

**Essential Standard Operating Procedure  
(SOP) Required for Affiliation with CBSE**

**Composite Science  
Laboratory**

**CENTRAL BOARD OF SECONDARY EDUCATION**

## 1. Introduction:

Laboratories aim to create opportunities to provide students with hands-on experience of laboratory experiments, which could bridge the gap between theoretical concepts and their application in everyday life. The laboratory performance is based on the idea that science focuses on hands-on, minds-on observational activities and that these activities help students make connections between various scientific concepts and real-life experiences. If students are to make use of any technology/ scientific skills in their classrooms, they must learn to make observations, formulate hypotheses, conduct experiments, collect data, use appropriate tools, analyse the data and interpret the obtained results. The practicals enable students to connect to other science areas, communicate the information effectively, and argue their conclusions logically. Students can learn these skills if they can participate in various laboratory exercises. In the study of Science, practicals are given special consideration as they are necessary to stimulate creativity, curiosity and critical thinking among students. Moreover, practicals help increase students' engagement, thus boosting their interest in the subject.

School labs are an excellent place for students which help them enhance their learning by understanding the theoretical concepts of science taught in classrooms. Well-designed laboratories make science experiments fun and help students achieve good academic results. It helps to close the gap in the achievement of learning outcomes, and classroom transactions will shift towards competency-based learning and education. Hence, a well-equipped Science Laboratory is required in every school to:

- Make learning Holistic, Integrated, Enjoyable, and Engaging
- Develop conceptual understanding giving a strong emphasis on Experiential learning in all stages of science education to move toward Competency-focussed education.
- Provide opportunities to students for hands-on learning to observe, experiment and innovate
- Fulfill curricular expectations in a holistic manner
- Create and facilitate a culture of research from the school level itself
- Promote collaborative learning

## 2. Curricular expectations

At this stage learners are expected to:

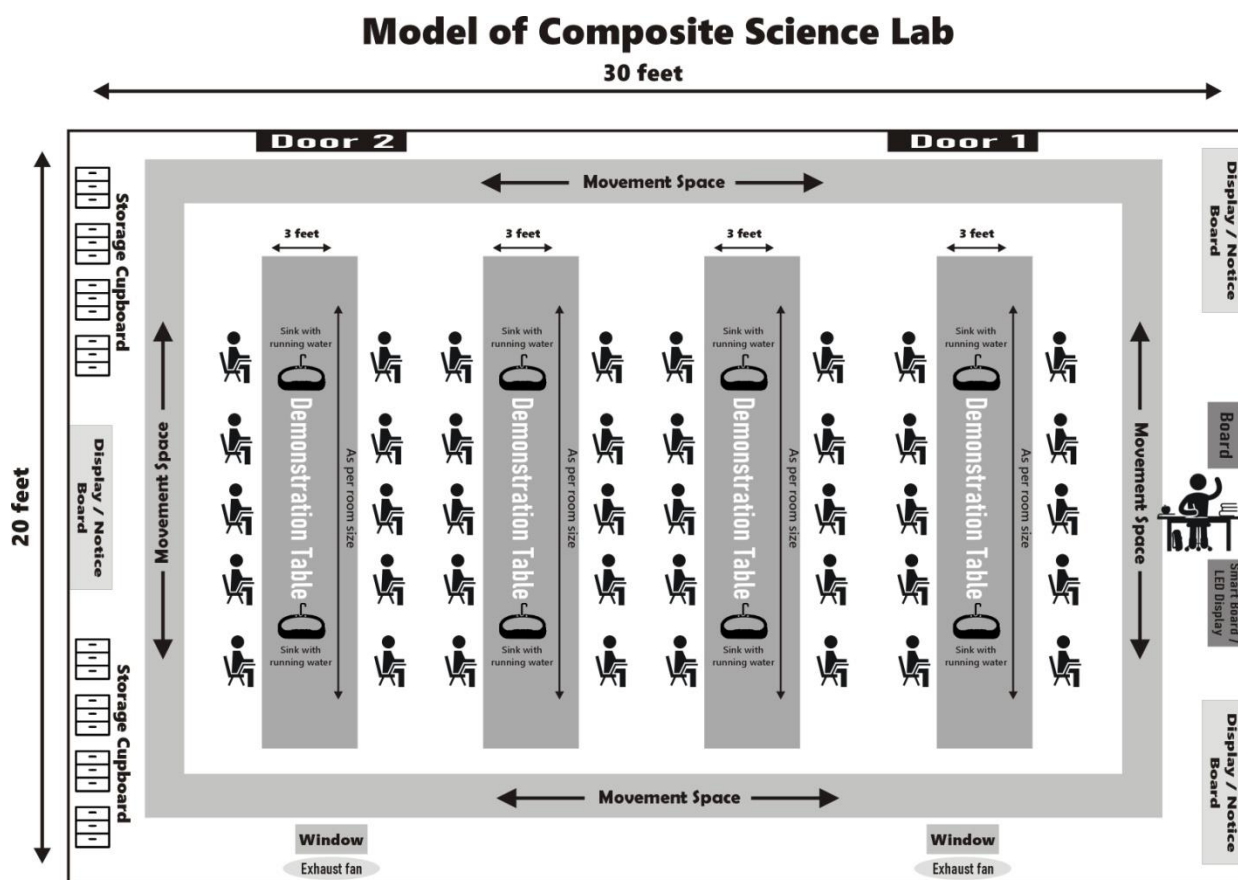
- Develop understanding of concepts, principles, theories, and laws governing the physical world, consistent with the stage of cognitive development.
- Develop ability to acquire and use the methods and processes of science, such as observing, questioning, planning investigations, hypothesizing, collecting, analyzing and interpreting data, communicating explanations with evidences, justifying explanations, thinking critically to consider and evaluate alternative explanation, etc.
- Conduct experiments, also involving quantitative measurements.
- Appreciate how concepts of science evolve with time giving importance to its historical prospective.
- Develop scientific temper (objectivity, critical thinking, freedom from fear and prejudice, etc.).
- Nurture natural curiosity, aesthetic sense, and creativity.
- Imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment.
- Develop respect for human dignity and rights, equity and equality.

### 3. Pedagogy of Science education as recommended by National Education Policy 2020:

- Chapter 4 of NEP 2020 'Curriculum and Pedagogy in Schools: Learning Should be Holistic, Integrated, Enjoyable, and Engaging' has laid a wide emphasis on Experiential learning in all stages of science education in Para 4.6.
- Chapter 7 of NEP 2020 in Para 7.5 has mentioned the importance of well-equipped science laboratories for strong science education.
- According to Para 12.1 Effective learning requires a comprehensive approach that involves appropriate curriculum, engaging pedagogy, continuous formative assessment, and adequate student support. The curriculum must be interesting and relevant, and updated regularly to align with the latest knowledge requirements and to meet specified learning outcomes which can be made possible by well-equipped science laboratories.

To align with the recommendations of NEP and for the convenience and clarity of all stakeholders, CBSE has prepared SOPs for laying down the requirements for Composite Science Laboratory in schools. The present SOP also illustrates adequately the safety rules for students and instructions for teachers in this regard. The SOP also attempt to sensitize schools about proper management of waste generated during the practical exercise carried out by the students. It is hoped that the SOPs will be helpful for schools and students in adopting basic rules for safe behaviour and hygiene, to avoid accidents in the laboratory.

### 4. Model Layout of Composite Science Laboratory



## 5. Infrastructure needed for Composite Science Laboratory:

### Recommendations for Infrastructure

S. No.	Category / Materials needed	Requirements
1	Physical Infrastructure	<ul style="list-style-type: none"><li>• Minimum Lab. Room size 600 Sq.ft.</li></ul>
2	Storage	<ul style="list-style-type: none"><li>• A separate room or cupboards within lab for consumables and non- consumables items in the lock and key mechanism, thus ensuring a safety, dust and vermin-free environment.</li></ul>
3	Teaching facility	<ul style="list-style-type: none"><li>• Preferably an intelligent board with an internet Facility or white / green board.</li></ul>
4	Demonstration Table	<ul style="list-style-type: none"><li>• The demonstration table should also have a sink along with a water tap. In the laboratory, seats are made available to the students, so students sit at the allotted place and note the instructions from the teacher.</li><li>• 40 seating facilities (lab stools)</li></ul>
5	Display / Notice Board	<ul style="list-style-type: none"><li>• Do's &amp; Don'ts/ rules for the laboratory use/ safety procedures</li><li>• List of practical activities</li><li>• Timetable- (laboratory timetable)</li><li>• Emergency Contact numbers</li></ul>
6	Gas/ heating	<ul style="list-style-type: none"><li>• Preferably gas pipeline. (2 heating burners)</li></ul>
7	Sink with Water supply	<ul style="list-style-type: none"><li>• 8 sinks with water supply</li></ul>
8	Waste management	<ul style="list-style-type: none"><li>• 02 bins to be installed for biodegradable and non - biodegradable waste.</li><li>• Flammable chemicals bottles must be packed separately. Empty chemical bottles can be packed in cartons/sacks. Disposal must be sent to the Material Management Division of the school.</li></ul>
9	Fire extinguisher	<ul style="list-style-type: none"><li>• To be installed at a prominent place within the laboratory or in the corridor outside the laboratory.</li></ul>
10	Exhaust fans	<ul style="list-style-type: none"><li>• 2 in number</li></ul>
11	Medical First Aid Kit	<ul style="list-style-type: none"><li>• 2 in number</li></ul>
12	Heating facility	<ul style="list-style-type: none"><li>• One Heater should be available in the lab to conduct Heat related experiments</li></ul>

## 6. Minimum requirement of equipment / items for a Composite Science laboratory

### a) List of Non-Consumable Items (for a batch of 40 students):

S. No	Materials Required	Requirement	S. No	Materials Required	Requirement
1	Assembled Microscope	10	26	Concave Lens	10
2	Test Tubes	10	27	Separating Funnel	10
3	Boiling Tubes	20	28	China Dish	10
4	Beakers (100ml)	10	29	Petri Dish	10
5	Beakers (500ml)	5	30	Needles (To keep the Coverslips)	10
6	Conical Flask	5	31	Laboratory Thermometer	10
7	Tripod Stand	10	32	Spring Balance (0-250 gm)	4
8	Wire Gauze	10	33	U-Shaped Magnet	5
9	Filter Paper	10 Boxes	34	Specimens	20
10	Assembling Box (Wooden Box for keeping Few Things)	5	35	Permanent Slides	80
11	Funnel (Small) (Both Glass and Plastic one)	10+10	36	Pin Hole Camera	4
12	Funnel (Big) (Both Glass and Plastic one)	5+5	37	Kaleidoscope	5
13	Spatula	20	38	Magnetic Compass	5
14	Round Bottom Flask (Small)	5	39	Bar Magnet	10
15	Laboratory Thermometer	10	40	Iron Fillings	4 Boxes
16	Glass Rod	10	41	Iron Stand	4
17	Droppers (Big+Small)	10+10	42	Thumb Pins	2 Box
18	Deflagrating Spoon	5	43	Bunsen Burners	To be attached to gas supply accordingly
19	Plane Mirrors	10	44	Glass prism	4
20	Stands for plane Mirrors	10 Pairs	45	Gas Jar	4
21	Test Tube Holder	10	46	Pair of Tongs	5
22	Scissors	4	47	Laptop/ Desktop Set	2 set up
23	Charts for Display	15	48	Convex Mirror	10
24	Portraits (as per choice)	20	49	Convex Lens	10
25	Concave Mirror	10			

**b) List of Consumable Items (for a batch of 40 students at any given time):**

S. No	Materials Required	Requirement
1	Hand Wash	2 Bottles
2	Hand Sanitizer	2 Bottles
3	Iodine Solution	200 ml
4	Copper Sulphate	200 gm
5	Sodium Hydroxide pallets	200 gm
6	Matchboxes	3
7	Slides	10 Boxes
8	Cover Slips	10 Boxes
9	Alcohol	1000 ml
10	Litmus Paper (Red and Blue)	20 Booklets Each
11	Sodium Chloride	2000gm
12	Hydrochloric Acid (Both Dilute and Concentrated)	200 ml each
13	Methyl Orange	2 Bottle
14	Phenolphthalein	2 Bottle
15	Lime Water	
16	Magnesium Ribbon	4 Coils
17	Sulphur Powder	200 gm
18	Zinc Granules	2 Bottle

**c) Biological Science requirements (for a batch of 40 students at any given time):**

S. No.	Specimen Required	Number
1	Insectivorous Plants	3
2	Hydrilla	2
3	Model of different types of teeth	2
4	Model of a Simple pendulum	2
5	Life Cycle of Silkworm	2
6	Root Nodules (Rhizobium)	2

#### d) Equipments and items Requirements (for a batch of 40 students at any given time):

S. No.	Permanent Slides Required	Number
1	Different Shapes of Bacteria (Bacilli, Cocci, Spirilla)	2 Each
2	Amoeba	2
3	Amoeba- Binary Fission	2
4	Hydra	2
5	Bread Mould	2
6	Spirogyra	2
7	Budding in Yeast	2
8	Paramecium	2
9	Chlamydomonas	2

### 7. Safety guidelines

In order to ensure the safety of students in Science Laboratories, the following provisions are mandatory:

#### ➤ List of general SOP applicable at all times

- Two wide doors for unobstructed exits from the laboratory.
- An adequate number of fire extinguishers near laboratory.
- Periodically checking vulnerable points in the laboratory about the possibility of mishaps.
- It should be ensured that gas fittings in the laboratory fulfill the desired norms and standards.
- Periodical checking of electrical fittings/ insulations for replacement and repairs
- Timely and repeated instructions to students for carefully handling chemicals and equipment in the laboratory.
- Display of do's and don'ts in the laboratory at prominent places.
- Safe and secure storage of all chemicals and equipments.
- Proper labelling and upkeep of chemicals and equipments.
- Proper safety and protection provisions include a fume hood, goggles and gloves while doing practical work.
- Careful supervision of students while doing practical work.
- Advance precautionary arrangements to meet any emergencies.
- Conduct any additional experimental work only under supervision and with due advance permission.
- Availability of First Aid and basic medical facilities in the school.

➤ **General work procedure for students**

- When entering a laboratory, avoid touching equipment, chemicals, electrical and electronic devices, or other materials until you are instructed to do so.
- The students should be careful when doing electricity experiments.
- He/she should not touch any wires if his/her hands are wet, even for low voltage equipment.
- Follow all written and verbal instructions carefully given by the teacher/ instructor.
- Do not start any practical work unless you are clear about its directions. Ask your teacher before proceeding with the activity.
- Be cautious at all times in the laboratory. Call the teacher immediately if you notice any risky conditions.
- Never work alone in the laboratory. The presence of a teacher or supervisor is necessary.
- In case of spillage, breakage or injury, report to the teacher instantly: stay calm.
- Do not taste or smell any chemical present in the laboratory.
- When removing an electrical plug from its socket, switch off and grasp the plug, not the electrical cord. Hands must be dry when touching an electrical switch, plug or outlet / socket.
- Never return unused chemicals to their original container.
- Do not take any chemicals away from the laboratory premises.
- Do not immerse hot glassware in cold water, as the glassware may break. Put the heated glassware in a different place to be cooled.
- Never look into a container that is being heated. Always observe containers from sideways.
- If the Bunsen burner goes out accidentally, immediately turn off the control device/ gas supply.
- Never leave a lit burner unattended.
- Wash your hands with liquid soap and water on leaving the laboratory.