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

Physics 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 Physics, 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:

As per the NCERT Learning Outcomes at Senior Secondary Stage, at this stage Learners are expected to:

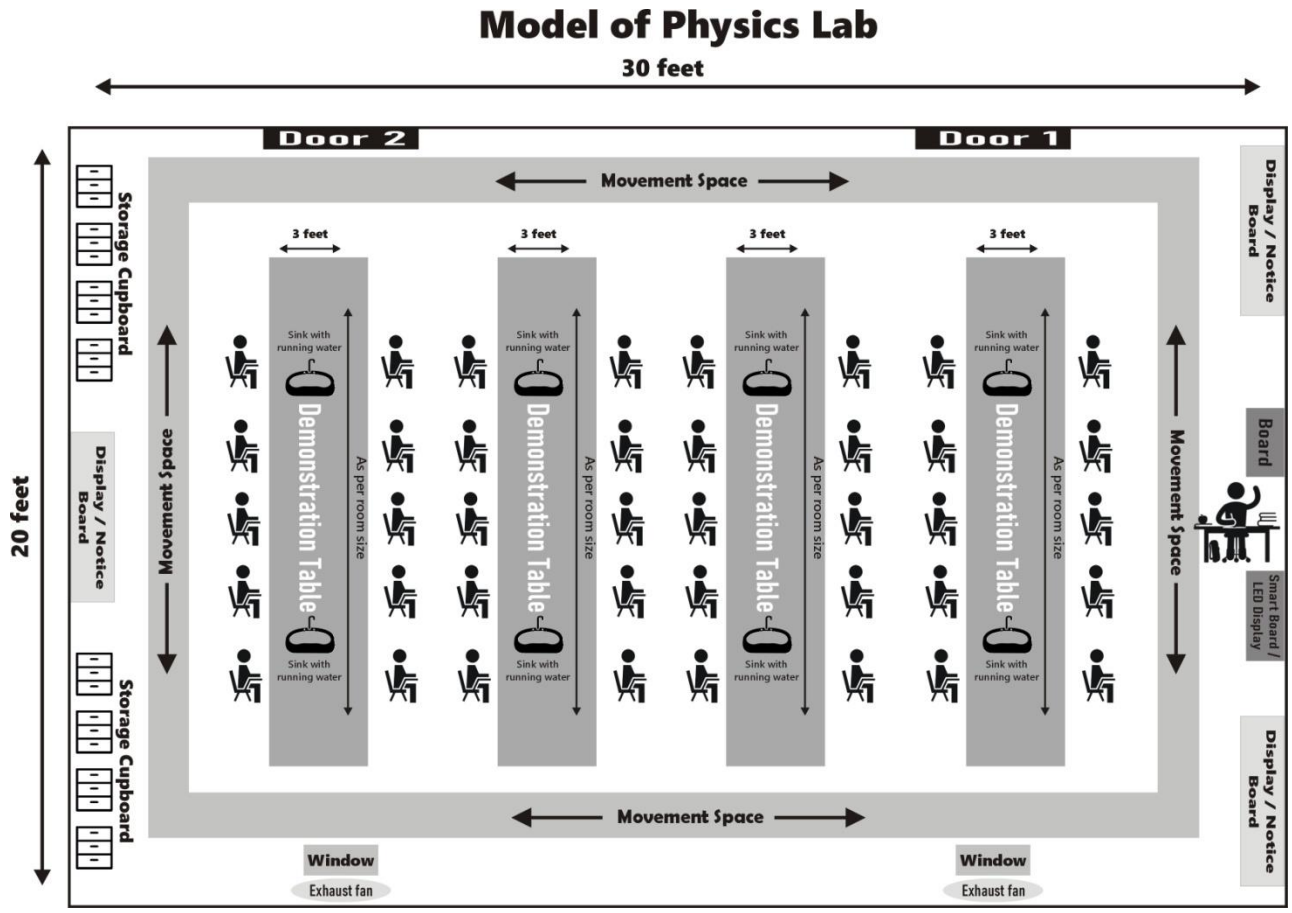
- develop interest to study physics as a discipline;
- strengthen the concepts developed at the secondary stage to acquire firm ground work and foundation for further learning of Physics more effectively and learning the relationship with real life situations;
- apply reasoning to develop conceptual understanding of Physics concepts;
- realize and appreciate the interface of Physics with other disciplines
- get exposure to different processes used in Physics-related industrial and technological applications;
- develop process-skills and experimental, observational, manipulative, decision-making and investigatory skills;
- synthesize various science/physics concepts to solve problems and thinking critically in the process of learning Physics;
- understand the relationship between nature and matter on scientific basis, develop positive scientific attitude, and appreciate the contribution of Physics towards the improvement of quality of life and human welfare;
- comprehend the contemporary knowledge and develop aesthetic sensibilities.
- appreciate the role and impact of Physics and technology, and their linkages with
- overall national development.

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 Physics Laboratory in schools. The present SOP also illustrate 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 Physics Laboratory



5. Infrastructure needed for Physics Laboratory:

Recommendations for Infrastructure

S. No.	Category / Materials needed	Requirements
1	Physical Infrastructure	• Minimum Lab. Room size 600 Sq.ft.
2	Storage	• 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.
3	Teaching facility	• Preferably an intelligent board with an internet Facility or white / green board.
4	Demonstration Table	• 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 instructionsfrom the teacher. • 40 seating facilities (lab stools)
5	Display / Notice Board	• Do's & Don'ts/ rules for the laboratory use/ safety procedures • List of practical activities • Timetable- (laboratory timetable) • Emergency Contact numbers
6	Gas/ heating	• Preferably gas pipeline. (2 heating burners)
7	Sink with Water supply	• 8 sinks with water supply
8	Waste management	• 02 bins to be installed for biodegradable and non - biodegradable waste. • 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.
9	Fire extinguisher	• To be installed at a prominent place within the laboratory or in the corridor outside the laboratory.
10	Exhaust fans	• 2 in number
11	Medical First Aid Kit	• 2 in number
12	Heating facility	• One Heater should be available in the lab to conduct Heat related experiments

6. Minimum requirement of equipment / items for a Physics laboratory

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

S. No	Materials Required	Requirement	S. No	Materials Required	Requirement
1	Ammeters different range	10	27	Rheostat	10
2	Battery eliminator	10	28	Resistance coil different range 1-5 ohms)	20
3	Daniell cell	8	29	Resonance apparatus	8
4	Drawing board	30	30	Spherometer	30
5	Friction apparatus complete set with weight box	8	31	Screw gauge	20
6	Galvanometer	10	32	Wooden scale (1-50 cm, 1-100 cm)	10 each
7	Parallelogram apparatus	10	33	Stopwatch	8
8	Key one way	20	34	Sonometer	8
9	Jockey pencil type	10	35	Sprit level	4
10	Two-way key	8	36	Thermometer	10
11	Laclanche cell	8	37	Tuning fork (250 Hz, 480 Hz and 512 Hz) withpad	5 each
12	Meter bridge	8	38	Vernier calliper	20
13	Multimeter digital	4	39	Voltmeter (different range)	20
14	Multimeter manual	4	40	Beakers	10
15	Magnetic compass	10	41	Connecting wires	1 Kg
16	Optical bench (1 meter long	10	42	Charts for display (bio visuals)	20
17	Prism (Indian glass)	30	43	Portraits (as per choice)	20
18	Potentiometer	8	44	Concave mirror	10
19	Plier	5	45	Convex mirror	10
20	Cutter	5	46	Convex lens	10
21	Screwdriver	5	47	Concave lens	10
22	Scissor	5	48	Wedge knife edge (for sonometer)	10
23	Resistance box (different range 0.1 to 10 ohm) • 1 to 10 ohms • 1 to 100 ohms • 1 to 1000 ohms • 1 to 100000 ohms	5 each	49	Glass slab	30
24	Dry cell 10g (chargeable)	10	50	Pendulum box	20
25	Dry cell charger	8	51	Cork rubber 1.5 inches	20
26	Helical spring apparatus with weights	8	52	Hanger weights 500 gm	8 set

S. No.	Materials Required	Requirement	S. No.	Materials Required	Requirement
53	Insulated copper wire	500 gm	71	Laptop/ desktop set	2 setup
54	Meter tape (1-100 meter)	4 roll	72	Balance (Physical)	2
55	Soldering iron	4	73	Boyle's law apparatus	2
56	Spring balance (0-250 gm)	10	74	Fortnis Barometer	2
57	U-shaped magnet	5	75	Metallic Cylinders	2
58	Copper calorimeter	2	76	Metal Sphere	2
59	Epidiascope	2	77	SG Bottles	2
60	Newton's Disc	2	78	Grave sand apparatus	2
61	Telescope	2	79	Young's Modulus	2
62	Camera	2	80	Spectrometer	2
63	Barometer tube	2	81	Hydrometer	2
64	Lactometer	2	82	Spirit Level	2
65	Stove (Oil)	2	83	Potentiometer	2
66	Electric bell	2	84	Silk and cat skin pieces	2
67	Proof Plane	2	85	Gold leaf electroscope	2
68	Binoculars	2	86	Tuning fork	2
69	Soldering rods	2			
70	P-N junction diode set up	4			

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

S. No.	Equipment	Requirement
1	Ammonium Chloride`	500 gm
2	All Pins 1.5 "	2 Packets
3	Copper Sulphate	500 gm
4	Drawing Pins	6 Packets
5	Thread Rolls	1 Roll

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 equipment in the laboratory.
- Display of do's and don'ts in the laboratory at prominent places.
- Safe and secure storage of all equipments.
- Proper labelling and upkeep of equipments/items.
- 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.
- Proper location of the laboratories.

➢ 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.
- 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.
- 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 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.