

Introduction to Professional Scientific Communication
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Lecture – 01
Introduction to the topic

Welcome to this NPTEL course Introduction to Professional Scientific Communication. I am Ganesh I am going to introduce to all of you the skill sets required to effectively communicate your scientific results. So, this turnover course as I introduced will have topics that talks about how do you evolve an hypothesis, how do you test them, how do you write them, how do you communicate including visual communication.

So, today we are going to look into some of the topics. Let us talk or let us start with something that is of interest to all of you as you know studies none of is like the most it is like medicine we go only when there is a need. However, if you look into hobbies whether you sing, whether you go and play, whether you watch movies, these something that comes out in it and you start liking them and you do not mind doing it again and again without anyone telling you. So, you are going to connect our topic with certain common interest.

What is shown on the screen is the photographs of many of the very famous artist.

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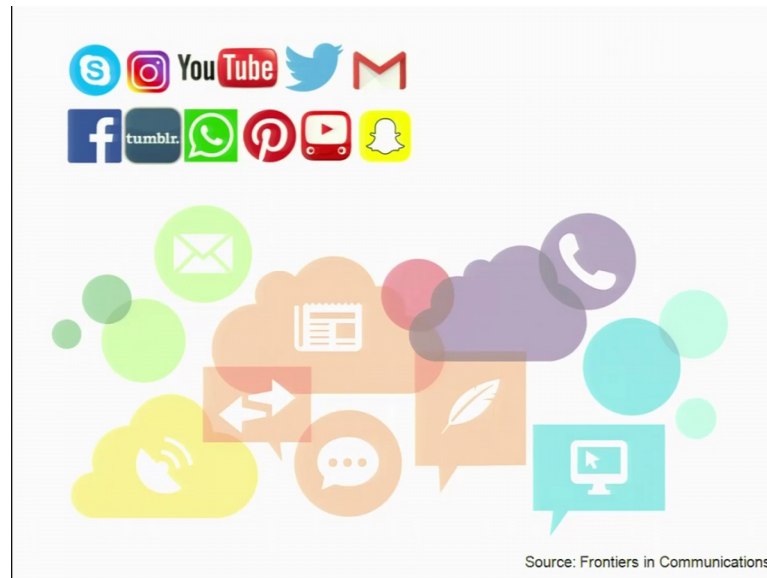
Could be performing artists like what you have seen Birju Maharaj who does kathak or Lata Mangeshkar who sings beautifully or sitarist or a person who you know plays flute so beautifully. Or for example, an artist like M F Hussain who are done wonderful you know contribution to the Indian arts and then of course, you also have the contemporary music composer A R Rahman who was given several hits right.

All these people what they do? Basically they communicate, they communicate via a medium which could be a music, which could be art, which could be the lyrics the song, or whatever you know form of art that they have chosen they have excelled they have done exceptionally well. In a given artist perform well you like them. It is easy to appreciate somebody does exceedingly well for example, somebody sings you know you are easy to know even easily tell that he or she has done excellent job likewise when you look into a picture somebody has drawn you say that it is wonderful its beautiful because you are able to appreciate.

If someone has not done well you know as in terms of you know singing or composing a song or for example, you know attempting to draw something then you become a critic is very very easy for us to criticize. When you are one among the audience then it is easy to evaluate all this things, but across the table if you have to think then it becomes difficult. If you have to draw something it become difficult, if you have to play a music instrument the noise will be unbearable. So, you have to train yourself and then develop interest and then master the art and deliver only then you become exceedingly good.

Science is or communication is one such you know theme. You know when you talk about communication when I said that visual communication these are figures like you must have seen cartoons which explain so many things just you know in a short small you know corner of a newspaper it conveys message it is a communication.

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So, in current world for example, with so many ways of communicating especially in the multimedia you find that you have hundreds and hundreds of information that is handicapped. For example, in your cellphone it could be message that your friends send, it could be through the Whatsapp or you may have news channels or it could be twitter or could be YouTube anything and everything that you can you know put together as a digital form can be transmitted can be shared with and that is one way of communication. The question is what percent of these communications are good in terms of conveying what they wish to convey and what percent of this communications actually represent fact if it is fabricated as news.

Or you know what takeover message that they provide you know when you talk about mass communication there has to be some takeover message and if you are trying to convey some ideas or it could be purely entertaining in terms of you know they come therefore, 30 minutes and then they forgot about all their miseries and then laugh with you. So, this is another way.

In each of this you should be able to put across the point that you wish to do if you are the person who is communicating right. If you are on the other side it is much easier you can sit relax and judge whether this personal done well or not well. So, even in this kind of you know current day communication you have different forms for example, it could be twitter where you are limited with the words or it could be Whatsapp again there is a

limitation or it could be email which can be one liner or it can be several pages right it all depends on to whom you write, why do you write, what you wish to convey and so on. So, this is how the communication is evolved given for the day to day life. But the challenge is when you really want to.

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You know convey certain ideas this is one of the cartoons that is taken from the, you know a website called Phd comics, a probably popular among those students who are doing research. You find if you want to really you know write together some ideas that you have in your brain, you want to convert them into words and convey the way you really want it to be conveyed when you start you will understand it is not easy its difficult.

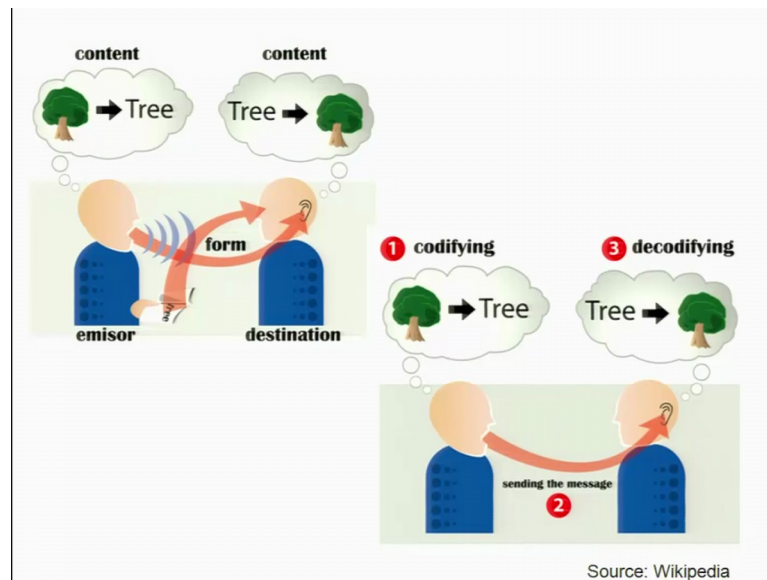
So, it when you are an audience in your amongst the audience somebody is communicating to you, you can say that well this guy did not make any sense he did not convey what he wants to do he did a poor job or he is an exceptional speaker you come up with verdict like this is very easy because if you are able to understand what he says you say is a good speaker if he is able to convince and inspire you again you are saying is a marvelous speaker if that guy did not make any sense then you say the poor communicator. So, therefore, there are different degrees or different levels of proficiency and is not easy to master that from day one. So, it takes time that is where this course possibly of will be of some help right.

So, if you try to even write a short story the short story which could be simply say one page about 500 words and try to put it together and you will find it exceeding difficult to convey effectively therefore, a reader would appreciate that you are done a good piece of work. So, that becomes challenging. So, to what you have in your mind what you think if you want to bring out in a either a visual form or in a textual form or even story telling for example, your grandma will do a fantastic job in narrating a story where if you have to do that will find it difficult its again an art you have to learn how to keep the audience you know you know sort of glued to your conversation. So, that is again an art that something that you need to understand.

The important aspect that you should understand is that that whatever you wish to communicate it is not necessary the other person would or front know about it. For example, I will talk about you know a language you know the language is nothing, but you know for example, currently I am speaking in English, but I can also speak to other languages right, but I cannot mix 3 different languages and speak to a person who does not know all 3 languages then it will make any sense. So, each of the word that we speak in a given language is coded in a sense when I say for example, its shown in the cartoon when I say tree you know then it is English and this wood tree gives a code for an object a living you know tree for example, you know living entity. So, this has be you know upfront too old that the other person should know that if he does not know even if you have communicated that it is a tree then you will not be able to visualize by word.

So, if something it is going to be extremely difficult to convey by word then you should have alternate way of explaining things.

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We can show for example, first here image an image of a tree and then say this is tree then he is able to register the word tree with that object and next time when you say tree without showing an image is able connect it with tree and that is how you build the you know kind of the theme in the topic that whatever you are talking about. This may look very very silly when I show tree as an example, but that exactly the way it is challenging when you come to scientific communication because the term that you would use, the example that you would use, the methods that you would use, to you know do any scientific research when it is told to somebody who is not in that field then it is going to be challenging because he or she may not know this word or meaning of it and it would sound exactly like you are talking to him or her in all together different language that person does not follow.

Therefore you need to even define what do you mean by tree by showing certain images and then later on we can explain about tree with words possibly that the person can understand. So, it is very important keep that in mind when you communicate to anyone therefore, we have to always start with something the person knows and then build on it then it becomes easy for that person. So, that is the exactly happens in scientific communications you have meetings, you have seminars, you have discussion groups there are researchers who come and present their work ideas, results, observations or even questions they may pose then you have audience who think about it right and then

they are called as receiver for example, you are one among the audience for this particular course.

So, you do not really talk to me when I am communicating to you. But you try and receive whatever points that I am telling to you. In the process what you do is you assimilate you learn something and may have a doubt or even you may not agree with some of the points that I am conveying to you therefore, you would have questions, you have criticism or you may have queries that is what called as feedback. That comes back at the end of the hour, for example if it is a seminar then there is a open hour for call discussion. So, then the audience can ask questions and the speaker would respond to it by giving a satisfactory answer or you may say that I never thought about it, it is a good thing that I can now look into that or he may say that this is something irrelevant to here is the depending on what kind of you know question that are there.

But feedback again is an important element in scientific communication because you can build on your hypothesis, build on your ideas, build on your knowledge by taking feedback from audience its important because questions alone make good signs. We will talk about that little later. You need to learn how to communicate. Let see the types of communication these are not very very structured I am just giving a broad perspective which perhaps may link to the scientific communication or professional scientific communication.


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Types of Communication

Verbal communication

- Oral communication
- Written communication

Non-verbal communication



Visual communication

- Right hand curve
- Left hand curve
- Narrow bridge sign
- Narrow road sign
- School

There are three distinct forms when you talk about any communication one is verbal communication using words and so on, and the other one is non verbal communication and the third one is visual communication. So, what are they?

Let us looking to the first one that is verbal communication. So, it could be oral communication or written communication oral in the sense like you know a teacher coming to the classroom and taking a class that is oral communication. I am communicating with you orally by talking to you conveying certain points discussing a topic that is oral communication, but at the same time you also have what is called as written communication.

You know and let me go back to oral communication in good old days or even now you may listen to fm radios this is nothing, but sound right. So, you put earphone connected to your cell phone you turn on fm and that could be several information that is coming from the given radio channel. So, we have nothing, but oral that there are only words that you could listen with that you are able to get information that is oral communication.

On the other hand you may you know wake up in the morning and then you will find the newspaper in your home or room and then you read there is no you know word that comes to your ear that you only look at the newspaper read from the words and sentences that is given and you are able to get again information that is written communication right.

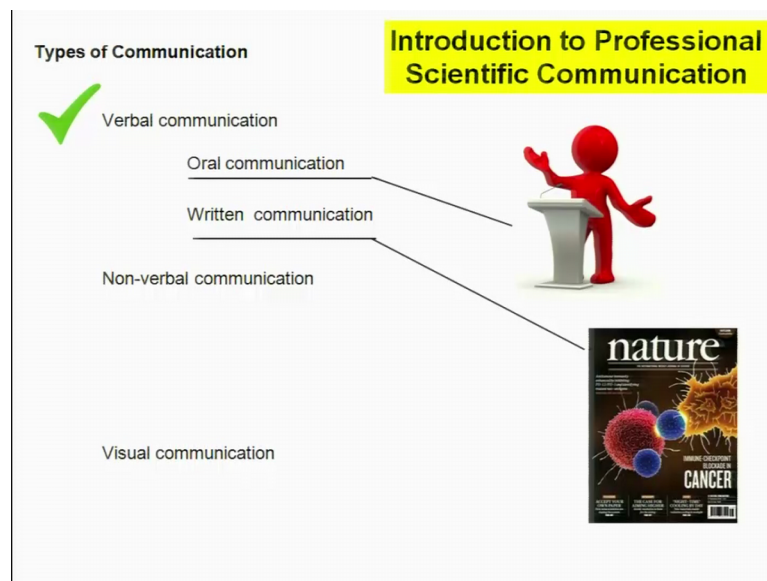
So, let us see how important these are in you know scientific communication. So, third element that is called as non verbal communication, here there is no word written this is nothing not even one words spoken, but by gesture you are able to communicate something. For example, I fold my hand and I bow, that is [FL] you do not need to say [FL], but that is the way you greet let us for example, an Indian example. Somebody is entering a room stare like that that is something that you are threatening why are you coming here it is a (Refer Time: 14:21), gesture right. So, these you know elements probably it does not come to that extent in scientific communication.

The third one is called a visual communication again when you go you in the road side you would find there are many symbols right. These are excellent example for visual communication because these are the symbols these are international symbols wherever you go they mean the same regardless in which country you are there. For example, you

have to you know go ahead turn on the right side the road is going to be turned on the right side or left or you are going to getting on to a bridge which is very narrow right or its going to be a school ahead of; ahead in this particular road that you have to be careful these are the you know communication whatever communicated which is just a symbol right. So, if you go to any movie theater or mall again you have to find you know board called exit with somebody running out from you know a door. That is again saying that where is the exit point.

So, these are symbols that is able to convey you know some information in a fraction of second right that is again a powerful visual communication which also we used in scientific communication. So, let see these three major types of communication how does it really help or how does it constitute or sort of you know coming to the professional scientific communication.

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It is obvious that the verbal communication is the most powerful tool in the scientific communication for example, you have as a researcher or as a student you have to go and present a topic. So, you go and you know talk about a given finding or particular topic or your ideas and so on. So, that is you know effective oral communication you have to be a good speaker to communicate what you wish to communicate.

Then you have a written communication that constitute the bulk of the you know information in scientific literature. So, what is called as a literature survey is something

you know fundamentally essential for you to start any research work because you need to know what has been done so far in the given topic that you have chosen to work right. So, this you can do by you know looking into the you know the literature and mostly these are research articles it could be reviews which sort of gives you the contemporary up to date you know information or it could be scientific article that came out in different journals these are basically you know written communication right. So, these are research articles.

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The slide is titled "Introduction to Professional Scientific Communication". On the left, under "Types of Communication", there are four categories: "Verbal communication" (marked with a green checkmark), "Oral communication", "Written communication", and "Non-verbal communication". Below these, "Visual communication" is also marked with a green checkmark. On the right, a detailed biochemical pathway diagram of the Citric Acid Cycle is shown. The diagram includes various molecules like Citrate, Isocitrate, α -Ketoglutarate, Succinyl-CoA, Succinate, Fumarate, Malate, and Oxaloacetate, along with their respective enzymes and cofactors. A legend in the top right corner identifies the symbols used in the diagram.

Visual communications are again very very important because that could be very complex information which really cannot be presented in a written form for example, the biochemical pathways for example, what is shown here is a text book you know information citric acid cycle. So, if I have to write that you know in a textual form it is going to be exceedingly difficult for you to understand. So, the best way to communicate is to provide a schematic again this is a visual communication, but it is a challenge how to put this kind of a thing it is not only that you know visual communication is important because the text book that you study you know has got lot many figures which are schematics or representative figures of many different you know component that is there in the cell or in the tissue and so on.

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The slide is titled "Introduction to Professional Scientific Communication". On the left, under "Types of Communication", there are two categories marked with green checkmarks: "Verbal communication" (subdivided into "Oral communication" and "Written communication") and "Visual communication". On the right, there is a complex metabolic pathway diagram showing the flow from Glucose to Pyruvate, then to Citrate, and through the Citric Acid Cycle. A legend identifies various components like Enzymes, Cofactors, and Cofactor A. Below the diagram is a red book cover titled "Molecular Biology of THE CELL The Problems Book" by John W. Lee and Tim Hunt, featuring a schematic of a cell with organelles.

For example, what I have shown here is the cover page of one of the popular books the cell and you can see on the cover page there is a schematic of a cell which shows where is the nucleus, where is the endoplasmic reticulum, where is the mitochondria these are depicted in certain form and there are standard ways of explaining it.

And now it becomes like you know any time you wake up and I will show you a picture of a cell having different component you will be able to identify because this has been told over and again therefore, you understand right. You are able to connect relate that with you know different organelles. So, the visual communication is exceedingly important right in science. Therefore, these two are going to form the bulk of our discussions later in this particular you know course.

It comes to then the third form which is nonverbal communication. He does not really constitute much to the scientific communication because you know when you are writing right or when you are giving a oral communication or visual communication your gesture does not really matter that much as compared to the two other communication. However, it is your choice whether you want to present yourself as a person who smile and who welcome questions or you want to keep a phase that is threatening nobody ask you question right.

Now, if your choice is the second you are not going to get any feedback no questions nobody will come and discuss with you. Remember if nobody gives you any feedback

nobody ask questions nobody appreciates you because of your behaviour you are going to lose a lot because the knowledge, the questions, the hypothesis that you would generate based on you know the feedback that you receive in science, you know feedback is as important as the discoveries or inventions. Therefore, you know you need to consider for that your gesture do matter. Be kind to people that is one of the fundamental ethics in research he said when you present any of your finding you should be open to criticisms, you should not get agitated, you should not get angered, you know you should be open to whatever questions being asked you be honest if you know the answers you convey if we do not know you say you do not know go back study about it may be you will be able to learn something new, able to do something better than what you have done.

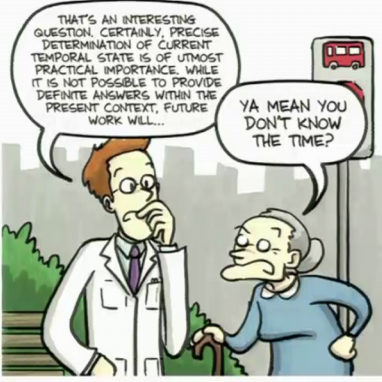
So, therefore, non verbal communication may not be that significant, but certainly you know could help it is your choice.

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Types of Communication

- Verbal communication
 - Oral communication
 - Written communication

Introduction to Professional Scientific Communication



THAT'S AN INTERESTING QUESTION. CERTAINLY, PRECISE DETERMINATION OF CURRENT TEMPORAL STATE IS OF UTMOST PRACTICAL IMPORTANCE, WHILE IT IS NOT POSSIBLE TO PROVIDE DEFINITE ANSWERS, WITHIN THE PRESENT CONTEXT, FUTURE WORK WILL...

YA MEAN YOU DON'T KNOW THE TIME?

Source: Nature Scitable

Let us see types of communication you are talking about scientific communication, how different it is from the regular conversation day to day conversation that you have. This is a cartoon that has come from just I picked up from one of the online educational link sightable right. So, I will share with you the link little later, which talks about how a science scientist interact with a layman. For example, here probably the poor lady has asked what time the bus might come to that particular bus stop right and the scientist

have a lingo, have the way of explaining things it is a very different from the way common man communicate with each other.

So, if you are standing in a bus stop and somebody is asking you say maybe in about ten minutes it might come this could be a simple answer. But if you think that the question in a scientific way then whether the bus would come depends on so many other parameters whether the bus is driven by an able driver, maybe he met with an accident if this day is not good careful or whether the bus is conditioned well that does not break down, what is the traffic in the end of the road it could be clogged, it could be chocked. So, it may take time. So, if you start saying all this things provided the driver is good and the roads are safe and everyone is fine the weather is good the probability that the bus making this is the scientific we have say and you say it may come because you are not sure about it right it depends on several parameters.

So, that is an example that is given. So, when you explain some scientific topics to experts or peers what they call as in your field then you explain a different way, but you explain to somebody who is not in that field who is not even a scientist you have to explain in a different way. So, what you communicate is not only about the profession that you have, but lot more depends onto whom you are communicating whether you are communicating to your experts, whether you are communicating to somebody in science, but not certainly in your field or you are communicating to somebody who are policymakers or communicating to the public. So, it defers and you need to change the way you communicate therefore, it is important.

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Types of Communication		Introduction to Professional Scientific Communication
Verbal communication		
Oral communication		<ul style="list-style-type: none">▪ Developing an hypothesis/defining a problem▪ Writing a research proposal▪ Defending your proposal for approval/funding▪ Record keeping/documentation▪ Writing your observations into a report/scientific paper/thesis [Introduction/methods/results/discussion]▪ Presenting the work experts (defence)▪ Presenting the work to specialist▪ Presenting your work to a common man
Written communication		
Visual communication		<ul style="list-style-type: none">▪ Figures/ tables/ schematic (written)▪ Presentation/ slides (oral)

Let us see what do you do in a typical communication right when you communicate your research. So, it is important is that you know you have to have a very good hypothesis or you should have a question. So, you have to justice as to why your hypothesis is attractive or why your research question that you are asking is an important question to ask right. Once you have it once the first thing that you do is to write a proposal, this is the question that you have for the reasons that you are mentioned or this is the hypothesis you have for the reasons that you have mentioned and you want to investigate or test the hypothesis or solve a given problem right. That is you know writing a proposal if you are entering into for example, a Phd program you are supposed to do that. Then you know what has been done already why you know a given particular question is to not being understood or not being addressed and how you wish to address and how addressing that question might help you know that is very important.

And defending your proposal, for example the Phd doctor or board may say that well defend your proposal in there is give some ideas and they approve or you may have to go and get funding for your research again you go and present. So, once you have these two either funding or the approval then you start doing experiments. It is important that you keep requires has to what are your observation that is extremely important the documentation is important whether you are doing theoretical research, whether you are doing experimental research or your research is simply based on questionnaire, survey and so on for everywhere he need excellent documentation because you know later some

point of time you may want to revisit the result and see a different aspect which you are not thought about before.

So, if you do not have this documentation you know there is you know element that you may not be able to revisit. So, it is important that you keep on your raw data good documentation is very you know essential for conducting science. And finally, once you have the observations done you need to write your observation what is called as presenting your you know observations, discoveries in the form of either a scientific report or a thesis right. So, which has got an element called introduction meaning you introduce your topic you say what are the methods you have used to address the question, what was your observation and finally, interpret as to what is the outcome you know you have done something what is that. This is scientific writing in you know written communication.

But you may need to present your work to the for example, experts you know for example, you have done your work, now you have written a thesis you defend your thesis work to the expert therefore, they can say that well you have done good enough for a particular degree right. Or to a specialist for example, you want to go and present the specialist meaning it could be a journal where you are submitting your work and then they look into and then say it is a very good work and they would publish right or you may wish to present your findings to a common person it could be even a policy maker who are not experts in the field because it has a relevance and you want to convey that and then you know you can change the perception and so on.

So, that is very very important. In all these things you have understand the science very well and you are able to define the problem, you should be able to identify a method of approaching you know the questions and answering them and then make observations write present and communicate you know it is very very important. So, in this aspect you would say mostly the verbal communications helped either it is oral or written, but let me tell you the visual communications are as important as the verbal communication. For example, you may have a complex data right, which possibly explain the trend, but if I put the raw data nobody will be able to understand. So, what you do? You present them in the form of chart, flowchart or a graph bar diagram and so on. So, that is visual communication. So, you make figures, you make tables, you make schematic you know

which you know a such presentations make it more easy for people to understand and follow if otherwise you have to written it, it is going to be extremely difficult.

So, when you make these things that is you know even in when you make a research report or paper you have these figures again visual communication, but you also need them when you make oral communication visual effects presentation. For example powerpoint slides the most common medium nowadays for presenting ideas you have animations, you have flowcharts, which help you to convey what you wish to convey. So, the visual communication is as important as the other aspects.

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So, considering their need that you need to communicate your findings and you should learn how to communicate in recent days a lot many affords. For example, American society of molecular biology you know they have they do run a course called the art of science communication you know basically helping people to learn how to communicate better. It is not that everyone is a born singer, but you will learn you know, you go and learn and then practice and master it and then you become better. Exactly the same way scientific communication also you are not that day one you are good, you have to train. So, there are ways by which you learn and you do this.

The second for example, in India likewise recent days there are several initiatives I am just showing one figure below for example, here communication workshop that was held at our institute IIT, Kanpur its being funded for example, partially wherever compressed

dbt India alliance which is conducted in various places again for example, communication workshops. But our own institute we have professional scientific communication course as one of the essential courses for all our masters and Phd degree students and we have it as a compulsory course. We tell them as to you know how you should structure you are writing how you should structure your talk because this is essential for you to become a good scientist because you are a scientist only if you are able to convince others at what you are doing is important. And if you are even if you are doing a marvelous work, but you cannot communicate that it becomes difficult right.

So, therefore, it is very very essential and precisely that is the reason that we have this particular course and very very hopeful that you guys are going to find it very interesting and would benefit by this course.

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Professional Scientific Communication

Objectives:

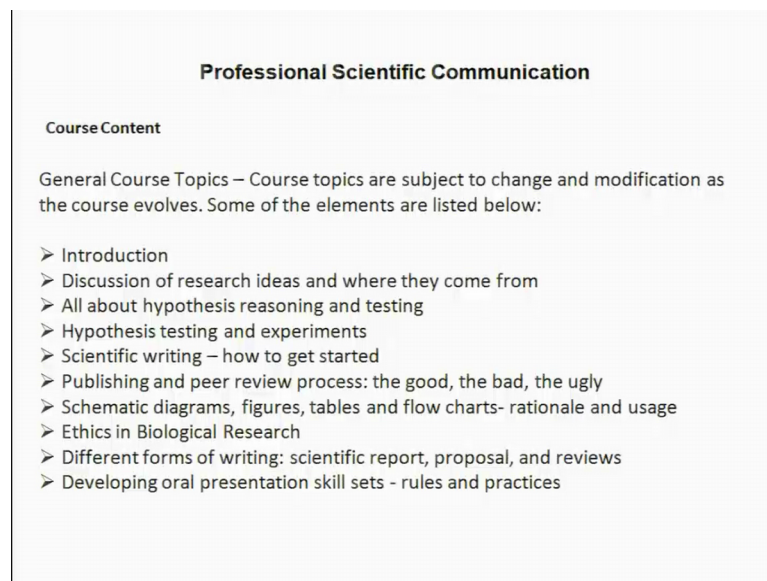
1. Understand the philosophy of science through biology centric topics
2. Develop and enhance skills required for effective communication of scientific knowledge (oral presentation and technical writing)
3. The importance of peer review and criticisms
4. Ethics in biomedical research

So, this course we are having the following objectives by going through this introductory topic we expect you to understand the philosophy of science through biology centric topics because I am a biologist, often I will be giving biology examples to explain certain philosophy of science, and in this scores might help you to develop and enhance skills required for effective communication with oral presentation or writing you know technical papers and so on that is something that I am going to introduce. And then the importance of peer review and criticism as I told you that, you can get better only by taking feedback you cannot be agitated or you cannot feel can have upset if somebody

ask you question that is not going to you know help you. You have to be open, we should appreciate, you should always welcome you know questions and criticisms that would help you right.

And then ethics it is very important. As a scientist you are expected that what you do his honest work and there are ethics therefore, that you must learn. You should never fabricate anything because it is extremely easy for others to test and find what you have done is accurate or not accurate. You cannot really fudge anything here because the science survives because whatever you do you know the other person can repeat and see whether they are able to get the same kind of findings that you got. So, therefore, there is no point in you know changing anything that is not real therefore, there are ethics that we will introduce at the end of the course right.

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Professional Scientific Communication

Course Content

General Course Topics – Course topics are subject to change and modification as the course evolves. Some of the elements are listed below:

- Introduction
- Discussion of research ideas and where they come from
- All about hypothesis reasoning and testing
- Hypothesis testing and experiments
- Scientific writing – how to get started
- Publishing and peer review process: the good, the bad, the ugly
- Schematic diagrams, figures, tables and flow charts- rationale and usage
- Ethics in Biological Research
- Different forms of writing: scientific report, proposal, and reviews
- Developing oral presentation skill sets - rules and practices

So, this is the course content something that you must have seen already on the web portal we will give you introduction then we will talk about the research ideas, because that is important for you to start a research problem then you will tell how you develop hypothesis and then you talk about how do you write you know scientific writing.

For example thesis, papers and so on and what is the flowchart for example, peer review. When you submit anything to a general it does not get accepted day one, it undergoes lot of review and most of you know rejected then accepted. So, you have to have you know how to sell your ideas and then how do you write. For example, schematic diagram

figures table, so how do you make. And then different types of writing, it is not the same you know formula for all. If you are writing an proposal for funding it is a different way write. If you are writing for example, you are experts you write it different way, if it is for layman you write it different way and then same is true for oral communication. So, that is the broad outline and we will take up which one of them when we meet in the next lecture.