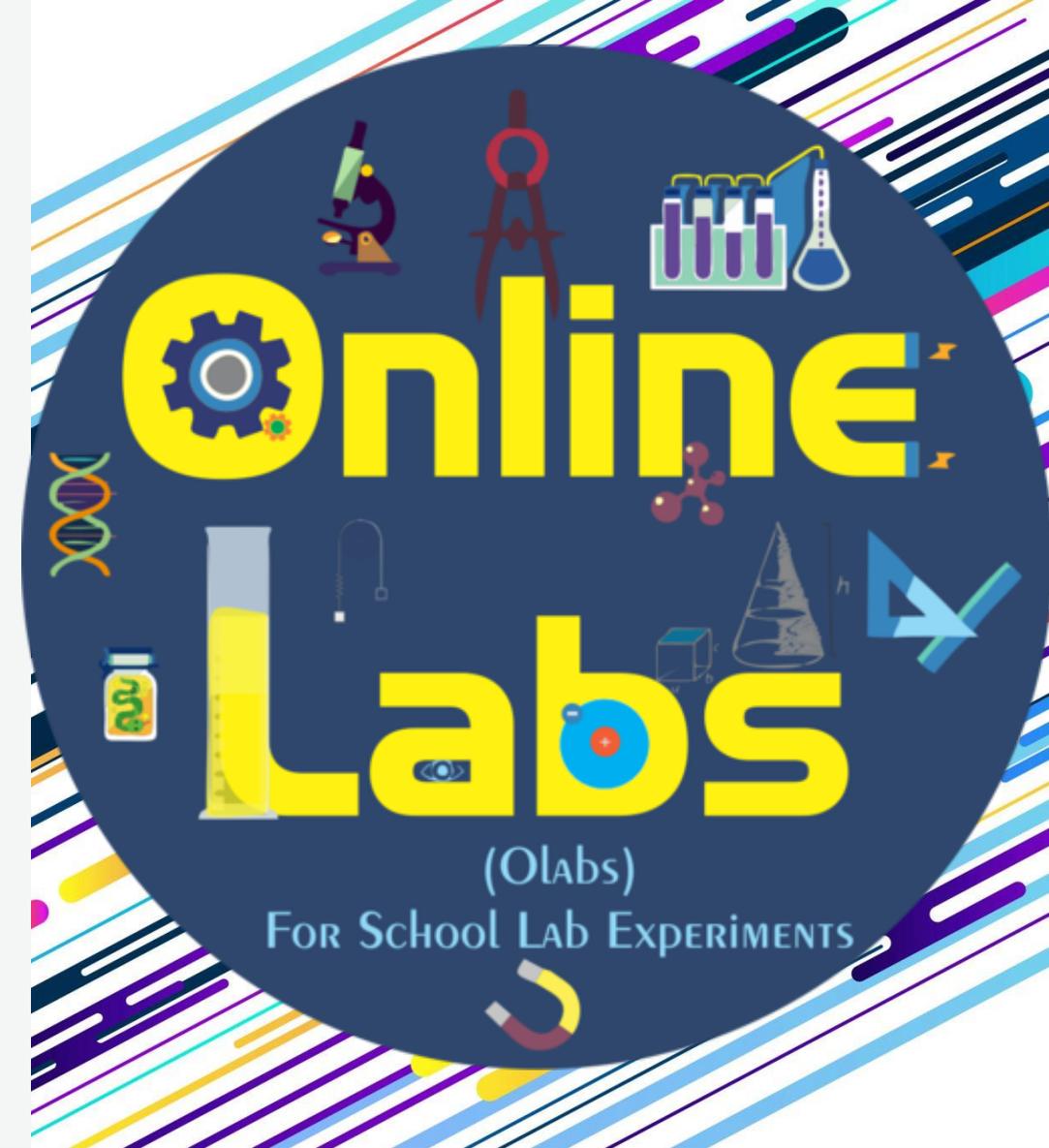# Learning Physics through Online Labs (Virtual Labs)

Archana Rane,

Associate Director, CDAC Mumbai

archana@cdac.in

Need for Virtual Labs

- **Problems with Physical Labs**
  - Limited Infrastructure
  - No/minimal lab session
  - Limited lab access
  - Safety constraints, expensive and fragile equipment.
- **Others**
  - Inadequate 'higher order thinking skills'
  - Assessment of experiments difficult
  - Lack of quality teachers
  - Support for divyang students
- Not all activities amenable to physical labs

Virtual labs

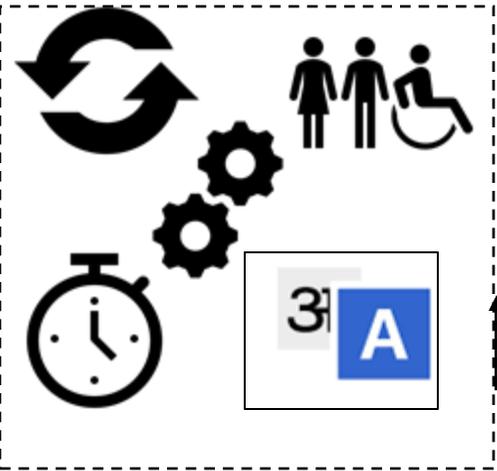Virtual labs and remote labs to the rescue?…

Virtual labs: simulation labs. Usually computer simulation of important aspects of the lab.
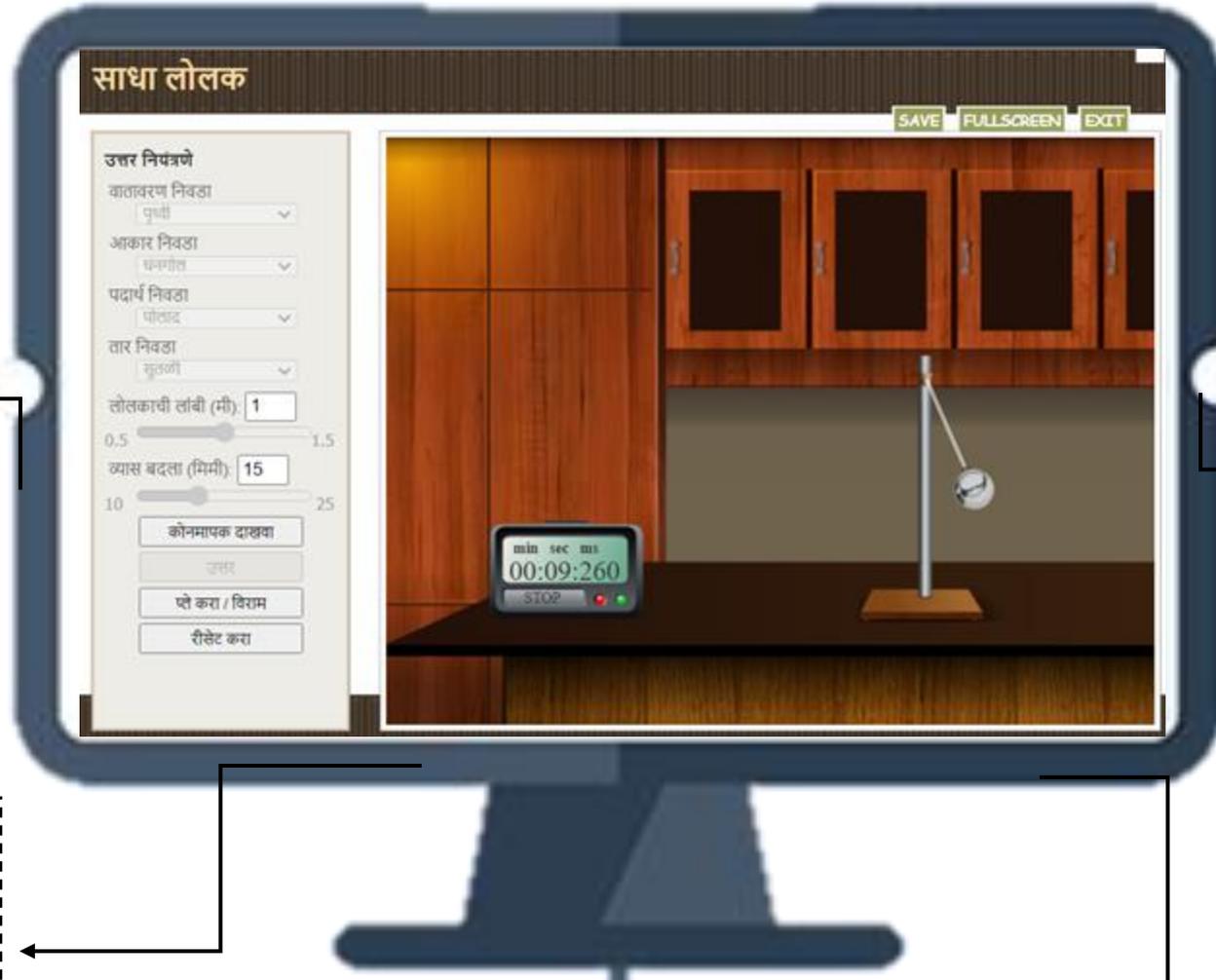
One of the recommendations in the NEP 2020

Remote labs: expensive equipments can be manipulated remotely; enables sharing of such resources.
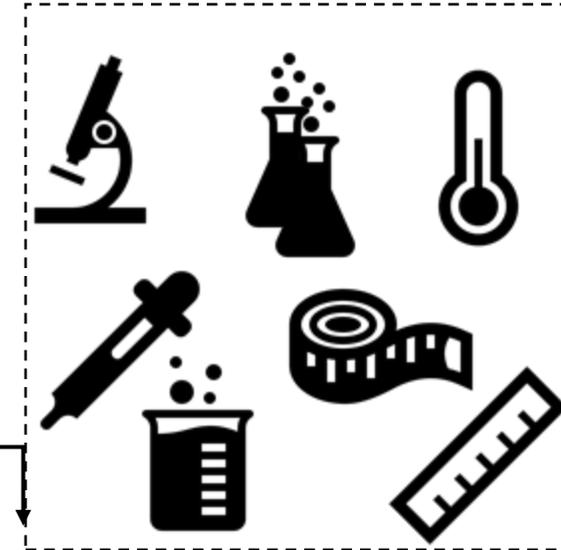
Virtual Labs (Simulation-based)

Affordances

Features

Accessibility & Flexibility

Lab Operations online

Can go beyond boundaries
of a traditional Lab

Observations & Analysis online

What is OLabs?

- Online Labs (OLabs) for school lab experiments are simulation-based labs

- Interactive simulations with real world behaviour

- Students can Explore, Conduct and Repeat at their own pace.

- Available for free web-based access on www.olabs.edu.in

olabs.edu.in
(soon to be under Diksha)

- Offline version available

- Not meant to replace physical labs!
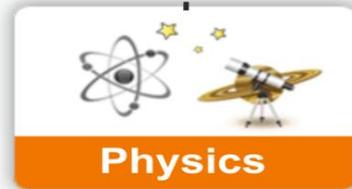 – But augment and amplify them.

OLabs at present

Classes:
- IX
- X
- XI
- XII

Available in
- English
- हिंदी
- മലയാളം
- मराठी

Experiment/Lab Details

Physics
54

Chemistry
46

Biology
36

Mathematics
25
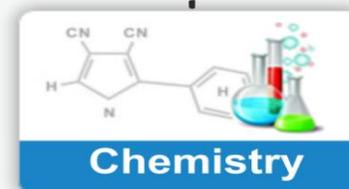
English
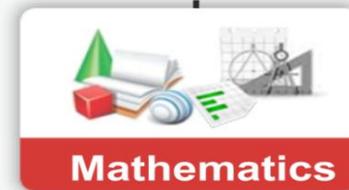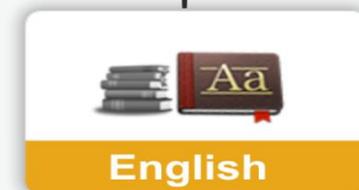12

Total Experiments : 173

Why OLabs?

- Compared to the many simulators available online, OLabs provide a complete eco-system for the lab.

- Consistency in terminology across the tabs

- Compliance with the NCERT curriculum.

- Content reviewed and approved by CBSE teachers.

- High degree of interactivity for the learner and multiple affordances.

OLabs is ready for use…

OLabs
Home page

OLabs eco-system

Theory relevant to the lab

Understanding of the process and its implications

The core simulator

Auxiliary requirements: plot, measurement and recording, etc

Review questions, references

OLabs Physics - Lab specific affordances

- In each lab, a set of affordances are provided.

- These are chosen based on the expectation and requirements of the lab.

- Lab tools such as Timer, measuring scale, protractor, calculator, thermometer, equipment that can be manipulated, etc

- Support Tools such as Play, Pause, Support, Help, etc

- Variants for various parameters
  - E.g. For simple pendulum, you can change - wire length, value of 'g', material of bob, atmosphere, etc.
  - E.g. In Ohms law – resistance of rheostat, diameter of the wire, metal of the wire, etc

- Observation Tables to record data, where there is multiple iterations of the experiment is required.

- Graph Plotting provision where applicable.

- Click to perform, where fine grained mouse control may be difficult. E.g. Connectors in electric circuits.

OLabs: A view of a lab
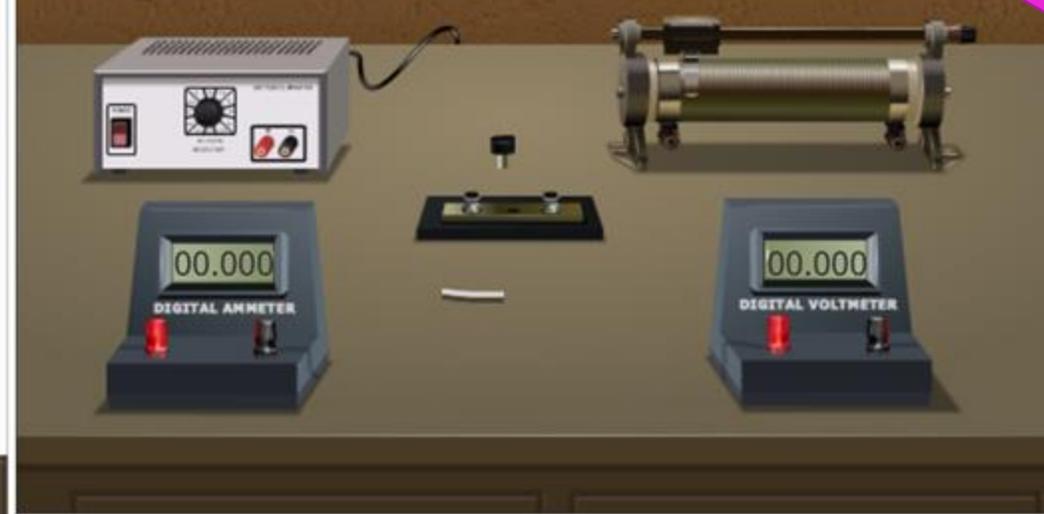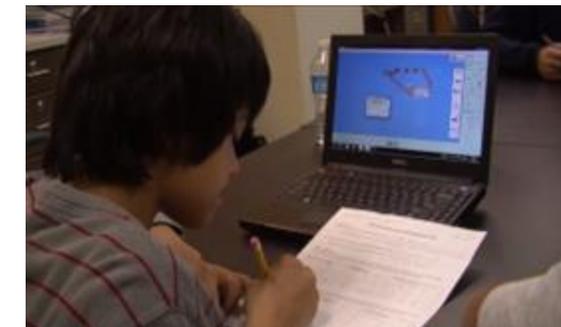
Virtual Labs: Settings & Use cases

Virtual Labs should be flexible enough to be adapted in diverse educational/learning environments and use-cases i.e.

- classroom & virtual classroom (formal education),

- in physical labs (revision or reflection),

- in computer rooms & at home (self-learning),

- in informal education, etc.

Usage mode-1 – Before the physical lab

- Usually students have no idea of what to expect in the lab, till they reach there.

- Being prepared will help to use the limited lab time more effectively.

- OLabs mimics the experimental setup with high fidelity.

- Use the virtual lab as a preparatory ground before the lab.

Usage mode-2 – After the physical lab

- Physical labs provide limited options to explore..
  - due to resource constraints
  - and time constraints.

- In the lab environment, adequate time to reflect may not be there.

- Ask the learner to explore the virtual lab in more detail and try out more scenarios.

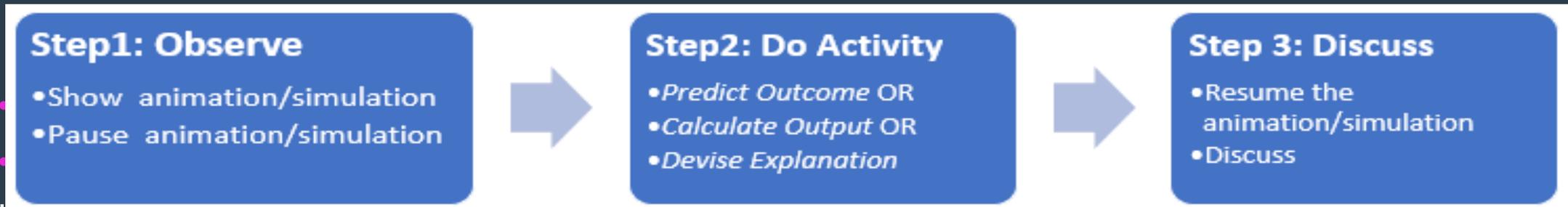- Use reflection in the class, with specific scenarios.

Usage mode-3 - As an instructional device...

- Explaining concepts like hooke's law, focal length of a lens, etc hard without a lab setup.

- OLabs can function as a replica of lab setup for this purpose.

- Demonstrate the intended behaviour using OLabs.

- Use affordances provided to try select use cases.

- Encourage the learners to try them out on their own.

Usage mode-4 - For active learning strategies...

- Active learning strategies like flipped classroom require mechanisms to engage a class without lectures.

- A lab setup replicated in the classroom can provide a fertile ground…

- Stop the experiment arbitrarily and ask learners to predict what happens?

Click to add text

Step1: Observe
- Show animation/simulation
- Pause animation/simulation

Step2: Do Activity
- *Predict Outcome* OR
- *Calculate Output* OR
- *Devise Explanation*

Step 3: Discuss
- Resume the animation/simulation
- Discuss

- Choose activity based on pedagogical purpose and learning objective of the Lab

- Deepens learning and encourages reflection.

Usage mode-5

- In absence of physical lab
  - When there is no physical lab – e.g. pandemic, lack of infra.
  - Can also function as replacement of physical lab in
    - Performing the activities envisaged.
    - Maintain lab records.
    - Getting a feel of the lab activities
      - Only appearance and activities though.

- For Self-learning
  - As Homework – Give inquiry-based activities around lab
  - Encourage self-evaluation using "Viva-Voce" section of each lab.

Virtual Labs challenges

LACK OF GUIDANCE

COLLABORATION

IMMERSIVE EXPERIENCE

NON-STEM SUBJECTS

LEARNER ENGAGEMENT

Our plans for future: OLabs NG!

WORKING IN ISOLATION

TRACKING

NO TOUCH AND FEEL

Physics Labs – Class IX

Class 9

Bell Jar Experiment

Force Required to Move a Wooden Block on a Horizontal Table

Newton's Third law of Motion
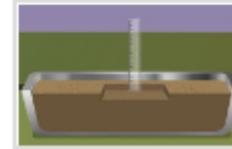
Pressure Exerted by a Solid Iron Cuboid on Sand

Verification of Archimedes Principle

Laws of Reflection of Sound

Determination of Density of Solid

Newtons Second Law
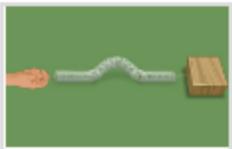
Velocity of a Pulse Propagated Through a Slinky

Physics Labs – Class IX
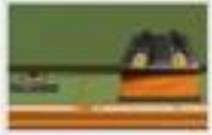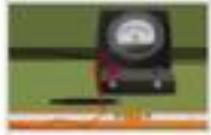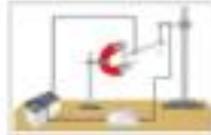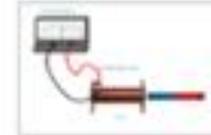
Physics Labs – Class XI

Class 11

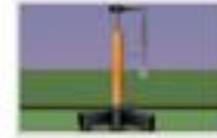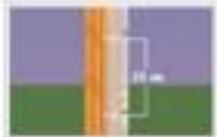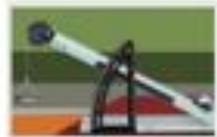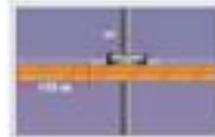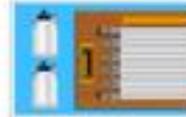|			
Screw Gauge	Vernier Calipers	Simple Pendulum	Beam Balance
Parallelogram Law of Vectors	Spherometer	Friction	Helical Spring
Viscosity of a liquid - Stoke's method	Inclined Plane	Boyle's Law	Surface Tension
Young's Modulus	Resonance Column	Sonometer	Newton's Law of Cooling
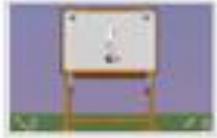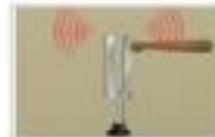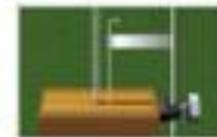
Physics Labs – Class XII
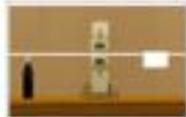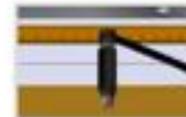
Demo of OLabs Physics Labs

By Suman Ninoriya, CDAC Mumbai

Summary

- We are happy to bring OLabs platform you to add value to the school education, in significant ways.

- We are working on to bring you better and more labs soon in form OLabs Next G

- Do share your feedback and suggestions; we certainly appreciate that.

- We do hope you will consider adopting it for your students and inform the students accordingly.

- You can also contribute – Translate, Train, Give feedback, Share ideas for new labs, etc

Important Links

- **OLabs website** – www.olabs.edu.in

- **OLabs FB page** - https://www.facebook.com/onlinelabs/

- **OLabs Email** – support@olabs.co.in / etu@cdac.in

- **Download Offline version** http://www.olabs.edu.in/?pg=topMenu&id=289

- **Are you using OLabs? Let us know** http://www.olabs.edu.in/?pg=topMenu&id=288

Thank you...

Archana Rane, CDAC Mumbai; Suman Ninoriya, CDAC Mumbai

archana@cdac.in, nsuman@cdac.in

Access OLabs at
www.olabs.edu.in

Access OLabs page at
https://www.facebook.com/onlinelabs/