



# Rashtriya Avishkar Saptah

2022-23

## Guidelines



Department of Education in Science and Mathematics  
National Council of Educational Research and Training  
Sri Aurobindo Marg, New Delhi – 110016, India



## DR. APJ ABDUL KALAM

Avul Pakir Jainulabdeen Abdul Kalam, born on 15<sup>th</sup> October, 1931 in a small village in Rameswaram in Tamil Nadu, rose to become the President of India. Dr. Kalam was elected as 11<sup>th</sup> President of India in July, 2002. One of the iconic Presidents of India, the late Dr. A P J Abdul Kalam, who was not only the country's Missile Man, but the most popular "People's President". Coming from a very humble background, he used to distribute newspapers as a child to supplement family income, relentlessly pursued education in the most difficult circumstances and became one of the leading space and missile scientists of India. A newspaper boy becoming President of India is the greatness of this country.

As President, he shared his vision for India, addressing youth and old with the same passion which formed his entire life. Dr. Kalam was passionate for transforming society through technology especially in inspiring the youth of India to harness Science and Technology for human welfare. Dr. Kalam, in spite of his achievements, always wanted to be remembered as a teacher. And it was as a teacher addressing a gathering at IIM Shillong that he breathed his last on the evening of 27<sup>th</sup> July, 2015.

Source: [http://pibmumbai.gov.in/English/PDF/E2015\\_FR44.PDF](http://pibmumbai.gov.in/English/PDF/E2015_FR44.PDF)

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## GUIDELINES FOR RASHTRIYA AVISHKAR SAPTAH 2022-23

### INTRODUCTION

Science, Technology and Innovation have emerged as the major drivers of national development globally. To make learning of Science and Mathematics a joyful and meaningful activity; to nurture a spirit of inquiry and creativity; to bring focus on innovation and use of technology, Ministry of Education (MoE), Government of India has set up Rashtriya Avishkar Abhiyan (RAA).

National Education Policy (NEP) 2020 emphasises on 'Experiential learning' that is 'learning by doing' to build conceptual understanding and skills through guided practice, reflection, observation, evaluation to accelerate learning, to improve retention resulting in amalgamation of all domains of learning—cognitive, psycho motor and affective in the learning process through an integrated and inter-multi-disciplinary approach of learning to ensure more meaningful, holistic and cohesive learning experience for the students.

For this, at middle and secondary stages of school education, systematic experimentation as a tool and working on locally significant projects involving science and technology are important parts of curriculum. In order to encourage school students for exploration and innovation, it is extremely important to engage them in experimentation.

Under Programme Approval Board (PAB), Government of India, it is proposed by Department of Education in Science and Mathematics (DESM), National Council of Educational Research and Training (NCERT), New Delhi that the last week of December 2022 to first half of January 2023, may be declared as 'Rashtriya Avishkar Saptah 2022-23'. During this week, all students at middle

and secondary stages, from preferably 3-5 schools of each block across the country, will uniformly carry out a study involving experimentation as per the Guidelines developed by NCERT.

The objective of this programme is to generate enthusiasm and to encourage experimentation or exploration among school students at middle and secondary stages so that they become motivated and engaged in Science and Mathematics. Involvement of students in understanding and sensitization of some common issues and local problems may be one of the ways to achieve this.

### DATES FOR CONDUCT OF RASHTRIYA AVISHKAR SAPTAH 2022-23

Rashtriya Avishkar Saptah 2022-23 is scheduled to be conducted during the last week of December 2022 to first half of January 2023 in preferably (3-5) schools from each block of the country.

**Note:** The schools which remain closed due to winter vacation from December to January can conduct the activities in February 2023.

### SELECTION OF SCHOOL

The State/UT government has to select 3-5 schools preferably from each block which has classes for middle and secondary levels, for conducting the activities 'Rashtriya Avishkar Saptah 2022-23' (However all the schools of the above-mentioned category may also be considered, if feasible). Composite schools may be selected. Some parameters have to be kept in mind while selecting the school. It is desirable to select a co-educational school. If not possible, then care should be

taken that within a State/UT almost equal numbers of girl's schools and boy's schools are being selected. While making selection for the schools, an equal representation of rural and urban schools may also be ensured.

In some States/UTs, middle and secondary schools are separate. In such cases, one middle and one secondary school may be selected from each block. If possible, twinning of these two schools may be done for Rashtriya Avishkar Saptah 2022-23. For special cases, such as some UTs, where there are no blocks, preferably schools (3-5) may be selected from each cluster/zone.

#### **FUNDING**

It is suggested that the State/UT may allocate Rs. 2000-3000/- per school to assist in carrying out the activities on "Study of soil health" that are to be conducted during Rashtriya Avishkar Saptah 2022-23. In States/UTs, where one Upper Primary school, one Secondary School and one Higher Secondary School has been selected from a block, Rs.2000-3000/- may be allocated to each school. For this purpose, the States/UTs may utilize fund allocated by Ministry of Education (MoE), through Programme Approval Board (PAB) of Rashtriya Avishkar Abhiyan (RAA) under Samagra Shiksha. For details please refer to page no. 18 of RAA Guidelines by Ministry of Education (MoE) initially known as Ministry of Human Resource Development (MHRD)) [scan attached].

#### **ACADEMIC SUPPORT**

The faculty members of SCERTs and DIETs may be involved for providing academic support to the selected schools. The science faculty member(s) of Higher Education Institutes (HEIs) located close to the schools may also be involved. Block

level administrator may steer through online mode during Rashtriya Avishkar Saptah 2022-23 to facilitate the conduct of experiment/activity.

**Stage appropriate involvement of the students in performing experiments:** All students of classes VI to XII of the selected school will carry out the experiments/activities within the stipulated time periods assigned to them in their timetable for performing practicals in science/chemistry or assignments at their home as per requirements. Students are expected to perform experiments individually at their home only under the supervision of guardians/parents/elder siblings.

**Procedure for performing experiments for study:** Understanding the procedure for performing the experiments/activities and importance of the chosen experiments/activities is one of the major factors for the efficient conduct of the event. For this, the guidelines containing procedure may be distributed to teachers, school heads, education administrators, etc., in advance. Students may be provided the procedure for conducting the experiments/activities on soil analysis.

**Role of teachers while performing experiments:** Teacher may provide instructions/hand holding to the students prior perform the experiments on the selected theme in a scientific manner. Teacher may provide the procedure for performing experiments. She/he may make the students aware about the scientific method for performing study, objectives of the study, how to gather the data scientifically and what precautions they may take while performing the experiments or doing preparations before the experiments. It is expected that, all the material required for the experiments should be made available and easily accessible prior to the activities.

**File No.**  
**Government of India**  
**Ministry of Human Resource Development**  
**(Department of School Education and Literacy)**

Shastri Bhawan, New Delhi  
 Date: 28<sup>th</sup> May, 2015

**ORDER**

**Subject: Guidelines on the Rashtriya Avishkar Abhiyan regarding.**

In pursuance of the focus on connecting school based knowledge to life outside the school and making learning of Science Mathematics a joyful and meaningful activity, to bring focus on innovation and use of technology, the Ministry of Human Resource Development has set up the *Rashtriya Avishkar Abhiyan*(RAA)- a convergent framework that aims at nurturing a spirit of inquiry and creativity, love for Science and Mathematics and effective use of technology amongst children and encourage those who show an inclination and talent for these subjects to be encouraged and supported to heights of academic excellence and research.

Rashtriya Avishkar Abhiyan will target students in the age group of 6 - 18 years and intum the execution of RAA will span across MHRD's schematic interventions of Sarva Shiksha Abhiyan, Rashtriya Madhyamik Shiksha Abhiyan in the Department of School Education & Literacy and programmes and schemes of Department of Higher Education to encourage Science, Mathematics & Technology.

**Background to RAA**

Science, Technology and Innovation have emerged as the major drivers of national development globally. India, with its near universalisation of access in school education and expanding Higher Education and Scientific institutions both under the government and private sectors, wants to give a direction to drive future innovations by encouraging children in exploration, discovery and innovation to support acclimate of innovation by teachers and students at school level.

The Koithari Commission (1964) noted that the destiny of this country is shaped in the classrooms and laboratories of schools, colleges and universities. India's Curriculum Framework recognises connecting knowledge to life outside the school and notes that learning takes place both within school and outside school and seeks to design learning tasks beyond textbooks and schools.

*Fig. 1 Guidelines of Rashtriya Avishkar Abhiyan (RAA)*

**Funding**

Listed activities/components of Rashtriya Avishkar Abhiyan would be funded under Sarva Shiksha Abhiyan (SSA) and Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and in cases of collaborative initiatives with Ministry of Science and Technology and Department of Higher Education institutions in coordination with their schemes and norms.

**Milestones for RAA initiatives:**

The milestones for 03 major initiatives under RAA, namely School Mentoring, Teacher Circles on Science/Maths and Science/Mathematics clubs are spanned out for five years from year 2015-16 to 2019-20 as follows:

Year	Coverage of Category of schools to be covered by Mentoring Institutions	Mentoring Institutions	Formation of SC/Maths clubs (in all schools taken up)	Participation in Children's Science Congress	Participation in Maths & Science Olympiads at District/State/National level
I 2015-16	Pilot Year: 100 Govt. schools	IITs, NITs, Central Institutions, ISERS	-	5	6
II 2016-17	10% of all KV and JNV Schools. 5% Govt. primary/upper primary and secondary/sr. secondary	All Higher Educational Institutions (Central/ State Universities / Colleges under UGC/AICTE	50% of schools selected in column 2	50% of schools selected in column 2	Children from 25% of schools selected in column 2
III 2017-18	25% of all Govt. schools including secondary/sr. elementary/primary schools	Do	"	"	"
IV 2018-19	50% of secondary/sr. elementary/primary schools	Do	"	"	"
V 2019-20	100% secondary & sr. elementary/primary schools, 75% secondary schools	Higher Secondary Schools for Primary Schools	"	"	"

This issues with the approval of the Hon'ble HRM.

(Anamika Singh)



**To facilitate the execution of the suggested activities by Children with special needs following points may be considered:**

- They may be allowed and encouraged to seek assistance from parents, caregivers or siblings.
- They may be given some time prior to commencement of the activity to familiarize themselves with the items used in the activity.
- They should be encouraged to use either a measuring device with markings for capacity of the container or the bottles of water and fruit juice etc. whose capacity is known to them.
- The use of units like Acre may be explained in the terms of units which they are familiar with (like square meter or square kilometer).

**Working Environment:** Experiments should be performed at a suitable place as

a normal routine of the laboratory practice. For a positive, calm, pleasant work atmosphere, teachers and parents may let the students experience/appreciate that they may get various data and errors may also be expected so that there will not be any fear, anxiety or tension among the performing students and inculcation of values among the students will be encouraged.

**Awareness about the event:** To create awareness about the event among the students, the school should fix a poster within the school premises and may click a clear photo of poster.

The poster may be hand painted on paper/cloth having following details: Schools may think of a catchy title in their local language, in place of the title **“Study of Soil Health”**. School Development Management Committee (SMDC) members and local community people may also be not only made aware about the event but attempt should be made to involve them.



*Fig. 2: Sample of poster on Rashtriya Avishkar Saptah 2022-23*

## STUDY OF SOIL HEALTH

Soil is one of the most crucial natural resources and takes thousands of years for its formation. The breakdown of huge rocks into smaller ones and fine particles by the natural forces such as water, wind and other result in the formation of soil. It is the topmost layer of the earth's crust mainly composed of minerals that support life. The soil is arranged in layers of horizons during its formation which are known as the soil profile. Soil provides anchorage for roots and provides the essential nutrients for the growth and development of plants. It regulates the discharge of rainwater and helps in recharging of groundwater. In this way, it also helps in preventing floods.

Soil texture, structure, porosity, density, water holding capacity, pH is some of the important parameters that determine the soil type. There are two types of soil particles categorized on the basis of their effective diameter i.e., primary and secondary. The primary particles have fixed composition since the time of their formation, whereas secondary particles result from the decomposition of the primary particle. Primary particles include sand and silt whereas clay particles are secondary minerals. Relative proportion of these particles in a soil is called soil texture. There are important differences in physical, chemical, and mineralogical properties of these fractions. It is a fundamental property of soil and not easily altered.

Soil type	Colour	Rich in	Poor in	Found in
<b>Alluvial soil</b>	Varies from the light grey to ash grey	Usually, potash	Phosphorous	Entire northern plains
<b>Black soil</b>	Deep black to grey	Lime, iron, magnesia and alumina	Phosphorous, nitrogen and organic matter	Gujarat, Maharashtra, Karnataka, Madhya Pradesh
<b>Red soil</b>	Yellow when hydrated	Iron and aluminum	Nitrogen, phosphorous and humus	Tamil Nadu, Madhya Pradesh, Jharkhand, Odisha, some parts of Karnataka, southeast Maharashtra.
<b>Laterite soil</b>	Reddish to yellow	Iron oxide and potash	Organic matter, nitrogen, phosphate and calcium	Western Ghats, Eastern Ghats
<b>Arid soil</b>	Range from red to brown	Calcium carbonates, sodium	Nitrogen is insufficient	Western Rajasthan, Haryana, Punjab and extends up to the Rann of Kutch in Gujarat
<b>Forest soil</b>	Dark brown	Hydrous mica, chlorite	Acidic with low humus content	Jammu and Kashmir

# India

## Major Soil Profile

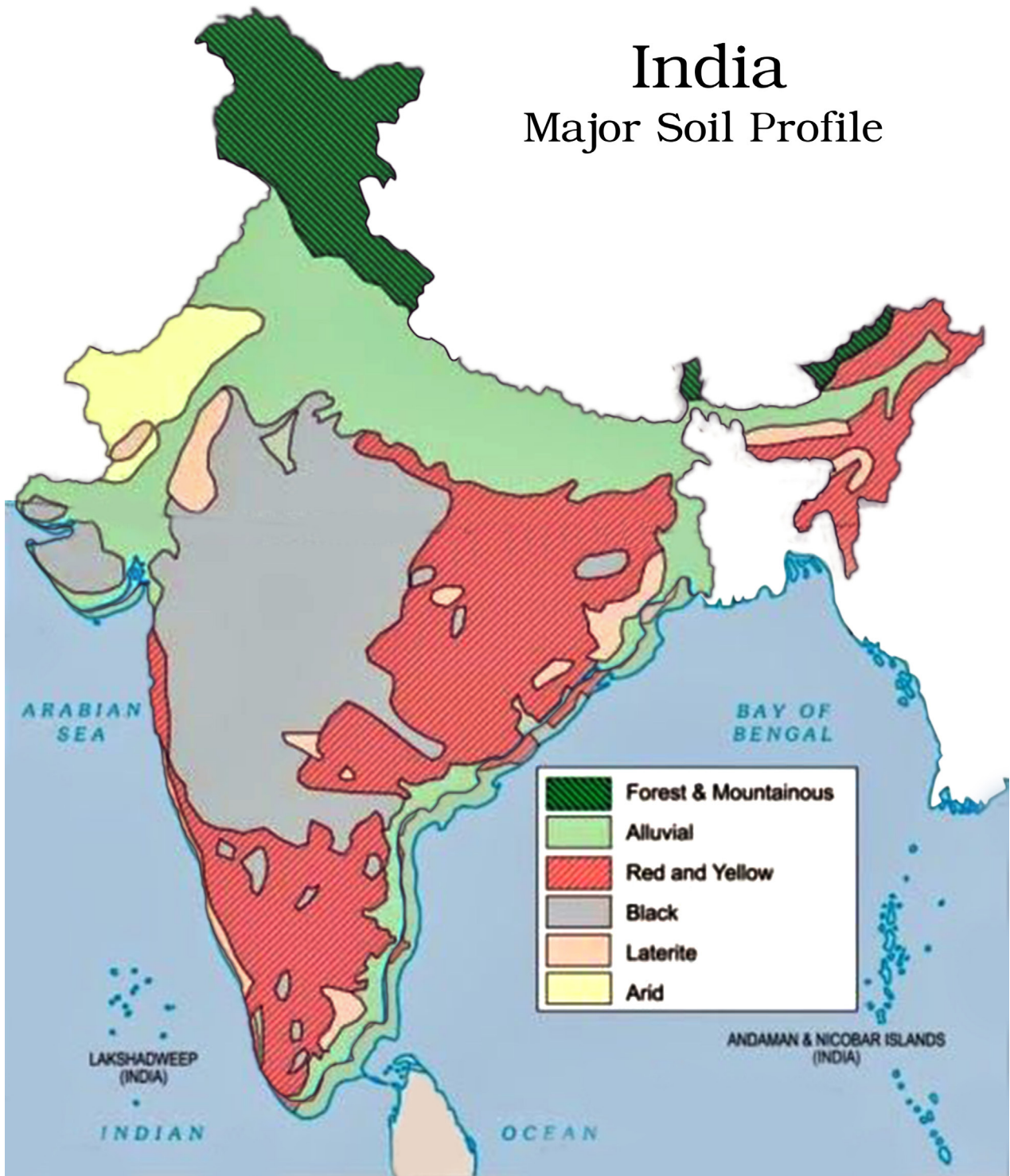


Fig. 3: Soil map of India

[Source: NCERT Class X textbook]

Soil structure is an arrangement of soil particles and can be amended. Soil texture and structure together regulate porosity, density, compactness, retention, and movement of water and air in soil. Soil temperature is slightly higher than air temperature at a place. It influences life processes of soil biota including plants. Soil air is retained in soil pores; its composition is variable and it contains higher carbon dioxide and moisture and lower oxygen concentration than atmospheric air. Soil air has a great role in respiration of plant roots and microorganisms.

Therefore, soil quality is the capacity of soil to function within its natural or managed ecosystems to sustain productivity and it is dependent on how a soil is managed. Soil quality is determined by the changes in its physical, chemical and biological parameters. Soil health is the condition of the soil and its capability to sustain biological functions, maintain ecological quality and promote plant health. Soil quality and soil health are crucial for sustainable agro-ecosystem management and survival on earth. Healthy soil is the support for profitable, productive and environmentally resonate agriculture systems.

In order to understand as to how the soil processes that support plant growth and regulate environmental quality are affected

by management practices, scientists have identified factors and components that affect soil quality and health considering the agricultural perspectives. Government has also started a scheme “National Mission for Sustainable Agriculture”. Soil Health Management (SHM) is one of the most important interventions under this scheme. SHM aims to promote crop specific sustainable soil health management and judicious application of fertilizers. Keeping this in view, Ministry of Agriculture and Farmers’ Welfare introduced the Soil Health Card (SHC) scheme on 19th February 2015.

A Soil Health Card provides the information for the nutrient status of soil, along with recommendations on the dosage of nutrients to be utilized for improving its fertility and health. SHC will be provided to all farmers in the country at an interval of 2 years to enable the farmers to apply recommended doses of nutrients based on soil test values to realize improved and sustainable soil health and fertility, low costs and higher profits. SHC is a printed report which contains nutrient status of soil with respect to 12 nutrients. The pH (acidity/ alkalinity) is an important characteristic of soil while some major, minor and micro nutrients are tabulated below:

<b>Major Nutrients</b>	<b>Minor Nutrients</b>	<b>Micro Nutrients</b>
Total Dissolved Salts Organic Carbon Phosphorous Potash	Sulphur Magnesium Calcium	Zinc Ferrous Manganese Copper

SHC is used to reduce fertilizer use, especially nitrogen and increase bio-fertilizers and other micro-nutrients use. Crop yields have also increased moderately for majority of the crops.

Similarly, a significant impact is the increase in the use of gypsum and other micro nutrients to some extent. The use

of micro-nutrients (especially gypsum) increased slightly after SHC distribution.

Students should understand this scheme because it’s one of the objectives is employment generation for rural youth. They will get to understand that how much the quantity of fertilizers and other nutrients should be used.


 Department of Agriculture & Cooperation  
 Ministry of Agriculture & Farmers Welfare  
 Government of India


 Directorate of Agriculture  
 Government of Goa


  
 Sothi Datta, Dal Varna

Soil Health Card No. : \_\_\_\_\_  
 Name of Farmer : \_\_\_\_\_  
 Validity : From \_\_\_\_\_ To \_\_\_\_\_

SOIL HEALTH CARD				Name of Laboratory				
Farmer's Details				SOIL TEST RESULTS				
Name				S. No.	Parameter	Test Value	Unit	Rating
Address				1	pH			
Village				2	EC			
Sub-District				3	Organic Carbon (OC)			
District				4	Available Nitrogen (N)			
PIN				5	Available Phosphorus (P)			
Aadhaar Number				6	Available Potassium (K)			
Mobile Number				7	Available Sulphur (S)			
<b>Soil Sample Details</b>				8	Available Zinc (Zn)			
Soil Sample Number				9	Available Boron (B)			
Sample Collected on				10	Available Iron (Fe)			
Survey No.				11	Available Manganese (Mn)			
Khasra No. / Dag No.				12	Available Copper (Cu)			
Farm Size								
Geo Position (GPS)	Latitude:		Longitude:					
Irrigated / Rainfed								

Secondary & Micro Nutrients Recommendations		Recommendations for Soil Applications	
Sl. No.	Parameter		
1	Sulphur (S)		
2	Zinc (Zn)		
3	Boron (B)		
4	Iron (Fe)		
5	Manganese (Mn)		
6	Copper (Cu)		
<b>General Recommendations</b>			
1	Organic Manure		
2	Biofertiliser		
3	Lime / Gypsum		
International Year of Soils		Healthy Soils for a Healthy Life	
2015			

Fertilizer Recommendations for Reference Yield (with Organic Manure)				
Sl. No.	Crop & Variety	Reference Yield	Fertilizer Combination-1 for N P K	Fertilizer Combination-2 for N P K
1	Paddy (Dhaan)			
2				
3				
4				
5				
6				

Fig. 4: Soil Health Card

**Instructions for performing the activities:**

1. Activity of section- I is compulsory to all the students.
2. Soil samples should be collected within the 50m x 30m area of land. Soil A, Soil B, Soil C..... should not be the same for performing the activities at middle stage and secondary stage.

**I. Activity to study the texture of soil samples**

**Activity1. (a) Quantitative Analysis**

Texture is one of the most important physical properties of soil. The soil texture is based upon division of the size of soil particles into three size fractions viz., Sand (2–0.05mm average particle diameter), Silt (0.05–0.002mm) and Clay (less than 0.002mm). If one of these fractions dominates in the soil, the name of that fraction is included in the name of the texture. A soil which has all of these fractions in nearly equal proportion is called a loam soil. The four terms—Sand, Silt, Clay and Loam— are combined in

various ways to name 12 different textural classes. The 12 textural classes and the percentages of sand, silt and clay fractions that are included in each are shown in textural triangle (Fig. 6). Texture affects several physico-chemical properties of soil like density, capillary and non-capillary pore spaces, water holding capacity, aeration, temperature and also the root penetration.

(Note: This activity is a part of class XII biology curriculum and students may be doing it as a part of their practical course)

**Materials required:** Soil samples, balance, weights, mechanical sieve set, and old newspapers.

**Procedure:**

1. Collect about 200–300 g of soil from two different locations. Label them as sample A and B.
2. Dry the samples A and B in an oven, or stove or in sun to remove the soil moisture (capillary and bound water).
3. Select the 3 sieves of different mesh sizes (2mm, 0.05mm and 0.002mm). Arrange them in a collecting chamber.

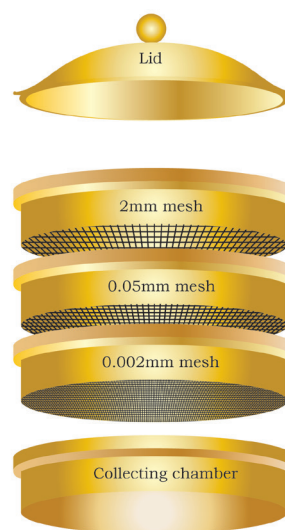


Fig. 5: Sieve Set

4. Place 100g of the soil in the 1st sieve (sieve of 2mm mesh) (Fig. 5) and close the lid. To sieve the soil, shake the set manually for 5–10 minutes and collect the three soil fractions.
5. Weigh the soil fractions viz- sand, silt and clay collected in the 3 compartments  
 Weight of soil sample taken - .....g  
 Weight of sand fraction - .....g  
 Weight of silt fraction - .....g  
 Weight of clay fraction - .....g  
 The weight of three fractions should be equal to the total weight of sample taken for analysis.

**Observations:**

Calculate the percentages of the various soil fractions and tabulate:

Calculate the percentages of sand, silt and clay fractions.

Soil sample	Percentage (%)			Texture class
	Sand	Silt	Clay	
A				
B				
C				

Now use the textural triangle given in Fig. 6. Note that the three sides of the textural triangle represent 0 to 100% of sand, silt and clay respectively. Note that (i) the percentage lines for clay run parallel to the base line of sand, (ii) the percentage lines of silt run parallel to the clay side of the triangle and, (iii) percentage lines of sand run parallel to the silt side of the triangle. In reading the textural triangle, any two particle fractions will locate the textural class at the point where these two intersect.

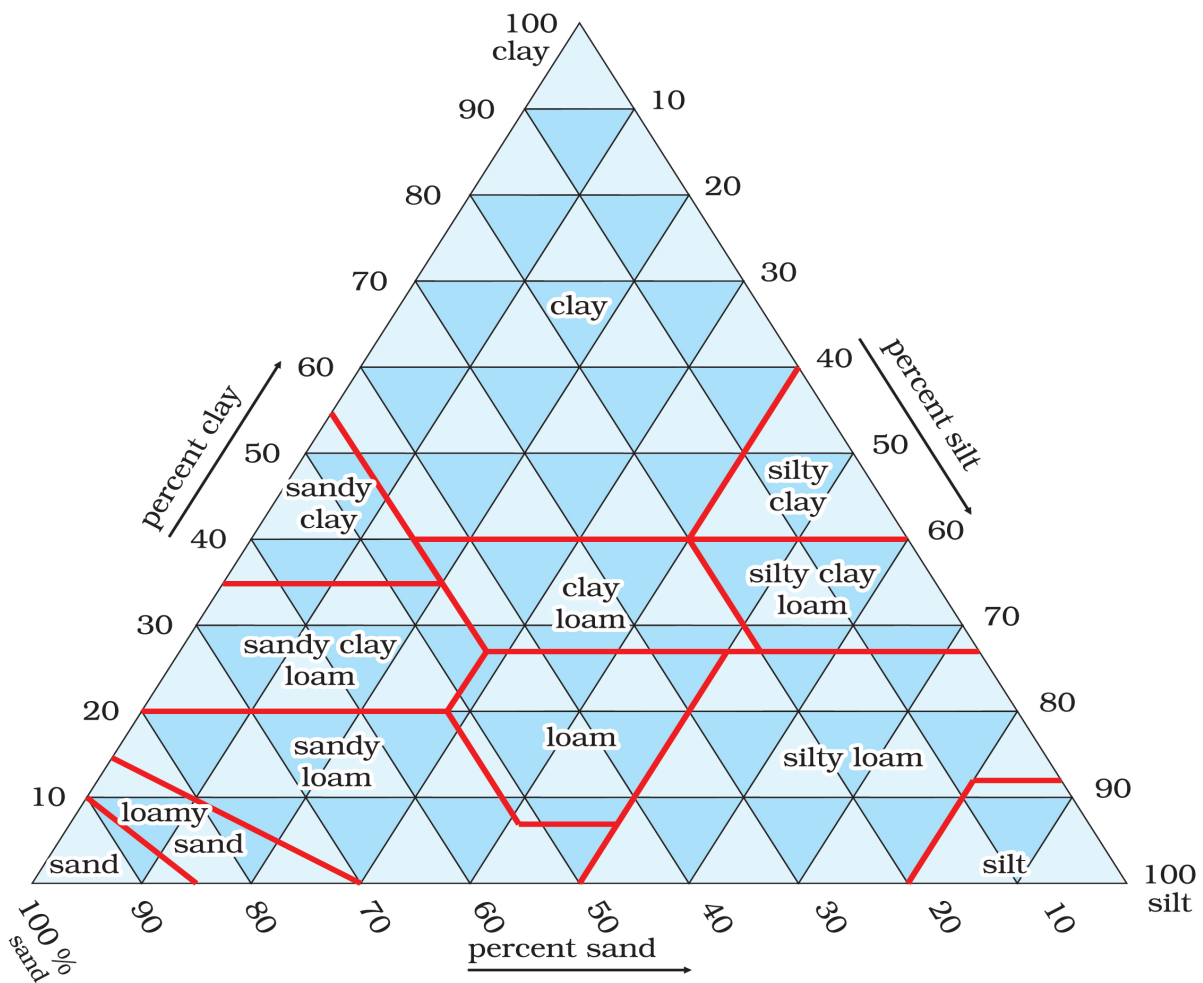


Fig. 6: Texture triangle

**Precautions:**

1. Soil should be dried thoroughly before sieving.
2. Soil should be free of debris.

**(b) Qualitative Analysis**

This test is used for identification of types of soil texture.

**Materials required:** Soil samples, Petri dish, distilled water beakers and spatula.

**Procedure:**

1. Take the soil sample in a Petri dish and add water in small quantities enough to prepare a semi-solid paste.
2. Using this semi-solid paste, prepare 10-15mm size crumb of soil.
3. Place these crumbs in a Petri dish and let it sun/air dry.
4. After drying, place these crumb in 250mL beaker filled with water.
5. Observe the changes and note them down.

**Observations:**

1. If soil crumb disintegrates immediately without turbidity- indicates sandy soil.
2. If crumb disintegrates within 5-7 minutes. without turbidity and contents start floating on the surface- indicates organic/peaty soil.
3. If crumb takes more than 5-7 minutes for disintegration and cracks with turbidity/cloud formation- indicates clay-silty soil.

Soil Sample	Time taken for disintegration of crumb (minutes)	Texture
A		
B		
C		

**Precautions:**

1. Ensure that the soil crumbs are free of cracks.
2. Do not add too much water to maintain the consistency of semi-solid paste.

**II. Activities for analyzing soil health at middle level:**

**Activity 2: To determine whether the soil is acidic, neutral or alkaline in nature:**

Do you know that soil type and texture vary from place to place? Soil plays a key role in growth and development of plants. Various minerals present in the soil are essential for plants. Besides, pH is an important factor for soil fertility. It affects the filtering and buffering capacities, the quality of organic substances, and accessibility of nutrients to the plants. pH determines the acidic or alkaline nature of the soil. If a soil has pH value less than 7 (pH<7) then it is said to be acidic in nature. For a pH value greater than 7 (pH>7), the soil is termed as alkaline in nature. pH equal to 7 (pH=7) indicates neutral nature of the soil. A pH value less than 5.5 is undesirable and requires treatment. In a similar manner, alkaline soil (pH>8.4) are limiting and appropriate measures are required to improve its productivity. Neither highly acidic nor highly alkaline soil promotes good agricultural practices, and hence, optimum pH is essential for the soil.

**Materials required:** pH strips, glass rod, beakers, distilled water, filter paper, soil samples, pH chart

**Procedure:**

1. Takesoilsamplesfromdifferentplaces such as garden, pot, playground etc. **Note:** In order to take the soil sample, dig 5-6 inches below the surface.
2. Measure 30 g of each soil sample and place it in a beaker.



- Pour 75 mL of distilled water in the beaker with soil.
- Stir the contents with the help of a glass rod for a minute. Afterwards, leave the sample undisturbed for about 30 minutes before proceeding further.
- Filter the content using a filter paper in a separate beaker.
- Now dip the pH strip in the container and check the colour. Compare the colour with the chart provided to determine the pH of the sample.
- Record your observations in the table.

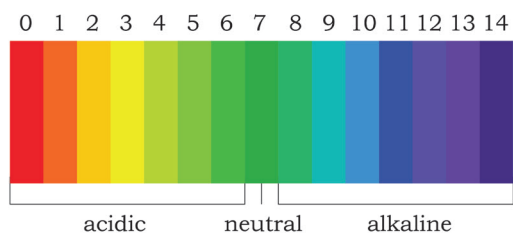


Fig. 7: pH scale

**Observations:**

Soil Sample	pH	Nature of soil
<b>A</b>		
<b>B</b>		
<b>C</b>		

**Precautions:**

- The soil sample collected should be free from any impurities such as stones, plant roots etc.
- Do not let the pH strip dry before comparing it to the pH chart.
- Avoid taking the soil from the surface.

**What more can be discussed?**

- What is pH and its role in fertility of soil?
- Which factors influence soil's pH?
- Can pH of a soil be altered? Give reason for your answer.

- Case studies which show severe effect of pH on quality of the soil.
  - Effects of soil acidity | Agriculture and Food (<https://www.agric.wa.gov.au/soil-acidity/effects-soil-acidity>)
  - Effects of Acid Soils on Plant Growth and Successful Revegetation in the Case of Mine Site | IntechOpen (<https://www.intechopen.com/chapters/57209>)

**Activity 3: To determine the water holding capacity of the soil:**

Have you ever thought why less vegetation is found in desert areas? Does it have any connection with the kind of soil found there? Is there anything special about the plants in those areas which make them thrive in such harsh conditions? Water holding capacity is the maximum amount of water a soil can hold at a given temperature.

**Materials required:-** Plastic bottles (500 mL), needle, soil samples (50 g each), weighing balance, and distilled water

**Procedure:**

- Take 50 g soil sample and crush it to fine particles.
- Take a plastic bottle and cut it into two halves.
- Make minute holes in the plastic bottle at the lower half of the bottom with the help of a needle.

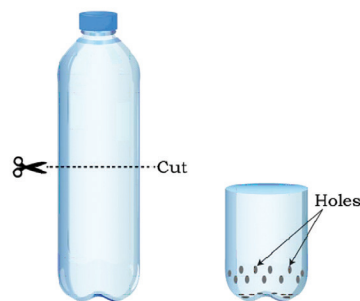


Fig. 8

- Weigh the empty perforated bottle ( $W_1$ ).

- Put the 50 g soil in the perforated plastic bottle.
- Weigh the bottle again with the soil sample ( $W_2$ ).

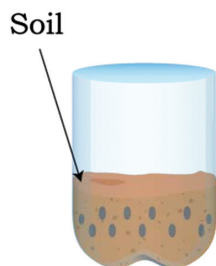


Fig. 9

- Pour water on the soil till water starts oozing out the holes. Allow the system to settle till no further oozing of water occurs.

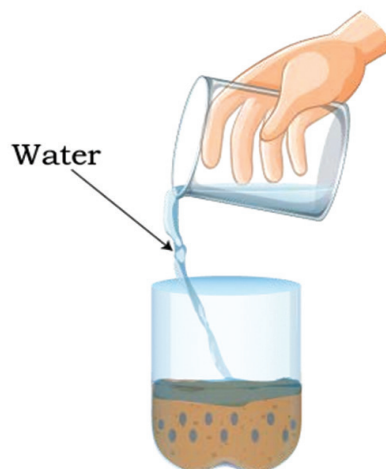


Fig. 10

- Weight the wet soil ( $W_3$ ).
- Repeat the above steps for all the soil samples, separately.

**Observations:**

Soil Sample	Weight of empty perforated bottle ( $W_1$ )	Weight of perforated bottle + soil ( $W_2$ )	Weight of soil after pouring water ( $W_3$ )	Water holding capacity (WHC) (%) = $\frac{W_3 - W_1}{W_2 - W_1} \times 100$
A				
B				
C				

**Precautions:**

- The soil sample should be finely crushed.
- Use the needle carefully.

**What more can be discussed?**

- Do you think that the water holding capacity of the soil varies in different seasons? If yes, when will it decrease or increase and why.
- Can you think of the ways in which soil is being harmed?
- Do you think that giving excess

water to soil can affect its fertility? How?

- Suggest some ways to conserve soil.

**Activity 4: To determine the bulk density of soil**

Soil is fundamental of our life support system. For a healthy plant growth, human growth and other organisms, health of soil is also important. It is home for various micro-organisms that help in  $N_2$  fixation of decomposition of organic matter which in turn benefits human life. Soil plays an important role in regulating the ecosystem

of earth. There are various metrics to constantly check the health of soil. One of such parameters is bulk density.

Bulk density indicates the structural strength of soil. Value of bulk density above upper threshold set limit and below lower threshold limit prepares the functioning of soil. Bulk density of soil may be interpreted as a relation between the mass and the volume of a dry soil sample. It can be calculated as dry weight of soil divided by its volume. It is expressed in  $\text{g/cm}^3$ .

**Materials Required:** Weighing balance, PVC pipe, measuring cylinder, soil samples.

**Procedure:**

1. Locate a clean, grass-free ground to obtain the sample.
2. Take a pipe of certain fixed measurements.
3. Place the pipe with its open end on the ground's surface and press it

firmly so that it sinks in the ground completely and soil fills the pipe. Pull out the pipe along with the soil.

4. Level the pipe well by removing excess soil is removed from both the ends, so that the volume of pipe remains same as the volume of soil.
5. Take the soil from the pipe and keep it under the sun to dry the soil thoroughly.
6. Weigh the dry soil and note the reading.
7. Calculate the bulk density using the formula.
8. Repeat the above steps for all the soil samples.

**Observation and Calculation:**

Bulk Density = Dry weight of soil / Volume of soil

Soil Sample	Dimensions of pipe(cm)		Volume ( $\text{cm}^3$ )	Dry weight (g)	Bulk density ( $\text{g/cm}^3$ )
	Diameter	Height			
A					
B					
C					

**Precautions:**

1. The soil sample should be dried such that no moisture is left in it.
2. Pipe should have well defined uniform dimensions.

- Collect different soil samples say from school, locality, park etc. and compare the bulk density.

**What more can be discussed?**

- Find out the effect of inappropriate bulk density of soil on plants.
- Also, try to figure out ways to maintain the level of bulk density at optimum level.

**III. Activities for analyzing soil health at secondary level:**

**Activity 5: To determine the organic content of the soil sample**

A fertile and healthy soil is the basis of all life support whether it is plants, animals or humans. For healthy agricultural practices and ecological balance, it is important to

understand the organic content in different types of soil.

Agricultural practices vary upon the percentage of organic matter in soil. Similarly, the types of crops also vary with organic content as the fertility of soil changes with its organic content. Soil organic matter consists of a number of compounds including oxygen, hydrogen and carbon. It helps maintain the health of soil on three bases: Physical, chemical and biological.

On a chemical basis, organic matter helps to improve the quality of soil by its ability to withhold various nutrients. On a physical basis, it helps the soil to maintain its structure to control soil erosion, improving water infiltration and strengthening the roots of plants. On a biological basis, organic matter is the focus for carbon which is the primary source of energy and nutrients to soil organisms.

For quantitative estimation of organic nitrogen, there are traditional methods like Dumas and Kjeldahl's but these methods are not easily feasible in a small-scale school laboratory. Hence, the following method will give rough estimation of organic nitrogen content in the soil samples.

Here, the hydrogen peroxide acts as a strong oxidizing agent and reacts with the nitrogen compounds present in the soil to release oxygen as a byproduct. This oxygen appears as bubbles in the soil sample.

Also, we have prepared an approximate scale after performing experiments with various soil samples. Classify your soil samples based on following table for organic nitrogen content.

<b>Bubbling time (in minutes)</b>	<b>Organic matter content</b>
Less than 5	Very low
5-15	Low
15-30	Moderate
Above 30	High

**Materials Required:** Dropper, 6% hydrogen peroxide, weighing balance, stopwatch, different soil sample, boiling tube, distilled water and marker

**Procedure:**

1. Take clean, dry boiling tube and add 1.0 g of soil sample to it.
2. Add 10.0 mL of 6% H<sub>2</sub>O<sub>2</sub> to it slowly and note the bubbling time using a stopwatch.
3. Repeat the above steps with other samples as well.
4. Then, classify the samples on the given scale.

**Observations:**

<b>Soil Sample</b>	<b>Bubbling time (in minutes)</b>	<b>Organic matter content as per scale</b>
<b>A</b>		
<b>B</b>		
<b>C</b>		

**Precautions:**

1. The boiling tubes should be clean.
2. Always store hydrogen peroxide in a dark bottle.
3. Hydrogen peroxide is corrosive in nature, therefore, its handling needs supervision by teachers.

**What more can be discussed?**

- Try to replicate the activity with soil sourced from your locality and school also.
- Based on the study of organic matter of your locality and school, suggest the type of crops could be grown in them.

**Activity 6: To determine the water infiltration rate for soils**

The ability of soil to allow the water to pass through it is referred to as water infiltration rate for that soil. It is generally expressed

in inches per hour. The texture of soil determines the rate of water infiltration which varies with the percentage of sand, silt and clay in the respective soil.

**Materials required:** Pipe having diameter 4 inches and height 6 inches, stopwatch, distilled water

**Procedure:**

1. Take a pipe of diameter of 4 inch and height 6 inch.
2. Clean the surface of soil and hammer the pipe into the ground soil up to 3 inches.

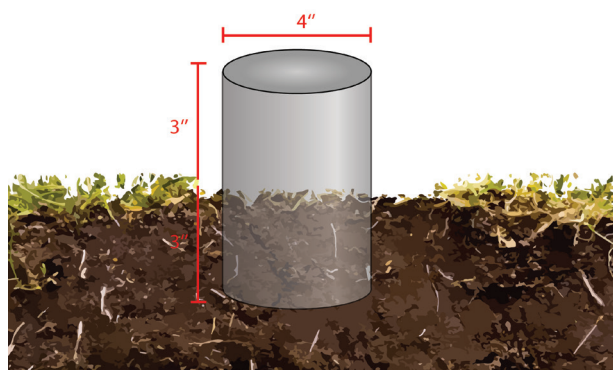


Fig. 11

3. Fill the above 3 inch of pipe with water and record the time taken by water to be fully absorbed into the soil with the help of a stopwatch.
4. Repeat the above steps for other places also.

**Observation and Calculation:**

Height of pipe above ground = 7.5 cm (~3 inch)

Diameter of pipe = 5 cm (~4 inch)

Volume of water/cylinder above ground =  $\pi r^2 h = 589 \text{ cm}^3$

Soil Sample	Time taken (min)	Rate = $\frac{\text{Volume}}{\text{Time of taken}}$ (mL/min)
A		
B		
C		

**Precautions:**

1. Insert the pipe in the soil carefully.
2. Make sure the surface of soil is clear of debris.

**What more can be discussed?**

- How does the infiltration rate of soil determine the health of soil?
- Does the infiltration rate vary for different soils?
- What factors affect the infiltration rate of soil?

**Reporting the Results of Study**

All students of classes VI to XII of the selected schools have to carry out the study uniformly on ‘Study of Soil Health’ in different area(s). The results obtained by all the students for the activities should be submitted as per format given in the guidelines for each activity.

The results of the study on ‘Study of Soil Health’ are to be reported by each school (assigned teacher(s) for RAS 2022-23) by filling up the details in the Google form on the following link: <https://forms.gle/JPt4ij1kFqwt1YKbA>

A Gmail ID is required for filling up the details on the Google Form. For this a new Gmail ID may be created for the school or an existing Gmail ID of the school or Gmail ID of any teacher may be used.

***The duly filled Google Form has to be submitted within fifteen (15) days after the conduct of Rashtriya Avishkar Saptah 2022-23.*** The results submitted by all schools will be collated, analysed and shared by DESM, NCERT.

### ***Extended Learning***

During Rashtriya Avishkar Saptah 2022-23, schools may organize/invite, talk, interaction and/or lecture by expert(s)

in the area for escalating importance of “Study of Soil Health” for wider awareness of all students, teachers, parents and even local community.

The activities are to help teachers to elicit students’ diverse ideas about analysing the soil health. The schools may explore and include some more activities to Study of Soil Health with the help of faculty members of nearby Higher Education Institutions (HEIs) to enhance the knowledge of the students towards the soil health. Even, a few groups of students may undertake investigatory projects on study of soil health.

## PROCEDURE FOR FILLING GOOGLE FORM

Filling up Google Form is very easy. You need to have a Gmail account for filling this Google form.

1. Once you have a working Google ID (Gmail), you can open any browser and copy/ type the following URL into browser:

<https://forms.gle/JPt4ij1kFqwt1YKbA>

2. It will take you to the following page where you need to enter the Gmail ID to proceed:

Data Submission Form- RAS 2022 | डेटा प्रस्तुति फॉर्म

Only Teachers must fill the form | फॉर्म केवल अध्यापक के द्वारा भरा जाए

rasncert2022@gmail.com Switch account

The name and photo associated with your Google account will be recorded when you upload files and submit this form. Your email is not part of your response.

\* Required

Email \*

Your answer

राष्ट्रीय अविष्कार सप्ताह 2022-23  
दिसंबर 2022 – जनवरी 2023  
Rashtriya Avishkar Saptah 2022-23  
December 2022 - January 2023

मृदा स्वास्थ्य का अध्ययन  
Study of Soil Health

राष्ट्रीय शैक्षणिक अनुसंधान और प्रशिक्षण परिषद्  
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

Instructions | निर्देश  
Click on the following link and go through the PDF carefully before proceeding further. |  
अगले बटन से भरने से पहले, नीचे दिए लिंक पर क्लिक करें तथा PDF को ध्यानपूर्वक पढ़ें।

Help | सहायता  
Checkout announcement section on [ncert.nic.in](https://ncert.nic.in) for all the updates regarding RAS 2022 |  
For any assistance/help, kindly email us at [rasncert2022@gmail.com](mailto:rasncert2022@gmail.com).

RAS 2022 के बारे में अधिक जानकारी के लिए [ncert.nic.in](https://ncert.nic.in) पर सौमना अनुभाग देखें। किसी भी तरह की सहायता के लिए हमें [rasncert2022@gmail.com](mailto:rasncert2022@gmail.com) पर टैग करें।

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3. After clicking on Next button, you will be taken to Section 2 of the Form, where you have to fill your School details like School Name, Address etc.

**School Details | विद्यालय विवरण**

State/Union Territory | राज्य/ केंद्र शासित प्रदेश \*

Choose ▾

Name of District | जिले का नाम \*

Your answer \_\_\_\_\_

Block where school is located | ब्लॉक का नाम जहाँ पर विद्यालय स्थित है \*

Your answer \_\_\_\_\_

Name of school | विद्यालय का नाम \*

Your answer \_\_\_\_\_

U-DISE code school | विद्यालय का U-DISE कोड \*

Your answer \_\_\_\_\_

Address of school | विद्यालय का पता \*

Your answer \_\_\_\_\_

Pin code | पिन कोड \*

Your answer \_\_\_\_\_

Locality of School (Urban/Semi-urban/Rural) | विद्यालय की अवस्थिति (शहरी/अर्ध शहरी/ग्रामीण) \*

Rural | ग्रामीण

Semi-urban | अर्ध शहरी

Urban | शहरी



Name of School Principal/Head Master | विद्यालय के प्रधानाध्यापक/संचालक का नाम

Your answer \_\_\_\_\_

Name and designation of Teacher(s) involved in guiding the activities | गतिविधियों के दौरान मार्गदर्शन करने वाले अध्यापक/अध्यापकों का नाम एवं पद

Your answer \_\_\_\_\_

Grade Level | श्रेणी स्तर \*

Middle Level | मध्य स्तर

Secondary Level | माध्यमिक स्तर

Middle & Secondary Level | मध्य & माध्यमिक स्तर

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Note: Select the Middle level option from Grade Level for filling the activities result data for middle level students, select the Secondary level option for filling the activities result data for secondary level students and select the Middle & secondary level option for filling the activities result data for the both middle and secondary level students.

- After clicking on Next button, you will proceed to Section 3 of the Form. In this section, you have to fill the data for Activity 1 (a) (Compulsory to all the students).

**How to Determine Soil Health | मृदा स्वास्थ्य का निर्धारण कैसे करें**

(Teacher should enter only the average data submitted by students | शिक्षक को केवल छात्रों द्वारा प्रस्तुत औसत डेटा दर्ज करना चाहिए )

I. Activity to study the texture of soil samples | मिट्टी के नमूनों की बनावट का अध्ययन करने के लिए गतिविधि

1. (a) Quantitative Analysis | मात्रात्मक विश्लेषण

Soil A | मृदा A  
Source of soil | मृदा का स्रोत

Choose ▾

Color of soil | मृदा का रंग

Choose ▾

Percentage (%) of Sand   रेत का प्रतिशत (%) Your answer _____
Percentage (%) of Silt   गाद का प्रतिशत (%) Your answer _____
Percentage (%) of Clay   चिकनी मिट्टी का प्रतिशत (%) Your answer _____
Texture Class of Soil A   बनावट वर्ग मृदा A के लिए Your answer _____

Similarly, fill for the other soil samples.

- After clicking on Next, you will move to Section 4 of the Form. In this, you must fill out data for Activity 1 (b) (Compulsory to all the students).

I. Activity to study the texture of soil samples | मिट्टी के नमूनों की बनावट का अध्ययन करने के लिए गतिविधि

1. (b) Qualitative Analysis | गुणात्मक विश्लेषण

Soil A | मृदा A  
 Time taken for disintegration of crumb (min)  
 | टुकड़े के विघटन के लिए लिया गया समय (min)

Your answer \_\_\_\_\_

Texture of soil A | मृदा A की बनावट

Choose ▼

Similarly, fill for the other soil samples.

6. After clicking on Next, you will move to Section 5 of the Form. In this, you must fill out data for Activity 2 (Middle level).

**II. Activities for Analysis of Soil at Middle Level | कनिष्ठ स्तर पर मृदा के विश्लेषण के लिए गतिविधियाँ**

**Activity 2:** To determine the nature of soil whether the soil is acidic, neutral or alkaline in nature | गतिविधि 2: मृदा की प्रकृति का निर्धारण करने के लिए कि क्या मिट्टी प्रकृति में अम्लीय, तटस्थ या क्षारीय है

If a soil has pH range less than 7 then it is said to be acidic in nature, if pH range greater than 7 then it is called as alkaline in nature and pH = 7 indicates neutral nature of soil. | यदि मृदा का pH मान 7 से कम हो तो वह अम्लीय प्रकृति की कहलाती है, यदि pH मान 7 से अधिक हो तो वह क्षारीय प्रकृति की कहलाती है और pH = 7 मृदा की तटस्थ प्रकृति को दर्शाता है।

**Soil A | मृदा A**  
pH range of Soil A | मृदा A का pH मान

Your answer \_\_\_\_\_

**Nature of soil | मृदा की प्रकृति**

	Acidic   अम्लीय	Alkaline   क्षारीय	Neutral   तटस्थ
Soil A   मृदा A	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Similarly, fill for the other soil samples.

7. After clicking on Next, you will move to Section 6 of the Form. In this, you must fill out data for Activity 3 (Middle level).

**Activity 3: To determine the water holding capacity of soil. | गतिविधि 3: मृदा की जल धारण क्षमता का निर्धारण करना।**

Water Holding Capacity of Soil C (WHC) (%) =  $(W3-W2)-(W2-W1) / (W2-W1)$  | मृदा C की जल धारण क्षमता (WHC) (%) =  $(W3-W2)-(W2-W1) / (W2-W1)$

Soil A | मृदा A  
Weight of empty perforated bottle (W1) | खाली छिद्रित बोतल का वजन (W1)

Your answer \_\_\_\_\_

Weight (perforated bottle + soil) (W2) | वजन (छिद्रित बोतल + मृदा) (W2)

Your answer \_\_\_\_\_

Weight of soil after pouring water (W3) | पानी डालने के बाद मृदा का वजन (W3)

Your answer \_\_\_\_\_

Water Holding Capacity of Soil A (WHC) (%) | मृदा A की जल धारण क्षमता (WHC) (%)

Your answer \_\_\_\_\_

Similarly, fill for the other soil samples.

8. After clicking on Next, you will move to Section 7 of the Form. In this, you must fill out data for Activity 4 (Middle level).

**Activity 4: To determine the bulk density of the soil. | गतिविधि 4: मृदा के थोक घनत्व को निर्धारित करने के लिए।**

Bulk Density = Weight of Soil (g)/ Volume of Soil (cm<sup>3</sup>) | थोक घनत्व = मृदा का वजन (g)/मृदा का आयतन (cm<sup>3</sup>)

Soil A | मृदा A  
Weight of dry soil (W) | सूखी मृदा का वजन (W)

Your answer \_\_\_\_\_

Radius of the pipe (cm) | पाइप की लंबाई (cm)

Your answer \_\_\_\_\_

Height of the pipe (cm) | पाइप की ऊँचाई (cm)

Your answer \_\_\_\_\_

Volume of the pipe (V) | पाइप का आयतन (V)

Your answer \_\_\_\_\_

Bulk density of Soil A in g/cm<sup>3</sup> | मृदा A का घनत्व g/cm<sup>3</sup> में

Your answer \_\_\_\_\_

Similarly, fill for the other soil samples.

9. After clicking on Next, you will move to next Section of the Form. In this, you must fill out data for Activity 5 (Secondary level).

### III. Activities for Analysis of Soil at Secondary Level | माध्यमिक स्तर पर मृदा के विश्लेषण के लिए गतिविधियाँ

Activity 5: To determine the organic content of the soil sample. | गतिविधि 5: मृदा के नमूने की जैविक सामग्री का निर्धारण करने के लिए।

To find the bubbling time add 1g of soil and 10 mL 6% hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) | बुदबुदाहट का समय खोजने के लिए 10 g मिट्टी और 10 mL 6% हाइड्रोजन पेरोक्साइड (H<sub>2</sub>O<sub>2</sub>) मिलाएं

Soil A | मृदा A  
Source of soil | मृदा का स्रोत

Choose ▼

Color of soil | मृदा का रंग

Choose ▼

Bubbling time (min) | बुदबुदाहट का समय (min)

Your answer \_\_\_\_\_

	Very low   बहुत कम	Low   कम	Moderate   मध्यम	High   उच्च
Organic matter content of Soil A   मृदा A की कार्बनिक पदार्थ सामग्री	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Similarly, fill for the other soil samples.

10. After clicking on Next, you will move to next Section of the form. In this, you must fill out data for Activity 6 (Secondary level).

**Activity 6: Determining Water Infiltration Rate for soil | गतिविधि 6: मृदा के लिए जल के रसने की दर का निर्धारण**

Take a pipe of diameter of 4 inch and height 6 inch. | 4 इंच के व्यास और 6 इंच की ऊँचाई का एक पाइप लें।  
Infiltrate rate = volume/ time taken (mL/min)  
| रसने की दर = मात्रा/लिया गया समय (mL/min)

**Soil A | मृदा A**  
Time taken by water to be absorbed (min)  
| जल द्वारा अवशोषित होने में लगने वाला समय मिनट में

Your answer \_\_\_\_\_

**Infiltrate rate for soil A (mL/min) | मृदा A के लिए रसने की दर (mL/min)**

Your answer \_\_\_\_\_

**Soil B | मृदा B**  
Time taken by water to be absorbed (min)  
| जल द्वारा अवशोषित होने में लगने वाला समय मिनट में

Your answer \_\_\_\_\_

**Infiltrate rate for soil B (mL/min) | मृदा B के लिए रसने की दर (mL/min)**

Your answer \_\_\_\_\_

Soil C | मृदा C

Time taken by water to be absorbed (min)  
| जल द्वारा अवशोषित होने में लगने वाला समय मिनट में

Your answer

Infiltrate rate for soil C (mL/min) | मृदा C के लिए  
रसने की दर (mL/min)

Your answer

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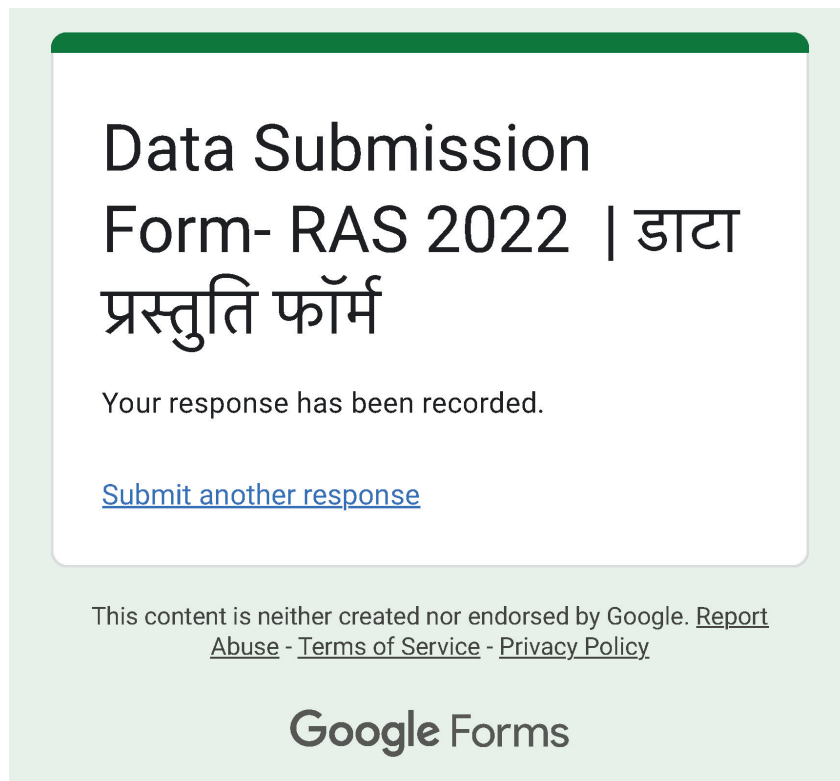


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Here, you have to share your experience and upload images (maximum 10). After this, you have to click on Submit button to finally submit your Form.



11. On successful submission of the Form, you will receive a message similar to the one as given below:



Note: You can check your responses again by clicking on the Back button before making Final submission. No changes can be made after Final submission of the Form.

12. After this, you may close the window/ tab of your web browser.

**For any assistance/ support, kindly email us at:**

**[rasncert2022@gmail.com](mailto:rasncert2022@gmail.com)**

विद्यया ऽ मृतमश्नुते



एन सी ई आर टी  
NCERT

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