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

Biology Laboratory

CENTRAL BOARD OF SECONDARY EDUCATION

1. Introduction:

In the study of Biology, 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 placefor 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. They help to close the gap in the achievement of learning outcomes so that 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 the Senior Secondary stage, learners who have opted for biology as one of the disciplines for study are expected to:

i.	Identify and develop an understanding of concepts, principles, theories, and laws governing the physical world around a biological entity.
ii.	Develop the ability to acquire and use the methods and processes of science, such as observing, questioning, planning investigations, hypothesizing, and collecting, analysing and interpreting data, communicating explanations with evidence, justifying explanations, and thinking critically to consider and evaluate alternative explanations in the biological perspectives.
iii.	Build upon the perceptive of essential tools and techniques used in concepts to analyse various issues in biology.
iv.	Conduct experiments also involving quantitative measurements in biology.
v.	Appreciate how biology concepts evolve with time, giving importance to its historical perspective.
vi.	Develop a scientific temper concerning biological phenomena (objectivity, critical thinking, creative skills, freedom from fear and prejudice) and Nurture natural curiosity, aesthetic sense, and creativity in biological processes and phenomena.
vii.	Imbibe the values of honesty, integrity, cooperation, concern for life and preservation of the environment.
viii.	Develop respect for human dignity and rights, equity and equality.

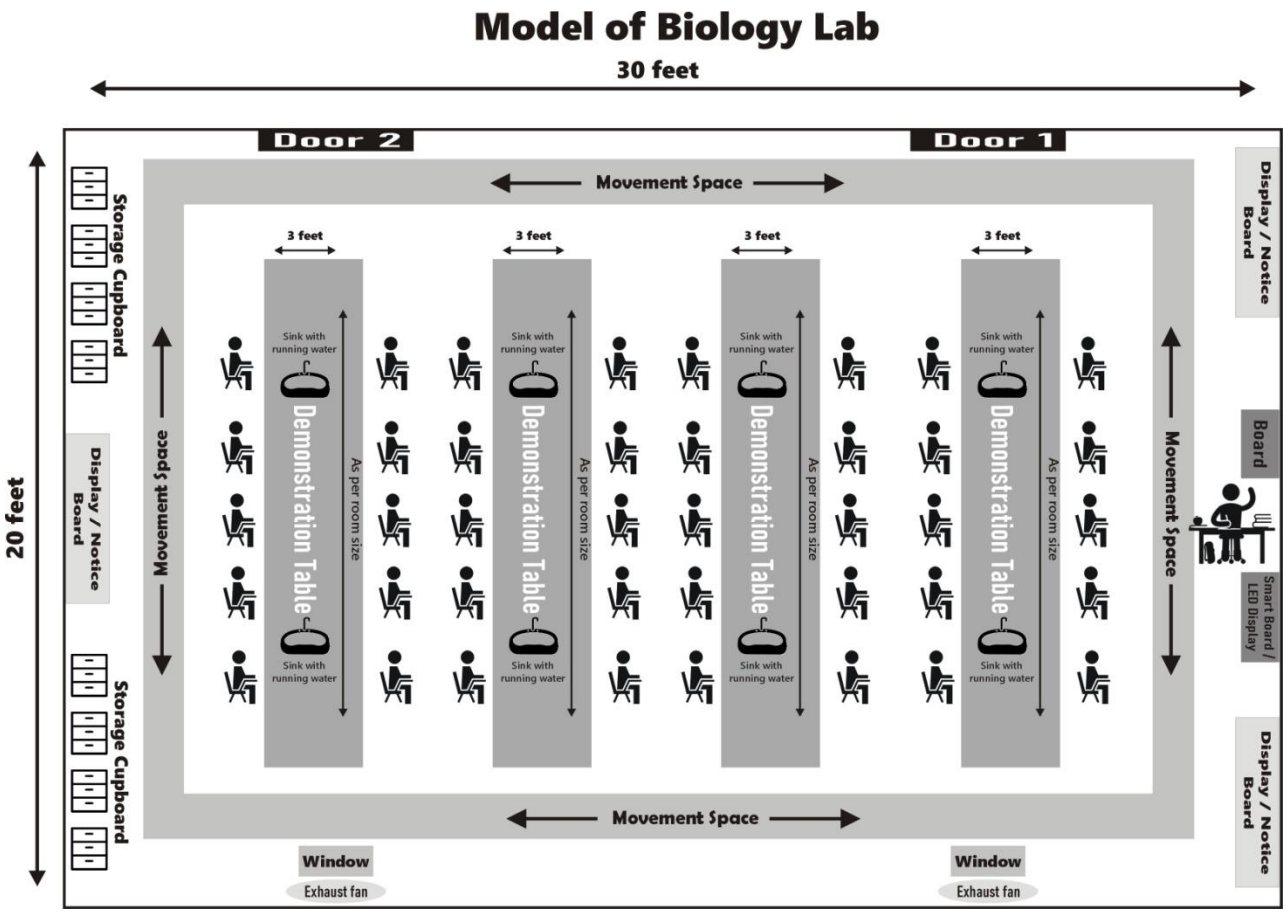
ix.	Connect biological concepts to real-life problems and develop innovative problem-solving abilities to solve problems related to life situations through an understanding of biological concepts.
x.	Widen skills to illustrate linkages of elementary aspects of biology with complex phenomena.
xi.	Integrate and interrelate biological concepts with other areas of knowledge by underlying common principles.

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 Biology 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 Biology Laboratory



5. Infrastructure needed for Biology 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 forbiodegradable 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

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

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

Sl. no	Non-Consumable	Requirement	Sl. no	Non-Consumable	Requirement
1	Beaker 100ml / 250ml /500ml	Twenty	25	Watch glass	Forty
2	Chart stand	one	26	Water bath	one
3	Conical flask	Twenty	27	Wash bottle	Twenty
4	Digital balance	Twenty	28	White cavity tiles	Forty
5	Dropping bottle	Twenty	29	Pipette stand	one
6	Forceps	Forty	30	All Pins	Four packets
7	Funnel	Forty	31	Burette (50ml)	Forty
8	Glass showcase	one	32	Burette 50 ml	Forty
9	Heater	one	33	Perforated beaker	250 ml - twenty
10	Hot plate	one	34	Capillary tube	Twenty
11	Human skeleton (Artificial)	one	35	Test tube holders	Forty
12	Leaf clamp apparatus	one	36	Tripod Stand	Forty
13	Measuring cylinder 50ml/100ml/250ml	Twenty	37	Thermometer	Forty
14	Micro viewers	Eight	38	Trough	Forty
15	Microscope compound	Eight	39	Wire gauge	Forty
16	Microscope dissecting	Eight	40	Burette Stand	Forty
17	Morter and pestle	Eight	41	Blade for section cutting	Eight
18	Petri dish	Forty	42	Chart display stand	Forty
19	Pipette (graduated 10ml)	Forty	43	Enamel Tray	Forty
20	Reagent bottle	Eight	44	Laboratory Coat	Forty
21	Skeleton (joints)	one set	45	Scissors 4"	Forty
22	Slide box	two	46	Scissors 6"	Forty
23	Test tube holders	Forty	47	Scalpel	Forty
24	Test tube stand	Forty	48	Staining Rack	Forty

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

Sl. no	Non-Consumable	Requirement
49	Charts	• Controlled pollination, and Pedigree charts • Roundworm, Earthworm, and Tapeworm • Pigeon, Rat, Scoliosis, Starfish, Frog, and lizard camel, and Cockroach • Mendels inheritance , and the life cycle of the mosquito • Racemose Inflorescence, Cymose Inflorescence, • Modifications of Roots and stem • Posters / portraits of Scientists
50	Models	• Claws and beaks, forelimbs modifications, Brain, Ear, and Eye • Human Torso model, and Human Skeleton Model • Root nodules of leguminous plants • Cuscuta onhost, lichens, homologous and analogous organs.
51	Slide permanent	• Asexual reproduction, Plant tissues, Animal tissues • Stages of mitosis, Meiosis, T.S. of the testis, T.S. of ovaries • Pollen tube germination, T.S. Blastula • Disease-causing agents, Bread mould, Amoeba, Hydra
52	Specimens	• Only plant specimens which are in the syllabus are: • Aquatic plants, xerophytic plants, monocot plants, • Dicot plants, moss, liverworts, fern • Stem root and leaf modifications, • Plant diseases., mushroom
53	Pictures / posters / Charts	• Ascaris, Entamoeba, Plasmodium, any fungus causing ringworm • Bacteria, Oscillatoria, Spirogyra, Rhizopus, mushroom • Yeast, liverwort, moss, fern, pine, one monocotyledonous plant • One dicotyledonous plant and one lichen, Amoeba, • Hydra, liver fluke, Ascaris, leech, earthworm, prawn • Silkworm, honey Bbee, snail, starfish, shark • Rohu, frog, lizard, pigeon and rabbit.

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

S.no	Consumable products	Requirement	S.no	Consumable products	Requirement
1	Acetic acid	250ml	39	Hydrochloric acid	100 ml
2	Acetone	250 ml	40	Detergent	20 gms
3	Alcohol	500 ml	41	Iodine	100 ml
4	AluminumSulphate	20 g	42	Methylene blue	10 ml
5	Benedictssolution	100 ml	43	Micro cover slip	Eight
6	Muslin cloth	20 metres (50 cm pertudent)	44	Micro glass slides	Eight
7	Brushes	Forty	45	Million's reagent	100 ml
8	Matchbox	One box	46	Needle	Forty
9	Ammonium solution	250 ml	47	Nitric acid	50 ml
10	Acetocarmine powder	5 ml	48	Petroleum ether	100 ml
11	Cavity block	Forty	49	Potassium nitrate	20 g
12	Cavity slide	10	50	Safranin solution	50 ml
13	Cellotape / paper tape	one	51	Bile salts	Five gms
14	Chromatography paper	Two sheets	52	Soap	one
15	Cobalt chloride	50 g	53	Starch	50 g
16	Cork	10	54	Starch iodide paper	one packet
17	Cotton Roll	one roll	55	Sucrose	100 g
18	Dettol	100 ml	56	Test tube - Boiling	Twenty
19	Dropper	20	67	Test tube - Ordinary	Eight
20	Dusters	5	68	Test tube Graduated	Forty
21	Filter paper	Five boxes of 24 pieces each	69	Toothpicks	Five jars
22	Formaldehyde	500 ml	70	Aluminum foil	Four foils
23	Glycerine	500 ml	71	Barium Chloride	Five gms
24	Grease	100 g	72	Dicot stem	Ten
25	Boric acid	Five gms	73	Urea	Ten gms
26	Monocot stem	Ten	74	Milk	10 ml
27	Ethanol	50 ml	75	Seeds/Pulses	50 gm
28	Fehling solution A	20 ml	76	Rice	50 gm
29	Fehling solution B	20 ml	77	Spinach Leaves	50 gm
30	Glucose	20 gms	78	Potato	50 gm
31	Lens cleaning solution	one	79	Sugar	50 gm
32	Lens cleaningpaper	one	80	Egg	one
33	Magnesium Sulphate	Ten gms	81	Onion root tips	50 gms
34	Onion root tips	Five roottips	82	Peas	500 gms
35	Plain stickers	Eight	83	Pineapple	50 ml
36	Robert solution	10 ml	84	Banana	one
37	Sodium Chloride	Ten gms	85	Apple	one
38	Sodium Hypobromide	10 ml	86	pH paper	one packet each of a narrow range anda broad range

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 biology 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.
- Proper location of the laboratories.

➢ General work procedure for students

- When entering a laboratory, avoid touching equipment, chemicals, electrical andelectronic 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, 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 equipment 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.
- Wash your hands with liquid soap and water on leaving the laboratory.