrates traditional climate-resilient seeds and farm produce* Mongabay March, 2023

List down some local varieties of millets in your landscape (give example)



Carbon cost of food transportation

Overview

In this activity students will visit their local market and note down food ingredients they purchase along with the place of its origin and the transportation used to ship it to their market. Through this activity students will learn how our food choices can play a role in CO₂ emissions

Learning Objective:

To learn to calculate one's carbon footprint met through the transportation of food and discuss possible solutions to lessen one's food carbon footprint

Detailed Activity:

- Begin by discussing ways in which green house gases are emitted and our own carbon footprint. Discuss how transportation is one of the contributors to green house gas emissions.
- Inquire how food produces reach us. Ask students to carry out the activity below during the weekend
- Students should visit their local market/grocery shop in the company of an adult, and fill in the observation sheet below (first row filled as example)
- Ask students to enquire and note (from the vendor) the origin/place of cultivation of each food item purchased.
- For packaged food items, students should look at the details provided on the back cover for the place of origin or region it was manufactured or packed.
- Students can also include food produce collected from their own garden
- Students should also enquire what mode of transport was used to get the produce to the market

Class/Grade

7-9

Activity

Outdoor (weekend)
Indoor (2 class hours)

Period of Activity

Any time of the year (weekend)

Place

Any part of the country

Materials Needed

Note pen and pencil

Curricular links

NCERT

- Class 9 Science
Environment and Natural resources- Chapter 14
- Class 11 Chemistry
Chapter 14
Environmental chemistry
- Class 11 Geography
Chapter 14 Composition and structure of atmosphere

- Once in class, together with students calculate CO₂ emitted for different vehicles and the distance it travelled

S.No	Item	Place of origin	Distance from the market you visit	Mode of transport	Type of fuel used in transport	CO ₂ generated*
1	Big onions	Bellary	550 km	Diesel Lorry	Diesel	86.5g

*Calculating CO₂ emissions

- Use a map of India in the classroom and use stickers to pin point regions from where the materials have arrived at the local market.
- With the teacher's help, students should use the internet to find the rough mileage of each vehicle (For ex: Lorry 17km/l, truck 15 km/l)
- Calculate the fuel used in travel (Petrol/diesel in litre) = kilometer covered/ mileage of vehicle

For example Onions from from Bellary was brought by a lorry

Petrol used to bring onions from Bellary to Coimbatore = $550/17 = 32.3$ litre of petrol was used

To find CO₂ emissions for burning 1 unit of each fossil fuel E.g. 2.3g of CO₂ is produced for burning 1l of petrol, 2.68 g of CO₂ is produced for burning 1l of diesel

Co₂ emission= $32.3 \times 2.68 = 86.564$ g of CO₂ is emitted in the journey

Resources

Click the links to open the resource below

- [Food miles here is how we can reduce them](#)

- Which types of vehicles emitted the most amount of CO₂?
- How can we reduce the amount of CO₂ emissions?
- Ask students to introspect which vehicle they use the most ?
- Which fruit/vegetables on the list contributed most to the CO₂ emissions by the journey it took for its travel?
- Is it better to eat foods that are grown locally or far away, if we want to reduce CO₂ emissions? What kind of food choices we can make

Local & Cultural references

Examine the extent to which our society and local communities depend on fossil fuels and the repercussions this reliance has on individuals' means of living.

*Read and discuss this story in the class
[Petrol price hike fuels Sidhi's salesmen's struggles](#) PARI, Nov, 2021*



Soil and Land

Soil formation is a gradual process spanning centuries, shaped by interactions among climate, parent material, topography, biotic factors, and time. It begins with the weathering of rocks and minerals, while crucial organisms like microorganisms, fungi, earthworms, and insects decompose organic matter to produce humus, enriching soil fertility. This combined action of weathering and biological processes gradually alters soil properties.

Climate change significantly affects soil composition by altering weather patterns, temperature conditions, and plant dynamics. Shifts in precipitation patterns due to climate change can lead to soil erosion and nutrient depletion, reducing soil quality. Likewise, higher temperatures accelerate organic matter decomposition, releasing carbon dioxide and impacting soil fertility. Changes in weather patterns and extreme events such as floods and droughts can exacerbate soil degradation.

Educators can utilize interdisciplinary activities blending science, geography, ecosystem studies, chemistry, and agriculture to enhance teaching. These activities provide students with practical experiences, impart scientific knowledge, and foster a deeper connection with the environment.



Mapping geographies

Class/Grade

6-9

Activity

Outdoor (half a day) &
Indoor (1 class hour)

Period of Activity

Can be a year round activity

Place

Any part of the country

Materials Needed

Colour pens, crayons, pencils,
charts, computer and
projector (optional)

Curricular links

NCERT

- Class 7, Social Science, Geography, Chapter 3, Our changing Earth
- Class 9, Social Science, Geography, Chapter Physical Features of India

Overview

Students will explore and learn how to categorize land cover and land-use types around their school and understand if this has changed over time using interactive media.

Learning Objective:

Identify and characterize different land cover and land use types in your area and observe changes in land usage over the years through visual tools, and discussion

Detailed Activity:

1. Start by selecting a small stretch of area close to the school that can be surveyed for its land use.
2. Visit google maps site and zoom in on the particular location (in default mode).
3. Capture a screenshot of the section of land you want to assess and make print outs. Ensure the printed map is not in satellite mode but in default mode. This will ensure students can make their own assessment of the land types they visually encounter. You can also use [National Geographic Map maker 4.0](#) where you can adjust and include additional layers to the map.
4. Provide a copy of the map to each of your class students.
5. Take a walk around the school along with your students and familiarise them with the general categories of land types around the school

6. Identify and categorise the different land types around the school using the list below, please include any additional categories that may exist in your local area but are not listed here.

Urban built up land	Places where people live or work in cities. Residential, commercial, industrial, land used for Transportation, communication, etc are all considered urban built-up land
Agricultural land	Places where plants are cultivated for food or other products. This land-use type is usually covered with crops , orchards, or plantations,
Grasslands or Open Natural Environments	Places which have few trees, and the ground is covered with grasses. This land is used for grazing by pastoralists and can be covered with shrubs, bushes in addition to grasses
Forest land	Places that are covered with lots of different kinds of trees growing on their own. This includes vegetation types like evergreen, dry deciduous , alpine, shola,
Water	Places with running or stagnant water, like streams, canals, river, lakes, swamp, ponds, well, sea shore
Barren land	Places that are devoid of any vegetation cover because of human use such as quarries or mines
Plantations	Places where the same kind of timber or other commercial use trees are planted. These are different from forest because you will find only one kind of tree in a plantation, like - Eucalyptus, Australian acacia, rubber, tea, coffee etc.
Hedges	Biofences
Hill and rocky areas	These areas include rocky outcrops, boulders across the landscape, uneven and elevated landforms

Resources

Click the links to open the resource below

- [National Geographic map maker 4.0](#)
- [Google earth engine](#)

7. Students should make an outline of each land category using a pencil and note down the specific land type on the map
8. Once back to class, students can colour each of the land type, add symbols, mark with appropriate labels.
9. Make use of [Google earth engine timelapse](#) , to visualise changes in land usage over the years in the same location. Try to zoom in to the same location that the students surveyed and press the timelapse icon for map images from 1984. You can project this timelapse in a class projector or copy the images on your computer for students to visualise

Discussion

Here are some questions you could ask students during the discussion:

- What are the major land use patterns around the school?
- To what degree has urbanization occurred? If you reside in an urban setting, do you believe that climate change could have a greater impact on you?
- What is the urban heat island effect?
- Do you think grasslands and open natural environments are wastelands? If yes, discuss why?
- From the time lapse images you saw from the google earth engine, do you think the land use pattern has changed over time in your area? What type of land-use was most common in 1984 v/s now? ? What factors might have led to the change in land use?
- How can extreme weather events like rainfall, intense drought, flooding affect your locality?
- Has there been any recent events of natural disasters/extreme weather events in your area ?



Local & Cultural references

Click on the link to know more

Nestled between the Kurudi hills and the Marudamalai hills near Coimbatore lies Thadagam valley, once a verdant expanse of fertile land. However over the last three decades, extensive mining of red soil for brick kilns has left the land fractured, riddled with craters of varying depths, and rendered both the land and streams nearby largely unproductive. Farmers who cultivated plantain had no choice but to give up farming due to low crop yield resulting from the dust and pollution from the area. This valley also serves as an elephant corridor, which has witnessed numerous man-animal conflicts over the years due to its changing landscape.

Have you observed any changes in the landscape in your locality? Have you noticed how it can affect people and wildlife?

The Wire, Oct 2019: [As Rogue Brick Kilns Wreck Thadagam Valley, Activists Hope for Aarey-Like Respite](#)





Soils around you

Background

Soil is composed of mineral particles such as sand, silt, and clay, along with organic matter from decomposed plants and animals. Water and air fill the spaces between these particles, essential for plant growth and microbial activity. Soil hosts various organisms like bacteria, fungi, and earthworms, pivotal for nutrient cycling and overall soil health. The composition of soil, including its mineral content and organic matter, influences important characteristics like drainage, water retention, and fertility. Climate change-induced factors such as altered precipitation patterns and increased storm intensity can accelerate soil erosion, leading to degradation and loss of fertility. Understanding these factors is crucial for devising effective mitigation strategies to preserve soil health and fertility.

Overview

Students will explore and collect soil samples from their surroundings and understand how different soil types vary in their characteristics like colour, texture, soil moisture and temperature. Through this activity students can understand and discuss how climate change can affect soil conditions.

Learning Objective

Examine the diverse soil varieties found within your locality, understand the unique traits of each soil type and learn the impact of weather conditions on soil characteristics through discussion

Class/Grade

6-9

Activity

Outdoor (Weekend)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

Colour pens, crayons, pencils, charts, computer and projector (optional)

Curricular links

NCERT

- Class 8- Geography- Chapter 2- Land, Soil, water and wildlife conservation.
- Class 9- Unit 4- Soil nutrient management in vegetable crops

Detailed Activity:

Activity 1

Collection of soil sample

- On a school holiday, ask each student to collect one soil sample from place of their choice. It can be a farm, garden, stream, empty plot, road side etc.
- Ask them to dig roughly 10cm deep in the point of collection and collect soil samples of about 250gm (two hands full). Let students place them in a paper bag and label them with the site of collection (from a farm, stream, paddy field, roadside, mountain area)

Introduction to Soil

- Initiate the session by acquainting students with the intricate process of soil formation, which encompasses the gradual weathering of rocks, sedimentation, and the extensive time scale involved in this phenomenon. Discuss about the components of soil- its abiotic components – minerals (soil particles), gases and water) and biotic component – plant, animal, fungi and other microorganisms.
- Discuss soil composition, comprising of sand, silt and clay.

Analysing soil texture by feeling

- Ask students to place their soil sample in a table, where everyone can assess the colour and texture of the soil.
- From each sample, take 2 spoonful of soil in a plate and add few drops of water to it. This is for students to feel the soil sample in wet condition
- Along with the dry sample, students can also feel the wet sample and note down their texture by feeling it in their hands.
- With the observations sheets given below, students can note down the colour and texture of the soil samples
- Some vocabulary that might be of use while noting down the texture of dry samples –can see individual grains, small particles, clumped together, tight, hard, smooth and fine.
- For wet samples some vocabulary that may come handy- grainy and coarse, smooth and fine, silky, slippery etc.
- Encourage students to express and articulate observations in their own words and are not required to adhere to the above mentioned vocabulary

Observation of soil texture through feel

(Some sample rows have been filled)

S.No	Sample from	Colour of the soil	Dry sample	Wet sample
1	Farm	Red-orangish	Looks clumped and tight, feels smooth and fine, particles are small	Smooth and fine, slippery
2	Stream	Light brown	Grainy, feels coarse, particles are small	Coarse and grainy

Activity 2

- After the first activity, pick 3 soil samples, which are distinct in colour and texture from the students collection of soil samples.
- Remove any rocks if present and air dry them in the sun for a week. Ensure the soil samples are not disturbed during this period.
- After a week, with the help the students, grind the soil samples separately using a mortar and pestle. After grinding each sample, place them separately.
- Take three equal sized glass jars with a lid.
- Add equal amount of soil sample to each jar. Make sure 1/3rd of the jar is filled.
- To each jar add equal amounts of water, filling up the jar to 2/3rds
- Close the lid, shake vigorously and leave the jar in a place without disturbance for 24 hours.

Resources

Click the links to open the resource below

- [Why soils are important to life on earth- and helps fight climate change](#)
- [Climate change is drying out earth's soils](#)
- [Characteristics of different soils](#)
- [Explore this teachers guide for activities on soil](#)

Glossary

- **Soil texture** refers to the relative proportions of sand, silt, and clay particles in a particular soil sample.
- **Soil porosity** refers to the volume of pore spaces or voids in the soil relative to the total volume of the soil. These pore spaces are the gaps between soil particles where air and water can reside.
- **Soil permeability** refers to the ability of soil to allow water, air, and other fluids to pass through it.
- **Water holding or retention capacity** of soil refers to the ability of soil to retain water against the force of gravity. It is a crucial property that determines the amount of water available to plants for uptake and use.

- Next day, gather the students around and observe how soils have been segregated into zones within the jar. Sand settles at the bottom layer due its large particle size, followed by silt above it and clay with the smallest particles settles above silt. Organic matter and humus floats on the top of the water.
- To calculate the total thickness of sand, silt and clay settlement. Percentages of each zone needs to be calculated by measuring the thickness of each zone using a scale.

(For example, if the jar has 10 cm of soil settled, 24 hours post shaking vigorously, and the sand zone is seen for 5 cm, silt- 2 cm, clay-3cm)

**Clay (or silt, or sand thickness)/ total thickness
=percentage of clay (or silt/clay)**

Sand (5cm) – $5/10 \times 100 = 50\%$

Silt (2cm)– $2/10 \times 100 = 20\%$

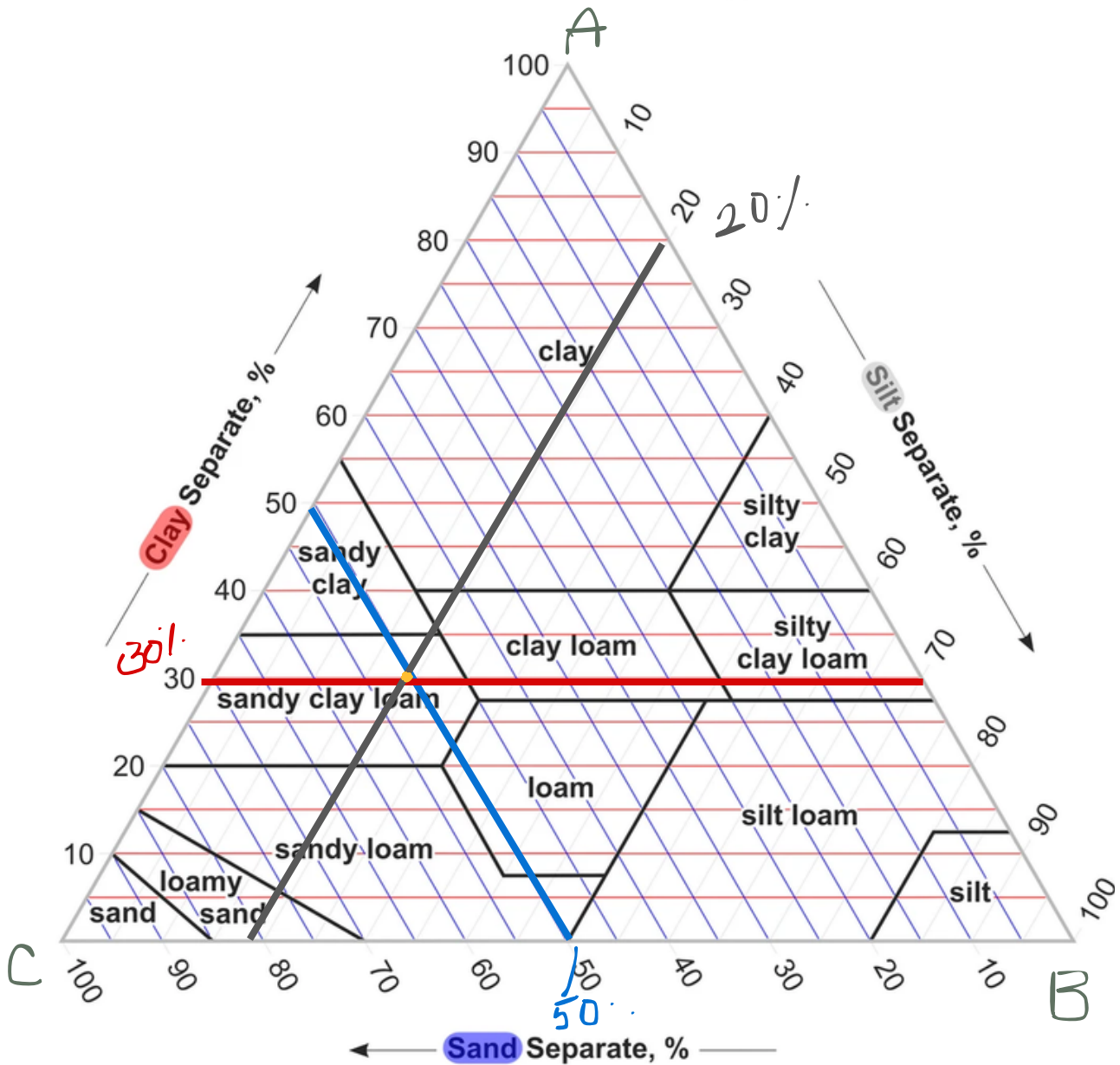
Clay (3cm)– $3/10 \times 100 = 30\%$

Activity 3 (Optional)

Using the soil texture triangle

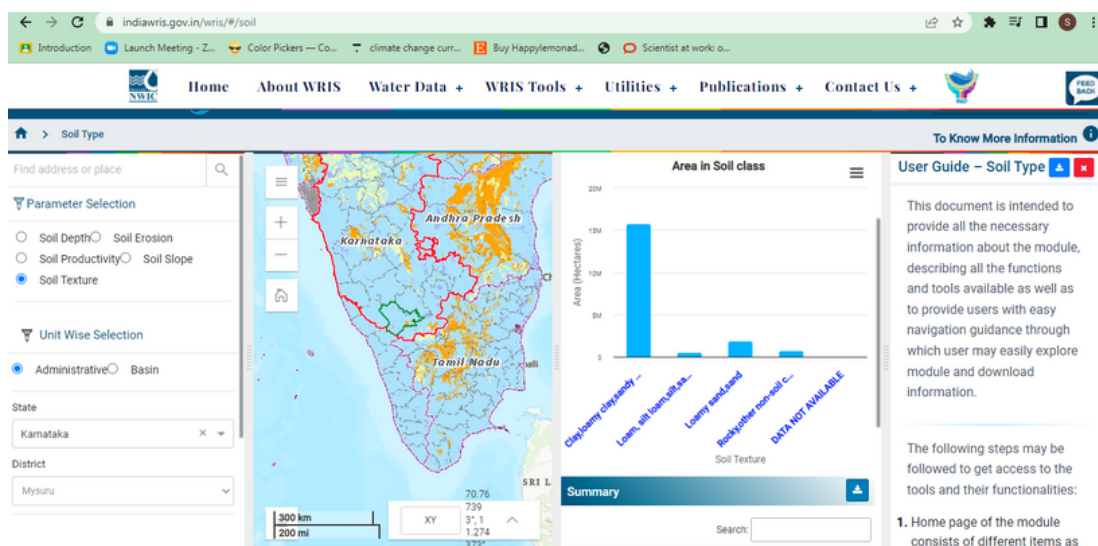
- By using the soil texture triangle, we can classify soils into different categories based on which we can understand soil permeability and water holding capacity. These factors influence what kind of plants grow in these soils and their erosion rates of soil
- Use this [resource](https://cdn.agclassroom.org/media/uploads/2015/10/20/Soil_Texture_Triangle.pdf), to make printouts for your class
- For the percentage of soil texture calculated above , look at the category in which our soil fall into in the triangle (see next page)

Soil Textural Triangle



- In the base of the triangle of sand category(BC), mark the percentage of sand and draw a straight line that is parallel to base AB
- In the clay category (AC), mark the percentage of clay and draw a straight line parallel to BC.
- Similarly in silt category, mark the percentage and draw a straight line parallel to AC.
- The point of intersection of all three lines is our soil category.
- Our soil sample falls under the **Sandy Clay loam** category


- You can get observe the soil texture in your district, at this site <https://indiawris.gov.in/wris/#/soil> Click on the link and select appropriate options on the side panel, such as state, district and select soil texture parameter
- Read more about the characteristics of each soil component [here](#)



Discussion

Here are some questions you can ask students during the discussion:

- Do you think a soil rich in clay, will drain water easily?
- What kind of soils do not allow water logging but also hold enough water for plants?
- How does organic matter help in water absorption during the rain?
- In a wetland such as a lake, which soil texture will be found in the highest percentage _____sand/clay/silt/
- Which soil has the least amount of pores?
- Which soil structure has most pores?
- Why is the top soil important?
- During drought and intense heat, soil particles lose moisture and soil particles reduce in size and come close together, becoming less porous. Imagine there is a sudden downpour of intense rainfall over this dry bed of soil, do you think water will get absorbed or will it run off?



Local & Cultural references

The shola forests found in the Western Ghats are crucial for the maintenance of numerous rivers across the Indian peninsula. These forests primarily feature loamy soil, which is characterized by its abundance of organic matter and deep, dark brown hue. Notably, this soil type demonstrates exceptional water retention and permeability. The roots of vegetation within these forests delve deeply into the soil, sometimes reaching depths of up to 80cm. Furthermore, a significant amount of litter contributes to the soil composition. Could these elements serve as the catalysts behind the shola forests' remarkable capacity to act like absorbent sponges, that soak up all moisture and gently release it?



Vegetation and soil

Background

The interplay between vegetation and soil in a given area is intricate. Soil conditions determine the types of vegetation that thrive, while vegetation, in turn, modifies soil conditions. The presence of plants and trees plays a crucial role in soil stabilization against erosion by rain and wind. Through decomposition of dead organic matter and the existence of root structures, soil develops a framework conducive to effective water absorption and retention, while simultaneously regulating soil erosion and runoff. Beneath the soil surface, diverse life forms including earthworms, nematodes, insects, and microorganisms contribute to enriching the soil with essential nutrients. This interaction between vegetation and soil is mutually influential—a two-way exchange shaping the environment.

Overview

Students will investigate three land plots: one beneath tree cover, another within a garden, and the third within arable land. In each plot, students will excavate soil to a depth of a few centimeters, analyzing and documenting the presence of dead plant and animal matter, as well as living organisms such as earthworms and insects. Additionally, they will examine the root structures of small plants in the plot. This activity aims to foster an understanding among students of the critical role played by soil organic matter in soil conservation.

Learning Objective

Observe and compare the influence of vegetation under different soil conditions

Class/Grade

6-12

Activity

Outdoor (Weekend)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

Colour pens, crayons, pencils, charts, computer and projector (optional)

Curricular links

NCERT

- Class 7, Social Science, Geography, Chapter 3, Our changing Earth
- Class 9, Social Science, Geography, Chapter Physical Features of India
- Class 9, Agriculture, Unit 4– Soil nutrient management in vegetable crops – Vocational stream
- Class 12, Biotechnology, Chapter 11, Bioremediation

Detailed Activity:

- Before starting the activity, identify nearby locations suitable for exploration close to your school. Choose a spot beneath a tree canopy where fallen leaves are not regularly removed, another spot in your school garden, and a third location in open, vegetation-free arable land, such as your school grounds or elsewhere.
- Begin the activity by introducing the class to the concept of decomposition and its significance.
- On a clear day, visit these three sites and mark out a square plot approximately 1m x 1m, where all observations will take place.
- At each plot, designate a point and dig a hole 20 cm deep using a scoop. Remove the soil and place it in a trough/tray for examination.
- Examine the soil from the tray or trough, noting its texture, moisture content, and color. Look for dry twigs, leaves, or decomposing flowers in the soil mixture. Additionally, search for dead insect parts, live earthworms, and other soil-dwelling animals. Utilize the provided observation sheet for recording observations
- Examine any small plants in plot 1 and plot 2, if present. Uproot the plants and instruct students to identify whether they have taproots or fibrous roots. Observe how soil is clumped together in the roots. Underscore the importance of root structures in holding soils together.

Observation sheet (with some filled-in examples)

Date _____

S.No	Observations	Plot 1 (under tree canopy)	Plot 2 (garden)	Plot 3 (no vegetation-school grounds)
1	Soil texture (feel)	Soft and smooth		Hard and clumped
2	Soil moisture	Slightly wet		
3	Soil colour			
4	Soil porosity	Good/Moderate/Poor		
5	Dead -leaf, flowers, twigs	Yes/No	Yes/No	Yes/No
6	Dead insect parts/earthworms	Yes/No	Yes/No	Yes/No
7	Live animals (earthworms, insects)	Yes/No	Yes/No	Yes/No

Resources

Click the links to open the resource below

- [Our living soil](#)
- [Watch: How soil organisms break down plant components and create soil pores](#)
- [More than half of life on Earth is found in soil – here's why that's important](#)

Glossary

Soil Organic Matter (SOM) is the fraction of the soil consisting of various plant and animal residues.

Discussion

Here are some questions you can ask students during the discussion:

- Are the trees in your vicinity currently blossoming, bearing fruit, or shedding their leaves? Where do the fallen leaves and flowers typically accumulate?
- Which soil exhibited a higher presence of living or deceased animals?
- How does the decomposition process transform dry leaves, flowers, twigs, and deceased animals/insects into organic matter?
- What kind of soil texture did you perceive in the plot lacking trees or plants?
- Considering the beneficial impact of plants and trees on soil, do you believe planting trees across all landscapes is advisable? Discuss how weather conditions influence soil dynamics, affecting the suitability of plant growth.
- Why are earthworms and other microorganisms crucial in soil ecosystems?
- What types of plants and soil characteristics are typically observed in desert environments?
- In mountainous regions devoid of trees, how might an intense rainfall event affect the soil?
- If the ground experiences severe drought conditions, how will it impact the plants and other organisms residing beneath the soil?

Local & Cultural references

Have you noticed the shape and size of leaves in the trees around you?

In semi-arid and desert regions, vegetation often features smaller leaves and thorny plants and trees. This adaptation helps minimize water loss through transpiration from the leaves. In these regions, the soil typically contains lower levels of organic matter, resulting in reduced water penetration.



Measuring soil organic carbon

Class/Grade

10-12

Activity

Indoor (Chemistry lab)

Period of Activity

Any time of the year

Place

Any part of the country

Materials Needed

Soil samples collected from three different habitats (eg farm, open natural environment, soil under a canopy of trees). Also titration reagents, chemicals and glasswares as per Walkley-Black Method

Notes to teacher

This experiment should be facilitated by a Chemistry teacher, and will require a chemistry lab setup.

Curricular links

NCERT

- Class 11, Chemistry, Chapter 14, Environmental chemistry
- Class 12, Biology, Chapter 14, Ecosystems

Background

The carbon component of soil organic matter is derived from decomposed plant and animal residues. It forms through the decomposition of organic materials by soil microorganisms, such as bacteria and fungi, in a process called mineralization. SOC levels are influenced by factors like climate, vegetation type, soil texture, and land management practices. It plays a vital role in soil fertility, structure, water retention, and carbon sequestration.

Overview

In this activity students will collect soil samples and measure the soil organic content using a chemical titration method. Soil organic content will be calculated for the different soils. Through this activity, students will understand how climate change can alter soil organic component and degradation of soil can release CO₂ from the soil and vice versa.

Learning Objective

Understand the variation of soil organic carbon content across different soil types and learn to quantify these differences through experimentation

Detailed Activity

- Students should be grouped into 3 batches,
- Ask each batch to collect one soil sample of 100g each from three different habitats (eg farm, open natural environment, soil under a canopy of trees)
- The soil samples should be air dried for a week inside the school/classroom

Resources

Click the links to open the resource below

Watch- [The protocol and procedure for estimating percentage of organic carbon in soil](#)

- The indirect method of assessing soil carbon is by looking at the colour of the soils –, the darker the colour the higher the organic content. Ask students to evaluate which batch of soil is likely to have higher organic carbon content.
- To quantify the organic content of the soil, the following experiment and calculation needs to be carried out using the Walkley-Black method that involves digesting the soil using chromic acid, ferrous sulphate and titrating it. The [link](#) provides the list of reagents and apparatus required for the experiment.
- [Standard Operating Procedure](#) by FAO

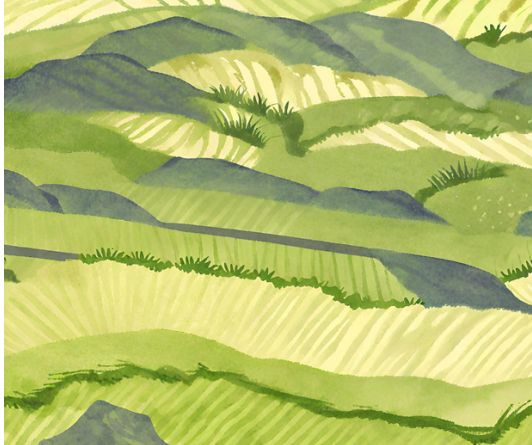
Discussion

Here are some questions you can ask students during the discussion:

- Of the three samples of soils titrated, which soil had a high soil organic carbon content?
- Why do old growth forests store more carbon? How will deforestation of these forests contribute to increase in CO₂ emissions?
- In degraded landscapes do you think soil organic carbon will be high or low?
- What happens to soil carbon when a tree is uprooted?
- What kind of impact do you think tilling of farm lands have on soil organic carbon ? (Tillage can cause significant loss of carbon by disturbing the soil organic matter of the soil by CO₂ emissions)

Local & Cultural references

1934, T.M.Jambulingam Mudaliyar was digging a well in his farm in Neyveli. Black liquid gushed out with water. This turned out to be lignite, compressed peat soil. Peat soil are formed by the accumulation of dead vegetative or organic matter for several year. Today this site is a thermal power plant named the Neyveli lignite corporation



Soil Erosion

Class/Grade

6-9

Activity

Outdoor

Period of Activity

Any time of the year (after the rains)

Place

Any part of the country

Materials Needed

Notebook, pen/pencil

Curricular links

NCERT

- Class 11, Geography, Chapter 6 Soils
- Class 12, Biology, Chapter 14, Ecosystems

Background

Soil erosion mainly happens when soil is exposed to strong winds, heavy rainfall, and flowing water. Human activities, such as farming and land clearing, can make soil more prone to erosion. Overgrazing and deforestation are additional causes of soil erosion. Climate change has exacerbated the situation with extreme weather events like heavy rainfall and flooding. Also, increasing temperatures impact soil moisture and its structure, leading to increased erosion by wind and water.

Overview

Students will visit their school surroundings after a rainy day to identify the different types of soil erosion that occurs. They will also discuss how climate change exacerbates this condition through discussion

Learning Objective:

Observe and identify soil erosion that occurs in the environment through field exploration

Detailed Activity:

- Prepare a field trip with the students, preferably after a few days of rain.
- Stop at a few locations and see if you can observe soil erosion at that site. Typically you may observe soil run off along the side of the roads, edge of barren lands. Make a note of the places, landscape structure and features where you observe these condition.
- At each stop, encourage students to actively look for signs of soil erosion and identify what kind of soil erosion it is (see photographs in the next page for reference)
- Take pictures or make drawings of the location at which you observe soil erosion

SHEET EROSION



©goseed.com

Sheet erosion occurs when the thin upper portion of the soil is displaced, usually due to heavy rain or water runoff.

RILL EROSION



©Donal Mullan

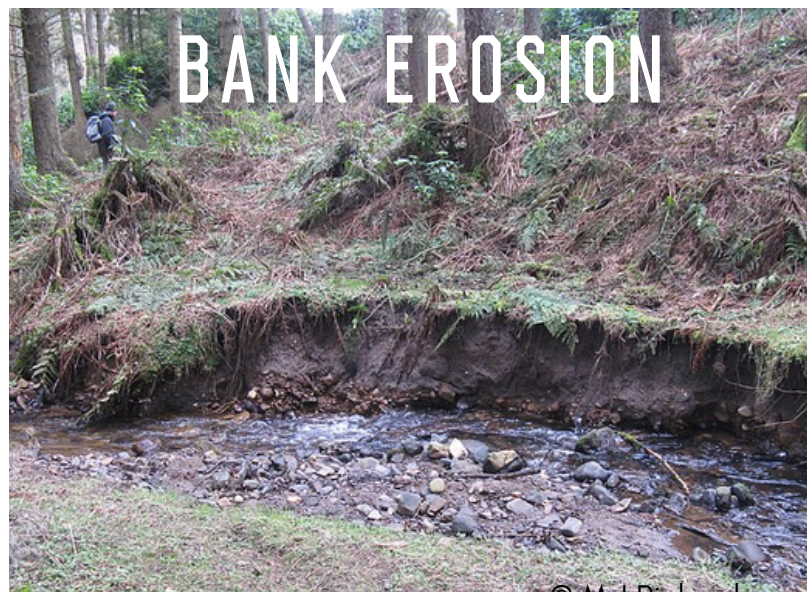
Rills are shallow drainage channels that form as rainwater flows into depressions in the land.

GULLY EROSION



Gully erosion, occurs when runoff flows strongly and is concentrated in one location. In many cases, gullies begin as a rill that transitions into a small "waterfall" that is strong enough to eat away topsoil.

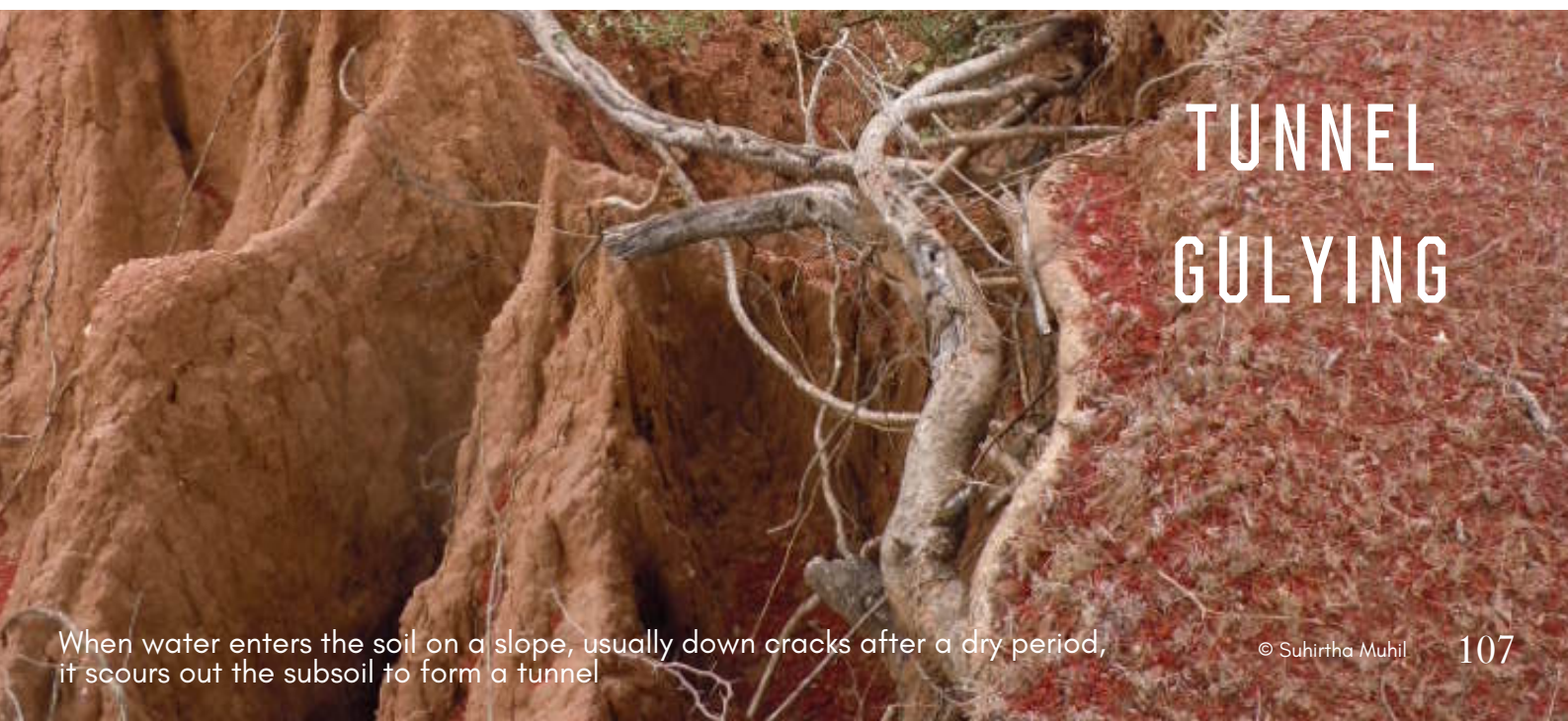
BANK EROSION



© M J Richardson

When the banks of rivers or ponds wear away, it is called bank erosion

TUNNEL GULYING



When water enters the soil on a slope, usually down cracks after a dry period, it scours out the subsoil to form a tunnel

© Suhirtha Muhil

Resources

Click the links to open the resource below

- [Soil erosion by water](#)
- [Types of erosion](#)
- [Soil erosion 101](#)
- [Soil water erosion and conservation](#)

Discussion

Here are some questions you can ask students during the discussion:

- From the field visit, list down the areas where you observed soil erosion
- What types of soil erosion did you observe?
- How does wind cause soil erosion?
- How does soil organic matter help in preventing soil erosion?
- How will soil erosion affect a farmer? How can the farmer mitigate this problem?
- How tree loss increases incidence of soil erosion?
- What happens to the soil after soil erosion? What important component does it lose? (Nutrients, topsoil)
- Why is it important to conserve the topsoil?
- What can we do to prevent soil erosion?

Local & Cultural references

Click the links to open the resource below

Read

[Soil degradation in India spells doom for millions](#)

Contact us

Email

sw@seasonwatch.in

Website

seasonwatch.in

Instagram

[seasonwatch.in](https://www.instagram.com/seasonwatch.in)

Twitter/X

[@seasonwatch_in](https://twitter.com/seasonwatch_in)



CC BY-NC 4.0 DEED

Attribution-NonCommercial 4.0 International

Citation: The Climate Change Educators Handbook, 2024.
The SeasonWatch Climate Change Educator Network,