



# IISERs at a glance

*by Sreepadmanabh M*



# Before we roll ahead ...


- Don't take notes – just listen (*relevant links will be shared, so relax*)
- Do jot down or make mental notes of all queries, however seemingly trivial
- Please, ask questions! (*30-45 mins talk + 15-30 mins Q&A*)

“Science”

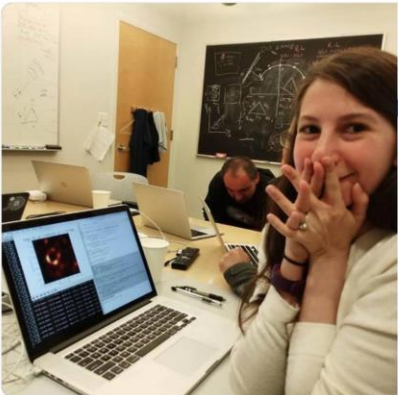





**MIT CSAIL**   
@MIT\_CSAIL


Following 

Here's the moment when the first black hole image was processed, from the eyes of researcher Katie Bouman. [#EHTBlackHole](#) [#BlackHoleDay](#) [#BlackHole](#) (v/@dfbarajas)



 Katie Bouman


Watching in disbelief as the first image I ever made of a black hole was in the process of being reconstructed.


 97


8 Comments 5 Shares


Share


View 2 more comments


 Huyser Bismarck This is amazing! [Full of Congratulations](#) 1h

 Wardah Inan That is so cool! 1h

 Shawn Pengfeng You are so cool! 1h

 Vikas Ramachandran very cool Katie! 47m

 Adrian Delia [Congrats](#) 34m

 Hui Robinson [Congratulations](#) 12m

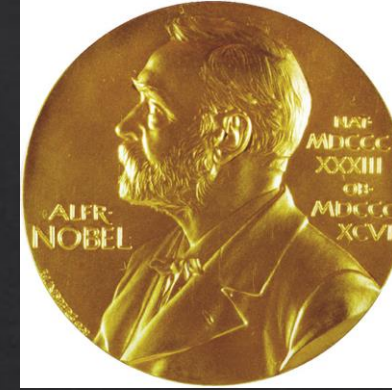
12:51 PM - 10 Apr 2019



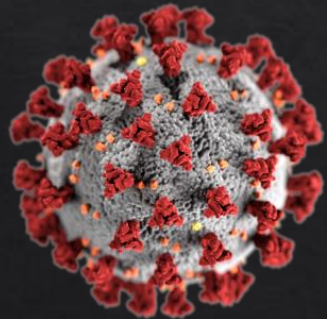


# Genetic Editing

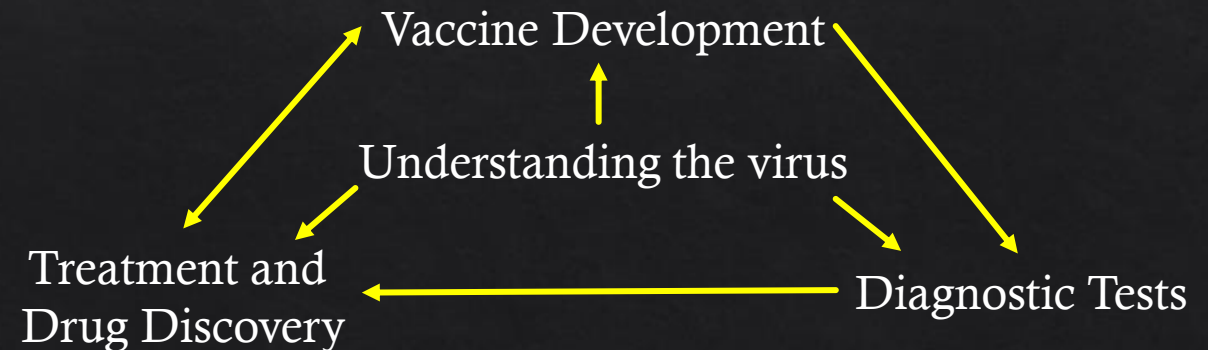
Nobel Prize in Chemistry, 2020:  
Jennifer Doudna and Emmanuelle Charpentier, for CRISPR



**Feng Zhang** – pioneered CRISPR for medical applications, neurogenetics, even designed diagnostic tests for COVID-19!



SARS CoV-2:  
causative pathogen for  
COVID-19



# “Science” has evolved in the 21<sup>st</sup> century

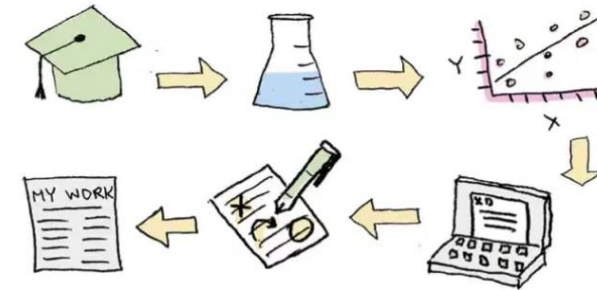
- ◆ Collaborative vs. independent - Team efforts > individualism
- ◆ Rapid communication – preprints, Twitter, e-publications
- ◆ Broader outlook and diversity – multi/inter-disciplinary
- ◆ Massive technological and widespread computational facilities

Master a few trades, but think like a jack-of-all-trades!



# Academic Research: an infographic by Katie Everson (DataWorthSeeing)

Getting science published  
is a **Rigorous Process**



Let's Break It Down...

step

## ① Get an Education



Bachelor's



Master's



PhD

Then more...

Then more...

+ 1 or more "postdoc" positions

## ② Conduct Research

(This could be its own graphic)



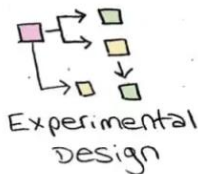
Grant writing



Lit review



Lab work



Experimental Design



Statistical analysis

## ③ Write It Up



Must include:

- Thorough review of other studies
- Detailed methods that other scientists can follow/replicate
- Figures, Tables, Stats

## 4 Submit to a Journal

## 6 Peer Review\*



2-3 scientists critique your paper

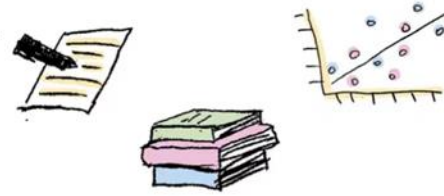
## 7 First Decision

Based on the peer reviews, you receive a decision:

- 1) Reject
- 2) Major Revisions ✓
- 3) Minor Revisions
- 4) Accept\*

\* This almost never happens on a first submission

## 8 Revise



This might involve collecting more data, conducting new analyses, & lots of writing

## 10 Accepted!

Did you know that Scientists are not paid for the papers they write?



After Publication...

## Citation

Other scientists might cite your paper or even try to replicate your results\*

ALL Scientists go through this process:

EVOLUTIONARY BIOLOGISTS

(like me!)



CLIMATE SCIENTISTS

(like my friends in Alaska, hey y'all!)

& MEDICAL RESEARCHERS

who study vaccines & COVID-19



With science we can



CURE DISEASE

DEVELOP NEW TECHNOLOGIES



& learn more about our PAST & FUTURE



# Industrial Research: A *bit* different

step

## ① Get an Education



Bachelor's



Master's



PhD

Then more...

Then more...

+ 1 or more "postdoc" positions

\*Optional, but useful!

## ② Conduct Research

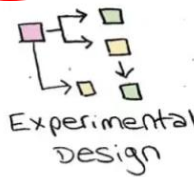
(This could be its own graphic)



Lit review



Lab work



Experimental Design



Statistical analysis

With science we can



CURE DISEASE

DEVELOP NEW TECHNOLOGIES



& learn more about our PAST & FUTURE

MAKE MONEY, duh...

## Influence of dendritic structure on firing pattern in model neocortical neurons

Zachary F. Mainen & Terrence J. Sejnowski

## Optical imaging reveals the functional architecture of neurons processing shape and motion in owl monkey area MT

D. Malonek, R. B. H. Tootell and A. Grinvald

## K<sup>+</sup> channel regulation of signal propagation in dendrites of hippocampal pyramidal neurons

Dax A. Hoffman, Jeffrey C. Magee, Costa M. Colbert & Daniel Johnston

### REPORT

## Linking Spontaneous Activity of Single Cortical Neurons and the Underlying Functional Architecture

M. Tsodyks, T. Kenet, A. Grinvald\*, A. Arieli

\* See all authors and affiliations

## Electrophysiological properties of in vitro Purkinje cell dendrites in mammalian cerebellar slices.

R Llinás, M Sugimori

## Trends in Neurosciences

Volume 20, Issue 1, January 1997, Pages 38-43

CellPress

## Bursts as a unit of neural information: making unreliable synapses reliable

John E. Lisman

obj  
situ  
and

we are touching a hot object? All information from our environment is detected by the specialised tips of some nerve cells. These receptors are usually located in our sense organs, such as the inner ear, the nose, the tongue, and so on. So gustatory receptors will detect taste while olfactory receptors will detect smell.

This information, acquired at the end of the dendritic tip of a nerve cell [Fig. 7.1 (a)], sets off a chemical reaction that creates an electrical impulse. This impulse travels from the dendrite to the cell body, and then along the axon to its end. At the end of the axon, the electrical impulse sets off the release of some chemicals. These chemicals cross the gap or synapse, and start a similar electrical impulse in a dendrite of the next neuron. This is a general scheme of how nervous impulses travel in the body. A similar synapse finally connects other cells, such as n

It is thus no surprise that a network of nerve cells can convey information via electrical impulses. Look at Fig. 7.1

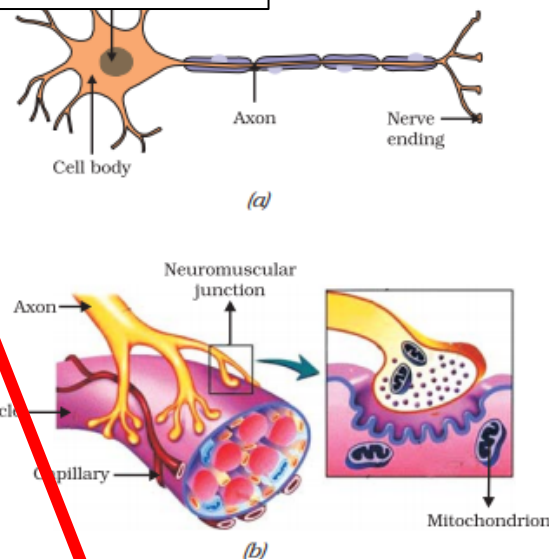


Figure 7.1 (a) Structure of neuron, (b) Neuromuscular junction

## Cell

Volume 104, Issue 5, 9 March 2001, Pages 661-673

CellPress

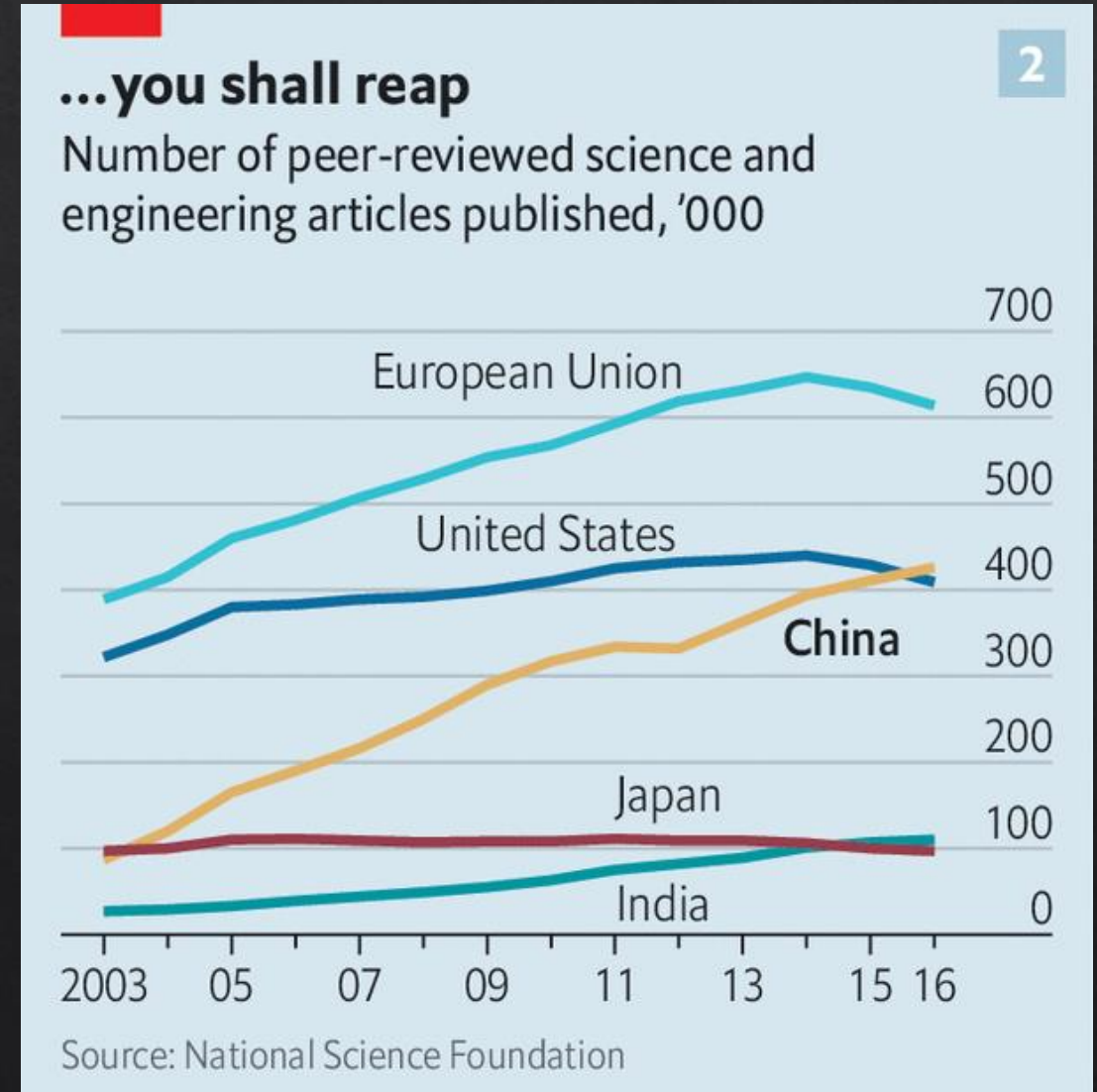
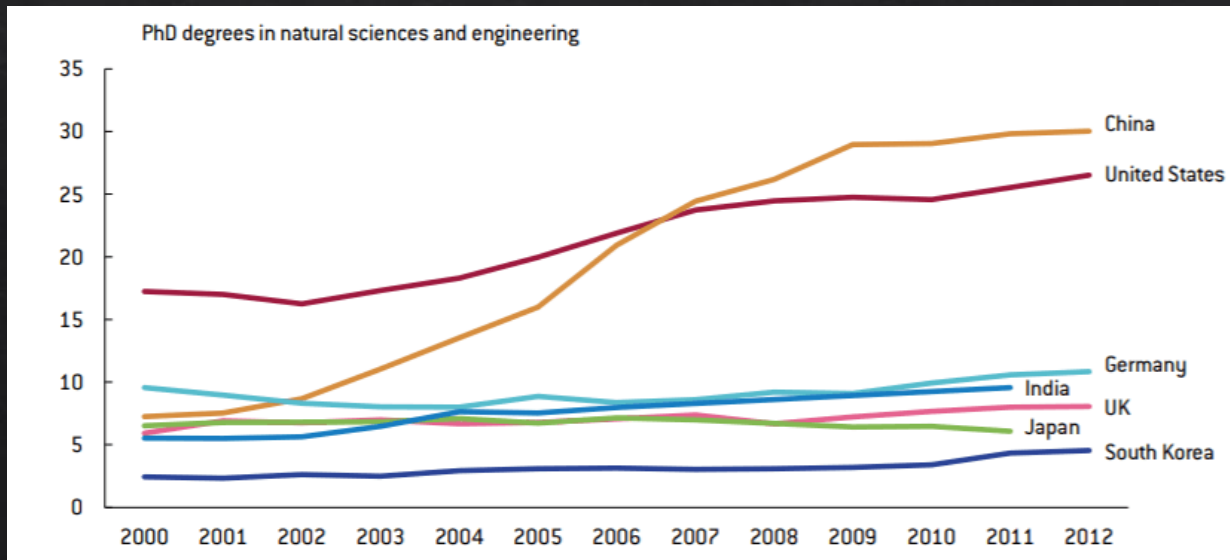
## A Chemosensory Gene Family Encoding Candidate Gustatory and Olfactory Receptors in *Drosophila*

Kristin Scott \*, Roscoe Brady Jr. \*, Anibal Cravchik I., Pavel Morozov †, Andrey Rzhetsky †, Charles Zuker §, Richard Axel \* & ☐



# Evolving times, evolving needs

- ◇ India – forever “developing”?
- ◇ The Chinese example
- ◇ Existing universities – cater to “need” of higher education
- ◇ **New generation of scientific leaders**



# IISER

Indian Institute of Science  
Education and Research





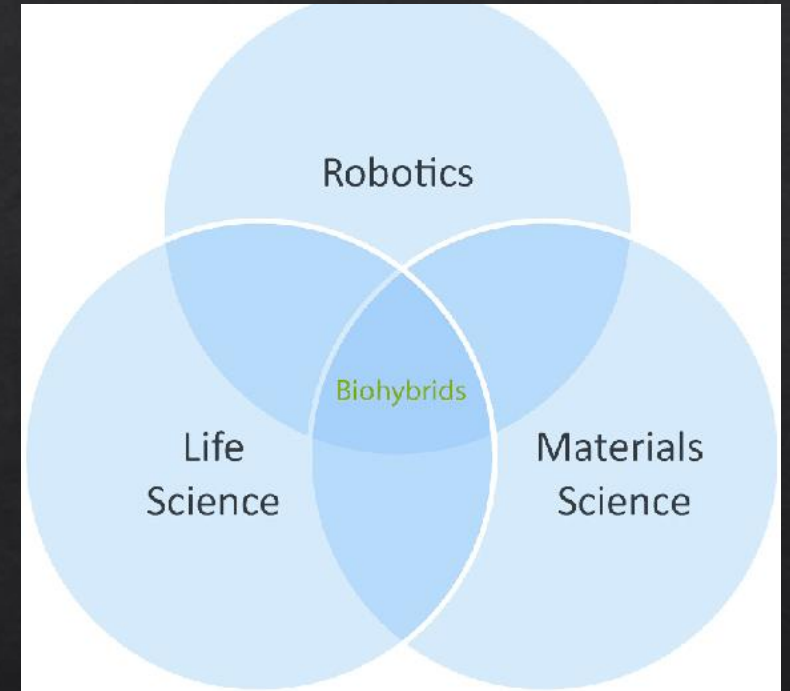
# “Inter/multi-disciplinary” science

Conventional system – **segregated disciplines**

- ◇ Pros - Perfect for laying foundations
- ◇ Cons - Limited scope, restricted applicability

## Why the change?

- ◇ Problems – more intricate and/or more **applicative**
- ◇ High **competition**
- ◇ **Technological** advancements



e.g. An emerging field like designing “smarter” equipment by combining biological principles with concepts from materials science and techniques from robotics. For instance, better prosthetic limbs.

Quantum  
simulations of  
photosynthesis?

Chemical  
synthesis of  
custom proteins?

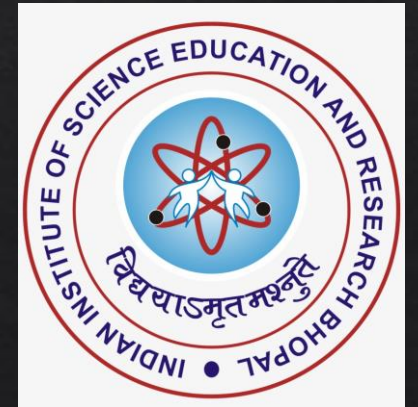
3-D and  
optical  
imaging tools

Detecting diseases  
using AI (artificial  
intelligence)

Physics of  
polymers

COVID-19, HIV,  
Influenza, Cancer,  
Tuberculosis, ...

Computational  
study of evolution  
and biodiversity



P.S. Yes, you should learn *both* Bio and Math / CS



# The USP

- Truly multidisciplinary **curriculum**

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## **2016-2017 Semester I**

BIO101	Biomolecules and the Origin of Life
BIO103	General Biology Laboratory I
CHM101	General Chemistry
CHM103	General Chemistry Laboratory
CS101	Introduction to Computers
HSS103	Basics of Communication Skills
MTH101	Calculus of One Variable
PHY101	Mechanics
PHY103	General Physics Laboratory I

## **2016-2017 Semester II**

BIO102	Diversity in the Living World
BIO104	General Biology Laboratory II
CHM102	Basic Inorganic Chemistry
CHM104	Inorganic Chemistry Laboratory I
EES102	Introduction to Earth Science
HSS104	Oral and Written Communication
MTH102	Linear Algebra
PHY102	Electromagnetism
PHY104	General Physics Laboratory II

## **2017-2018 Semester I**

BIO201	Flow of Genetic Information
BIO205	General Biology Laboratory III
CHM211	Basic Organic Chemistry
CHM213	Organic Chemistry Laboratory I
EES201	Earth System components
HSS209	Technical Writing
MTH201	Multivariable Calculus
PHY201	Quantum Physics
PHY203	General Physics Laboratory III

## **2017-2018 Semester II**

BIO202	Biology IV: Basic Genetics
BIO206	Biology Laboratory II
CHM222	Classical Thermodynamics
CHM224	Physical Chemistry Laboratory I
EES202	Introduction to Environmental Sciences
HSS207	Macroeconomics
MTH202	Probability and Statistics
PHY202	Basic Electronics
PHY204	Electronics Laboratory

## **2018-2019 Semester I**

BIO301	Cell Biology
BIO303	Biochemistry I
BIO305	Plant Biology I
BIO307	Biology Laboratory III
BIO311	Cell Signaling and Stress Biology
BIO313	Virology

## **2018-2019 Semester II**

BIO302	Biochemistry II
BIO304	Molecular Biology
BIO306	Immunology I
BIO308	Biology Laboratory IV
BIO312	Recombinant DNA Technology
BIO314	Plant Biology II

## **2019-2020 Semester I**

BIO401	Immunology II
BIO405	Developmental Biology
BIO410	Epigenetics
BIO411	Advances in Microbiology
BIO417	Advances in Omics
BIO418	Biophysics and Structural Biology
ECO500	Law Relating to Intellectual Property and Patents

## **2019-2020 Semester II**

BIO402	Bioinformatics
BIO404	Neurobiology
BIO406	Evolutionary Ecology
BIO412	Cancer Biology
BIO420	Molecular Therapy
BIO424	Drug Development and Mechanism of Drug Action

# The USP


- Exceptionally **active research** faculty
- Highly visible, cutting-edge research
- Diverse areas, generous funding

 ThePrint

## IISER Bhopal develops affordable oxygen concentrator to tackle shortage amid Covid surge

IISER Bhopal develops affordable oxygen concentrator to tackle shortage amid Covid surge. According to the team, the device, called 'Oxycon', is ...  
26-Apr-2021



 Business Line

## IISER Bhopal team develops a unique 'Crowd and Mask' Monitoring System to prevent Covid-19 spread

IISER Bhopal team develops a unique 'Crowd and Mask' Monitoring System to prevent Covid-19 spread · This one-of-its-kind low cost AI-enabled ...  
22-Feb-2021



 NDTV.com

## IISER Bhopal Scientists Discover New Species Of African Violet In Mizoram

IISER Bhopal Team Develops Affordable Oxygen Concentrator · IISER Bhopal Innovators Develop Monitoring System To Prevent COVID-19 ...  
1 month ago



 Times of India

## IISER-Bhopal in top 10 of Nature Index

BHOPAL: The Nature Index has ranked the Indian Institute of Science Education and Research (IISER), Bhopal, among the top ten institutions ...  
07-Jun-2020



 India Today

## Coronavirus N protein plays critical role in viral transmission, says IISER Bhopal's research

Researchers from the Indian Institute of Science Education and Research (IISER) Bhopal have shown that proteins from the Covid-19 virus other ...  
06-May-2021



 Republic World

## IISER Bhopal scientists invent technology for precision engineering of proteins

READ | IISER Bhopal innovators develop unique monitoring system to maintain COVID rules. Thus, FK first attaches itself to the lysine in the ...  
3 weeks ago



 Firstpost

## IISER, UNMC scientists explore Rapamycin as repurposed drug to treat elderly, obese with COVID-19

... Rapamycin as repurposed drug to treat elderly, obese with COVID-19 ...  
Science Education and Research (IISER) Bhopal and the University ...  
23-Mar-2021



 The Hindu

## IISER Bhopal scientists' study on seed germination may lead to crop improvement

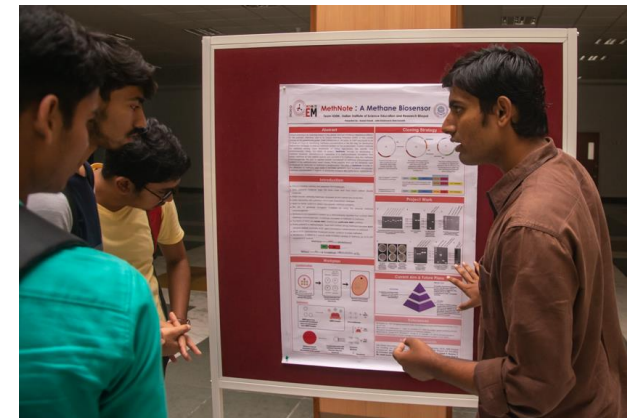
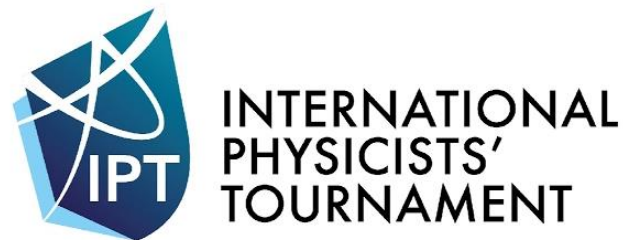
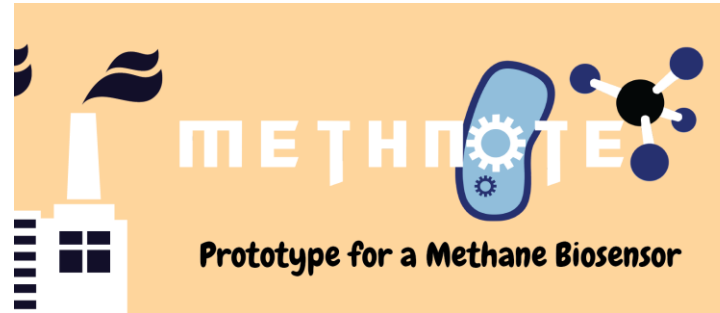
Datta said, adding that just like humans were forced to mediate a COVID-19-induced lockdown, plants, too mediate a "developmental lockdown" ...  
13-Aug-2020





# The USP

- A strong culture of **undergraduate research**
- Heavy emphasis on multiple internships
- Research-oriented courses



# Why does all this matter?

- ◇ The ideal **academic environment** – sheltered, nurtured, and well-provided for
- ◇ **Expert guidance** and support – readily available
- ◇ A plethora of top-notch **career opportunities**
- ◇ Exceptional **infrastructure**
- ◇ You'll be actively (*and indirectly!*) motivated to excel

*An IISER is a privileged place to be*



# Making it to an IISER

- ◇ **KVPY** (Kishore Vaigyanik Protsahan Yojana):  
SA stream (11<sup>th</sup>); SX stream (12<sup>th</sup>); SB stream  
(college first year, but very competitive!)
- ◇ **JEE Advanced** (Merit List)
- ◇ **IISER Aptitude Test** (SCB)



**INDIAN INSTITUTES OF SCIENCE EDUCATION & RESEARCH**  
Berhampur, Bhopal, Kolkata, Mohali, Pune, Thiruvananthapuram, Tirupati  
Autonomous Institutions under MHRD, Govt. of India

**BS-MS ADMISSION 2020**

**IISER APTITUDE TEST : MAY 31, 2020 (SUNDAY)**

किशोर वैज्ञानिक प्रोत्साहन योजना

**KVPY**



NATIONAL FELLOWSHIPS FOR STUDENTS  
INTERESTED IN RESEARCH CAREERS

# Available Programs

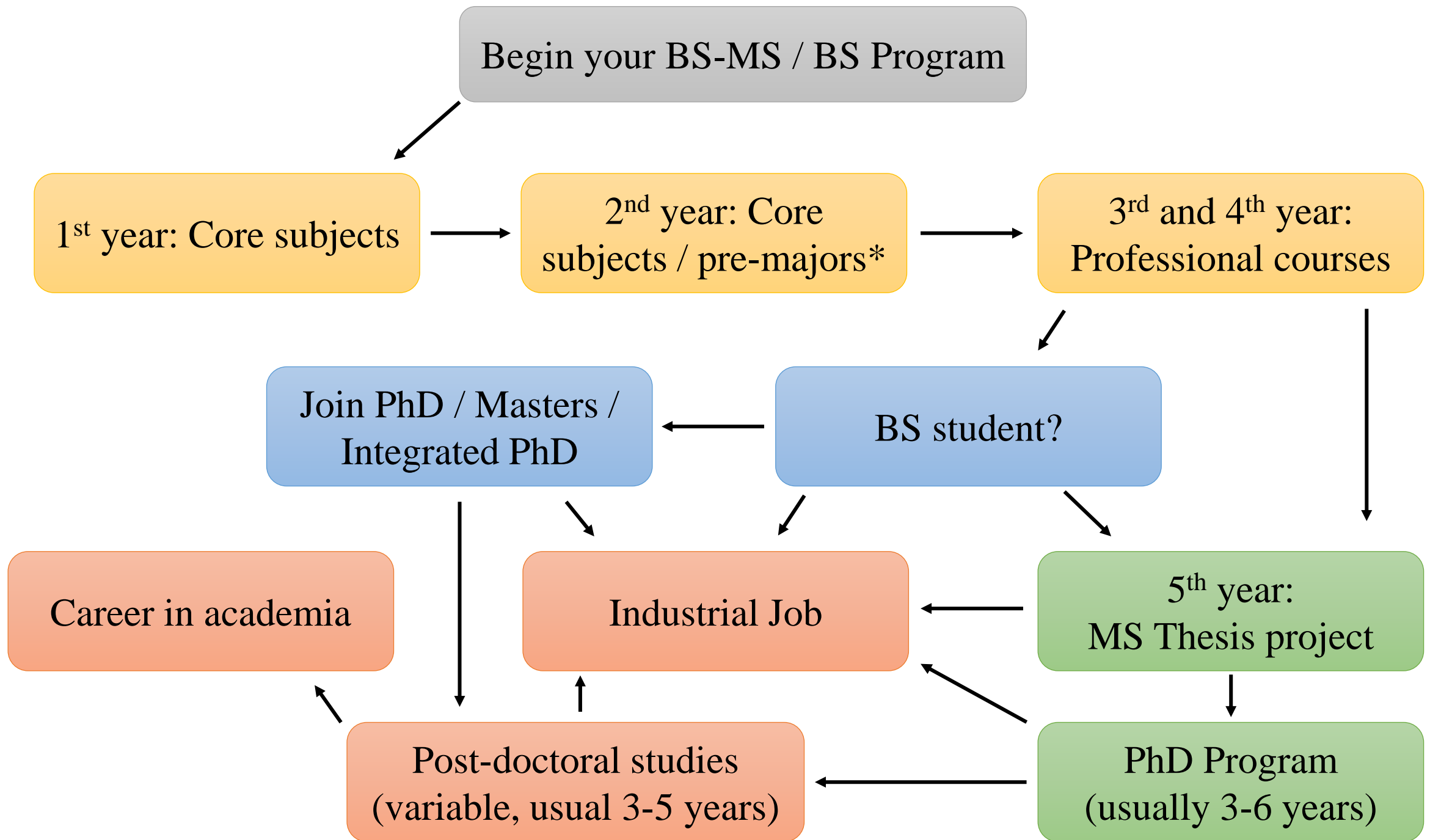
## 5-year BS-MS (all IISERs)

- ◇ Biological Sciences
- ◇ Chemistry
- ◇ Earth and Environmental Sciences
- ◇ Physics
- ◇ Mathematics

## 4-year BS\* (specific IISERs)

- ◇ Economic Sciences
- ◇ Chemical Engineering
- ◇ Computer Science and Electrical Engineering
- ◇ Data Science

*\*option for one-year MS may be available*





# “Great, but where do I go from here?”

- Amazing **PhD positions** at top labs – future career in academia
- **Industrial R&D**: up-and-coming in India
- **STEM-based startups**: big business, infinite potential
- **Specializations** – Intellectual Property Rights Lawyer, Management, Consultancy / Risk Analyst / Technical Analyst, Data Analytics, Finance, IT, Science Communication, Forensics, Actuarial Sciences, Grant Manager, Marketing / HR Executives, Patent Agent, etc.

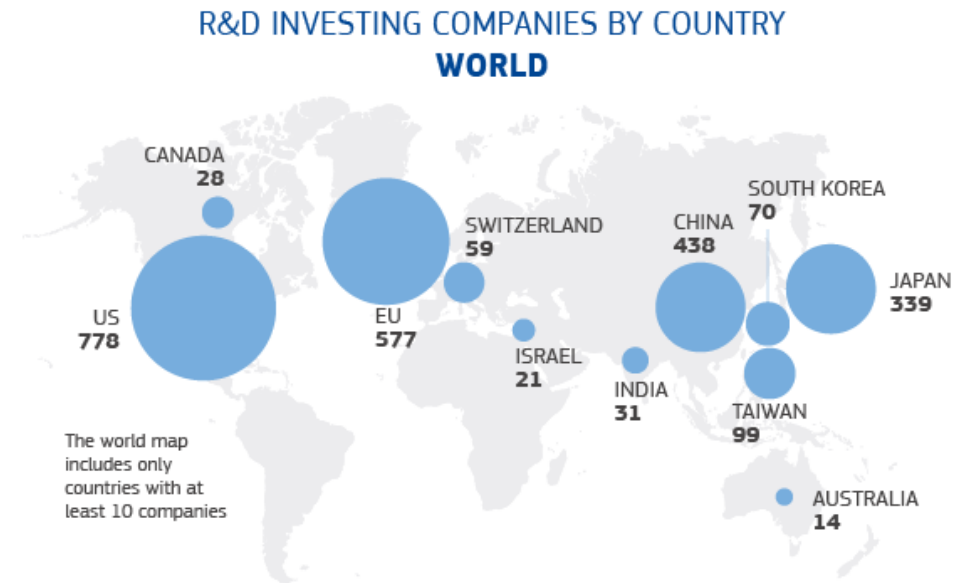
# Industrial R&D

## Primary objectives:

- Develop new applications / tools
- Design **commercially profitable** processes
- Improve existing products
- **Hot fields:** Biotech, healthcare, agriculture, environmental sciences



ANNUAL PERFORMANCE  
**2500 WORLD'S TOP R&D INVESTORS**



Companies, based in 46 countries, each invested over €25 million in R&D for a total of €736.4bn which is approximately 90% of the world's business-funded R&D.

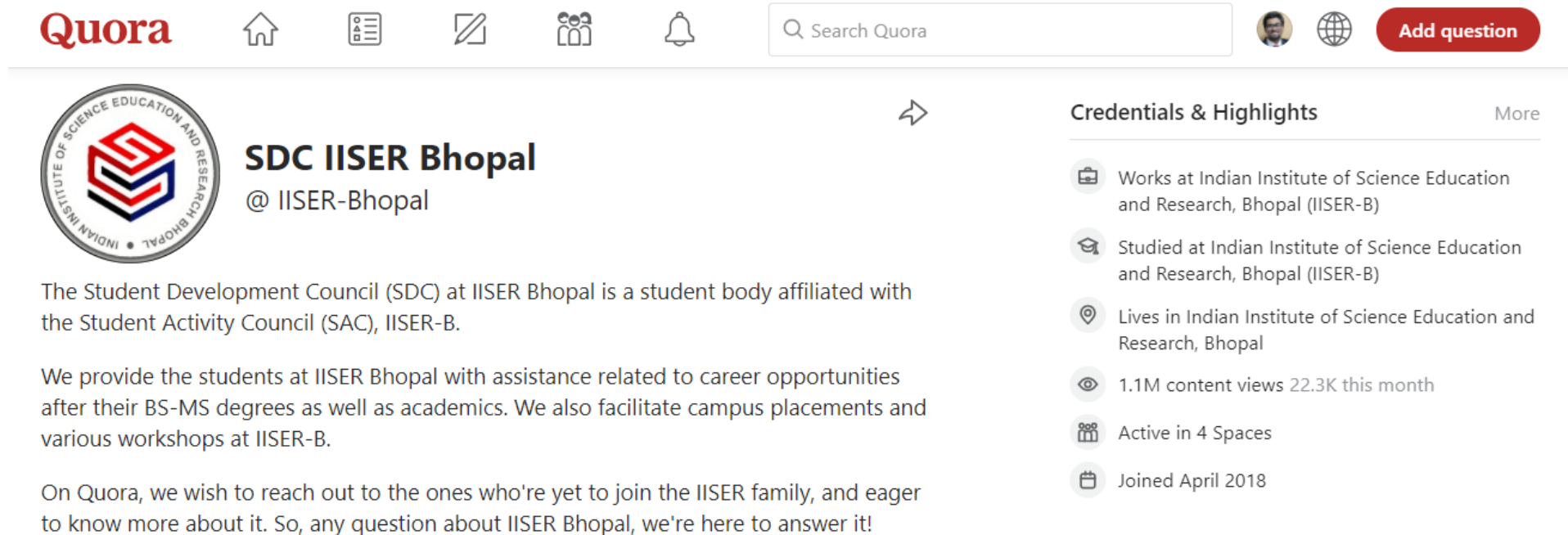
# An IISER is for you, if you -

- ◇ Have a stomach for **academic rigor**
- ◇ Possess a perennially **curious** temperament
- ◇ Exhibit an **entrepreneurial** streak
- ◇ Love **tinkering** and experimenting
- ◇ Are an active, **critical thinker**
- ◇ Constructively and **creatively question** concepts
- ◇ Are willing to **persevere**




# Wish to learn even more?

- Follow on Quora – **SDC IISER Bhopal**
- Voluntary outreach program by the Students' Development Council, IISER Bhopal
- 800+ answers – all by students, for students



The screenshot shows the Quora profile page for SDC IISER Bhopal. The header includes the Quora logo, navigation icons, a search bar, and a user profile picture. The profile section features the SDC IISER Bhopal logo, the name "SDC IISER Bhopal @ IISER-Bhopal", and a bio. The bio states: "The Student Development Council (SDC) at IISER Bhopal is a student body affiliated with the Student Activity Council (SAC), IISER-B. We provide the students at IISER Bhopal with assistance related to career opportunities after their BS-MS degrees as well as academics. We also facilitate campus placements and various workshops at IISER-B. On Quora, we wish to reach out to the ones who're yet to join the IISER family, and eager to know more about it. So, any question about IISER Bhopal, we're here to answer it!" To the right of the bio is a "Credentials & Highlights" section with a "More" link. This section lists: "Works at Indian Institute of Science Education and Research, Bhopal (IISER-B)", "Studied at Indian Institute of Science Education and Research, Bhopal (IISER-B)", "Lives in Indian Institute of Science Education and Research, Bhopal", "1.1M content views 22.3K this month", "Active in 4 Spaces", and "Joined April 2018".

**Quora** Home Write Ask Join Search Quora Add question

 **SDC IISER Bhopal**  
@ IISER-Bhopal

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We provide the students at IISER Bhopal with assistance related to career opportunities after their BS-MS degrees as well as academics. We also facilitate campus placements and various workshops at IISER-B.

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**Credentials & Highlights** More

- Works at Indian Institute of Science Education and Research, Bhopal (IISER-B)
- Studied at Indian Institute of Science Education and Research, Bhopal (IISER-B)
- Lives in Indian Institute of Science Education and Research, Bhopal
- 1.1M content views 22.3K this month
- Active in 4 Spaces
- Joined April 2018

# Useful Links

- SDC IISER Bhopal (on Quora):

<https://www.quora.com/profile/SDC-IISER-Bhopal>

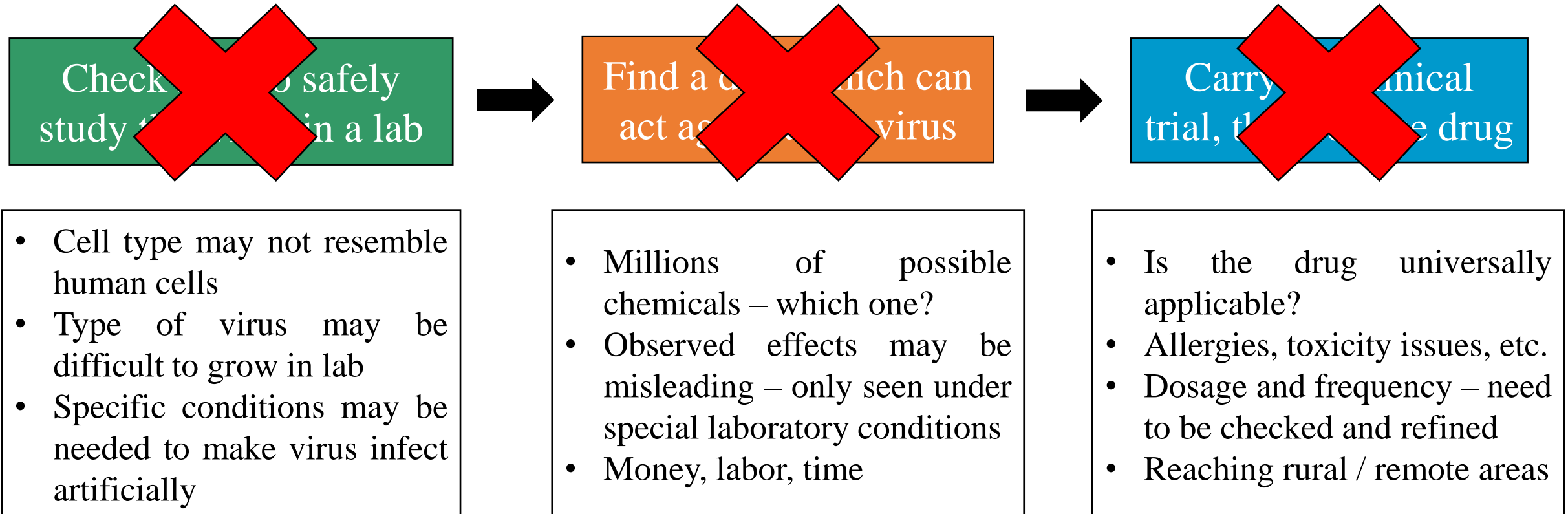
- IISER Admissions page: <http://www.iiseradmission.in/>
- The IISER System: <http://www.iisersystem.ac.in/>

Supplementary



# Example: tackling a real-life problem

Q. There is a new strain of the flu virus which is causing a epidemic with high mortality. You are tasked with developing a vaccine.



Check how to safely study this virus in a lab



Find a drug which can act against this virus



Carry out clinical trial, then release drug

- Compare with known viruses from available databases
- Decide a suitable experimental strategy

- Compare features with known viruses against which antiviral drugs are available – **computational biologists and virologists**
- Find out novel features of new virus to target these – **molecular biologists and biochemists**
- Computational analysis (modelling software) to predict protein structures – **biophysicists and applied mathematics**
- Virtually screen chemical compounds OR synthesize new ones – **computational and organic chemists**

- Consult with **doctors** to develop optimal strategy with minimal side effects
- Work with policy makers and **government bodies / NGOs** to effectively deliver treatment

# “But, what am I suitable for?”

- ◇ 1<sup>st</sup> rule – **don't overthink** it!
- ◇ Keep an **open mind** – easy to say, necessary to implement
- ◇ Let go of your **prejudices** – especially school/coaching experience
- ◇ Your **interests WILL change** over time (barring rare exceptions)

Your job – work hard and grab every promising opportunity with your gut feel!