

**Essential Standard Operating Procedure
(SOP) Required for Affiliation with CBSE
Chemistry 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 practical 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. Hence, a well-equipped Science Laboratory is required in every school to:

1. make learning Holistic, Integrated, Enjoyable, and Engaging
2. Develop conceptual understanding giving a strong emphasis on Experiential learning in all stages of science education to move toward Competency-focussed education.
3. provide opportunities to students for hands-on learning to observe, experiment and innovate
4. fulfill curricular expectations in a holistic manner
5. create and facilitate a culture of research from the school level itself

2. Curricular Expectations

At the Senior Secondary stage, learners who have opted for Chemistry as one of the disciplines for study are expected to:

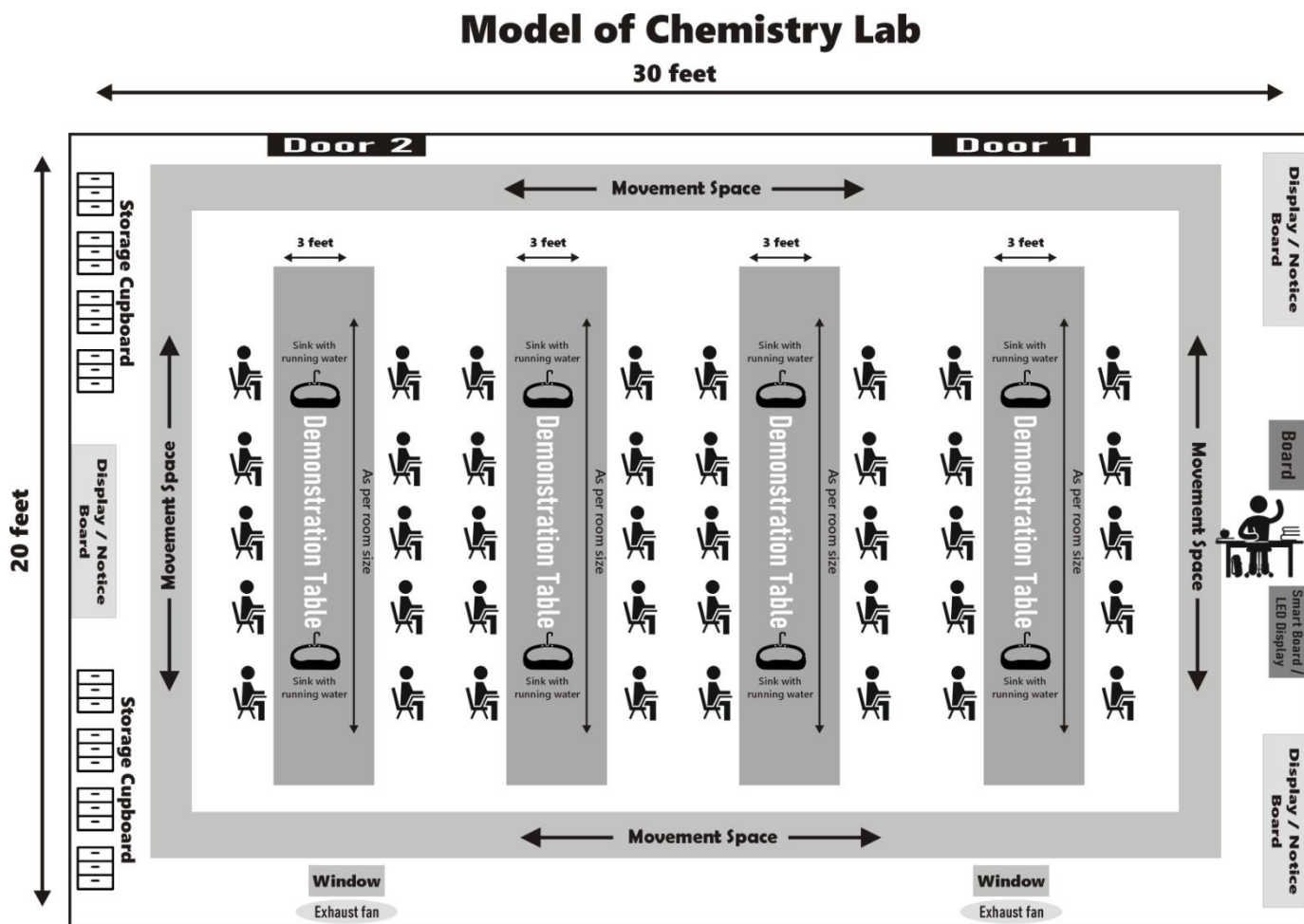
i.	Develop an interest in students to study chemistry as discipline;
ii.	Gain understanding of basic principles in chemistry while retaining the excitement in chemistry;
iii.	Develop per caption for chemistry not only as a discipline of science but make them realize the need and importance in the world around us;
iv.	Strengthens the concepts developed at the secondary stage and to provide firm foundation for further learning of Chemistry at tertiary level more effectively;
v.	Develop ability to acquire and use the methods and processes of science, such as, observing, questioning, planning investigations, hypothesizing, collecting, analysing and interpreting data, communicating explanations with evidences, justifying explanations, thinking critically to consider and evaluate alternative explanation, etc
vi.	Develop positive scientific attitude and appreciate contribution of Chemistry towards the improvement of quality of human life;
vii.	Appreciate how concepts of Chemistry evolve with time giving importance to its historical prospective.
viii.	Develop problem solving skills and nurture curiosity, aesthetic sense and creativity;
ix.	Inculcate values of honesty, integrity, cooperation, concern for life and preservation of the environment;
x.	Makes the learner realize the interface of Chemistry with other disciplines of science such as Physics, Biology, Geology, Geography, Pharmaceutical Science etc;
xi.	Be equipped to face challenges related to health, nutrition, environment, population, whether, industries, agriculture etc;
xii.	Develop respect for human dignity and rights, equity and equality.
xiii.	Develop an appreciation for chemistry as a career option in future.

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

- i. 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.
- ii. Chapter 7 of NEP 2020 in Para 7.5 has mentioned the importance of well-equipped science laboratories for strong science education.

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 Chemistry Laboratory in schools. The present SOP also illustrates adequately the safety rules for students and instructions for teachers in this regard. The SOP also attempts 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 Chemistry Lab:



5. Infrastructure needed for Chemistry Laboratory:

Recommendations for Infrastructure

S.No.	Category/ Materials needed	Requirements
1	Physical Infrastructure	<ul style="list-style-type: none">• Minimum Lab. Room size 600 Sq.ft.
2	Storage	<ul style="list-style-type: none">• 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	Criteria for Storage Area	<ul style="list-style-type: none">• Store chemicals inside a closable cabinet or on a sturdy shelf with a front-edge lip to prevent accidents and chemical spills. All storage areas have doors with locks. Keep chemical storage areas off-limits to all students. Venti latest or age areas adequately.
4	Teaching facility	<ul style="list-style-type: none">• Preferably an intelligent board with an internet Facility or white / green board.
5	Demonstration Table	<ul style="list-style-type: none">• 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.• 40 seating facilities (lab stools)
6	Display / Notice Board	<ul style="list-style-type: none">• Do's & Don'ts/rules for the laboratory use/safety procedures• List of practical activities• Timetable-(laboratory timetable)• Emergency Contact numbers
7	Gas/heating	<ul style="list-style-type: none">• Preferably gas pipeline.(2 heating burners)
8	Sink with Water supply	<ul style="list-style-type: none">• 8 sinks with water supply
9	Waste management	<ul style="list-style-type: none">• Purchase chemicals in the smallest quantity needed.• Use safer chemical substitutes/alternatives such as chemicals determined to be less harmful or toxic.• Use micro scale experiments, i.e. micro kits, where Chemical experiments use smaller quantities of chemicals. Recycle chemicals by performing cyclic experiments where one product of are action becomes the starting material of the following experiment.• Use pre-weighed or pre measured chemical packets such as chem-capsules that reduce bulk chemical disposal problems (no excess chemicals remain).• Do not treat hazardous waste on-site. Contact professional licensed hazardous waste hauliers/transporters that will ensure appropriate disposal.• Solid Chemical waste should be disposed of separately in Solids waste Bin which should be adequately covered.

10	Fire extinguisher	<ul style="list-style-type: none"> To be installed at a prominent place within the laboratory or in the corridor outside the laboratory.
11	Exhaust fans	<ul style="list-style-type: none"> 2 in number
12	Medical First Aid Kit	<ul style="list-style-type: none"> 2 in number
13	Proper Use of Chemical Storage Containers	<ul style="list-style-type: none"> Never use food containers for chemical storage. Make sure all containers are properly closed. After each use, carefully wipe the outside of the container with a paper towel and secure it in the storage area. Properly dispose of the paper towel after use.
14	Chemical Segregation	<ul style="list-style-type: none"> Store acids in a dedicated acid cabinet. Nitric acid should be stored alone unless the cabinet provides a separate compartment for nitric acid storage. Store highly toxic chemicals in a dedicated, lockable poison cabinet with an obvious sign. Store volatile and odoriferous chemicals in a ventilated cabinet. Store flammables in an approved flammable liquid storage cabinet Store water-sensitive chemicals in a water-tight cabinet in a cool and dry location segregated from all other chemicals in the laboratory.
15	Fume cupboard	<ul style="list-style-type: none"> One fume cupboard in the laboratory, which is placed away from the work stations for a safety demonstration. A fume cupboard in which harmful and volatile chemical can be used or stored. The fume cupboard ensures a safe atmosphere in the laboratory.
16	Fume hoods	<ul style="list-style-type: none"> 20 numbers at least six ft. wide.

6. Minimum requirement of equipments / items for a Chemistry laboratory

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

S. No.	Metal and Wooden Apparatus/Non-Consumables	If fixed years	S. No.	Metal and Wooden Apparatus/Non-Consumables	If fixed years
1	Balance(Chemical)	5years	24.	Tripod Stand(Iron)	5 years
2	Blow Pipe (Iron)	2 years	25.	Trough(Tin)	2 years
3	Burette Stand(Wooden)	2 years	26.	Wire Gauze(Iron)	1 year
4	Test Tube Brush	1 years	27.	Weight boxes(Wooden)	5 years
5	Cork Borer (Iron)	2 years	28.	Triangular Clay Pipes (Iron wire covered with clay)	4 years
6	Cork Presser(Iron)	5 years	29.	Beehie Sheft	1years
7	Crucible Tongs (Iron)	2 years	30.	Beaker	1 year
8	Charcoal Slab Borer(Iron)	2 years	31.	Burette	3 years
9	Crucible(Silica)	Breakable	32.	China Dish	1 year
10	Deflagrating spoon (Iron)	5 years	33.	Conical Flasks	1 year
11	Distilation Apparatus (Iron)	2 years	34.	Dessicator	5 years
12	Drying Cones (Iron)	5 years	35.	Gas Jar Dises	1 year
13	Funnel stand or filter Stand (Wooden)	2 years	36.	Flasks (R.B. &F.B.)	1 year
14	Pestle and Mortar	2 years	37.	Funnel	1 year
15	Pinch Cock(Iron)	2 years	38.	Gas Jar or Cylinder	2 years
16	Retort Stand with Ring and Clamp	10 years	39.	Glazed Tile	2 years
17	Round File	5 years	40.	Measuring flasks	1 year
18	Sand Bath	5 years	41.	Pipette	1 year
19	Spirit Lamp (Barss)	4 years	42.	Retort	1 year
20	Stoves	5 years	43.	Thistle Funnel	1 year
21	Test Tube Stand(Wooden)	2 years	44.	Woulfe's Apparatus	2 years
22	Test Tube Holder (Iron)	5 years	45.	Kipp's Apparatus	3 years
23	Triangular Stand (Iron)	2 years	46.	Watch Glass	1 year

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

S.no	Consumable	Requirement	S.no	Consumable	Requirement
1.	Ammonium carbonate	2kg	28.	Potassium chromate	1kg
2.	Ammonium chloride	2kg	29.	Lead acetate	1kg
3.	Ammonium sulfate	2kg	30.	Sodium sulfate	1kg
4.	Ammonium bromide	1kg	31.	Potassium iodide	1kg
5.	Aluminum sulfate	1kg	32.	Lead nitrate	2kg
6.	Iron sticks	2kg	33.	Cedric ammonium nitrate	200gm
7.	Potassium nitrite	500gm	34.	2,4 DNP	200gm
8.	Ammonium oxalate	1kg	35.	Universal indicator	1Lt
9.	Sodium thiosulphate	1kg	36.	Ammonia solution (NH ₄ OH)	3Lt
10.	Zinc sulfate	2kg	37.	Phenol	2Lt
11.	Cobalt nitrate	2kg	38.	Aniline	1Lt
12.	Sodium hydroxide	1kg	39.	Bromine water	1Lt
13.	Copper sulfate	2kg	40.	Acetaldehyde	2Lt
14.	Potassium nitrate	1kg	41.	Acetic acid	2Lt
15.	Oxalic acid	1kg	42.	Fehling solution(A-B)	2Lteach
16.	Magnesium sulfate	1kg	43.	Acetone	2Lt
17.	Magnesium chloride	1kg	44.	Carbon disulfide	1Lt
18.	Ammonium phosphate	2kg	45.	Phenolphthalein	250ml
19.	Sodium chloride	1kg	46.	Nessler's reagent	250ml
20.	Potassium ferrocyanide (K ₄ Fe(CN) ₆)	1kg	47.	Ammoniumm olybdate	500gm
21.	Ferrous sulfate	1kg	48.	Nickel carbonate	1kg
22.	Sodium bromide	1kg	49.	Nickel sulfate	1kg
23.	Ammonium ferrous sulfate	2kg	50.	Manganese chloride	1kg
24.	Potassium dichromate	1kg	51.	Calcium chloride	2kg
25.	Barium chloride	1kg	52.	Sodium bisulphate.	500gm
26.	Strontium nitrate	2kg	53.	Cobalt acetate	1kg
27.	Sodium sulfide (Na ₂ S)	1kg	54.	Chloroform	1Lt

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

S. no	Consumable	Requirement	S. no	Consumable	Requirement
55.	Hydro chloric acid (HCL)	5Lt	70.	Picric Acid	250gm
56.	Sulphuric acid (H ₂ SO ₄)	5Lt	71.	Borax	500gm
57.	Nitric acid (HNO ₃)	5Lt	72.	Cobalt Glass	1pcs
58.	Ethanol	3Lt	73.	Aluminum Metal	250gm
59.	Test tube (50/125mm)	5box	74.	Spatula	30pcs
60.	Test tube holder (thick brass)	30pcs	75.	Bunsen burner	30pcs
61.	Dropper glass (150mm)	40pcs	76.	Droppers	50pcs
62.	Funnel (2")	50pcs	77.	Burettes(50ml)	40pcs
63.	Pipette (10ml)bulb tube	40pcs	78.	Wire gauge	40pcs
64.	Conical flask (250ml)	20pcs	79.	Watch Glass	40pcs
65.	Volume tric flask (100ml)	40pcs	80.	Spatula	30pcs
66.	Filter paper(12.5cm)	10pkt	81.	Tripod Stand	30pcs
67.	Glass rod(thick)	10pcs	82.	Burette stand	30pcs
68.	Plain white labels (2/1)	3pkt	83.	Laboratory thermometer (-10°C to 110 °C)	30pcs
69.	Sodium sulfite (Na ₂ SO ₃)	1kg			

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.
- 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.
- Safe and secure storage of all chemicals.
- Proper labeling and up keep of chemicals.
- Proper safety and protection provisions include a fume hood, goggles and gloves 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.
- 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, break age 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 glass ware in a different place to be cooled.
- Never look in to 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.