Experimental Biotechnology
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Module-I
Basics of Laboratory Research

Lecture-02
Good Lab Practices (Part-2)

(Video Starts: 00:22) (Video Ends: 00:56) Hello, everybody this is Dr. Vishal Trivedi from department of biosciences and bioengineering IIT Guwahati.

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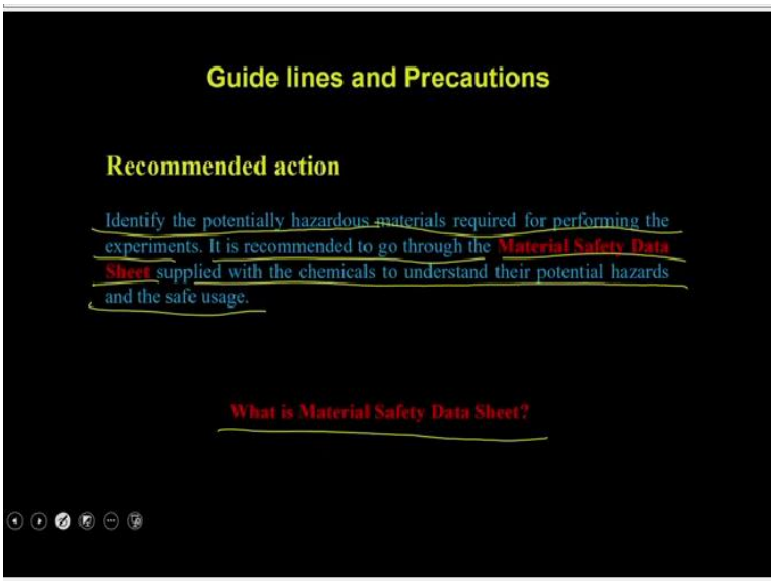
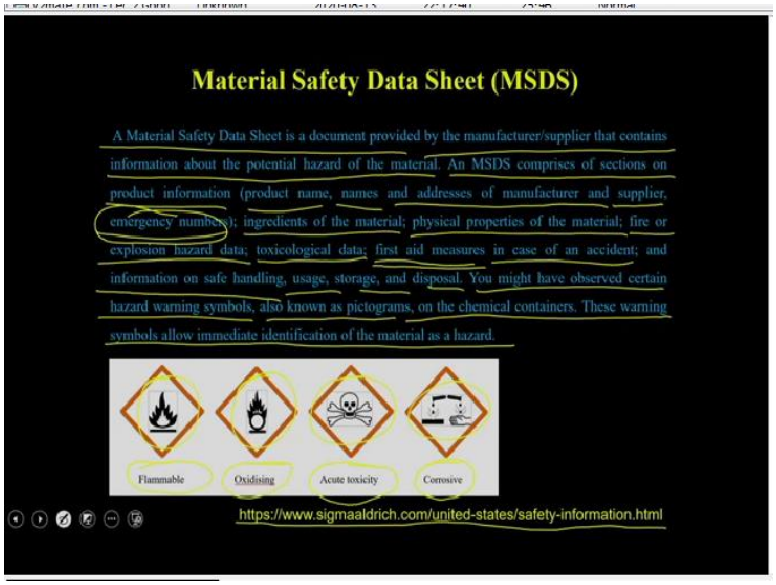


Before you start the experiment, identify the potentially hazardous material equipped for performing the experiments. It is recommended to go through the material safety data sheet supplied with the chemical to understand their potential hazard and the safe usage, which means, before you open the container, whether you know that this experiment has to be performed, what are the chemicals are required.

You have to read the material safety data sheet, so that you know what kind of material it is, in what way it can actually cause the damage to your body and how much exposure limit is actually not lethal for the human being and so on and that all information is available in the material data

sheet. So, what is the material data sheet. Material data sheet is a kind of a safety information, what is been provided along with the chemical.

So, that you will know whether it is a fire hazard, whether it is causing the any kind of burn or whether it is having the strong acid or strong base, so that it can actually damage the skin or whether it is a carcinogen, so that it can cause the carcinogenic effects. So, let us understand what is the material data sheet. **(Refer Slide Time: 02:24)**



A material data sheet is a document provided by the manufacturer or supplier that contains information about the potential hazards of that material. An MSDS comprised of sections on product informations like it will give you the product names and the address of the manufacturers and the suppliers. It will give you the emergency numbers, so in case there will be a spillage, there could be an exposure to the particular student or to the particular person.

It will actually going to tell you the emergency number, so that you can call those numbers and they are actually going to help you in terms of providing the solutions how to handle that. Then it is going to tell you the ingredients of the material, it is going to tell you the physical property of the material, fire or explosion hazard data. So, it is going to tell you whether the material is having a it is going to catch up the fire or not whether it is explosive or not.

It is going to tell you the toxicology data which means it is going to tell you what is the toxicology explosively limit, what is the LD 50 of that particular material and so on, it is going to tell you how if you got bond or if you got the exposure of this particular material, what kind of first aid you can actually do in case there will be accident and information on safe handling usage, storage and disposal, which means all the information what you require before you use this chemical will be provided in a data sheet.

And that is called as the material safety data sheet or MSDS. You might have observed certain hazard warning symbols also known as pictogram on the chemical container, these symbols allows immediate identification of the material as the hazard. For example, if you see this kind of signal that means, it is the inflammable material, it means, this material is not, it is going to catch up the fire very soon.

So, you should keep this material away from the fire when you are using. Similarly, this kind of symbol, it is oxidizing material, which means it is actually a material which will get oxidized and it can cause the other kind of injury to your skin and other kind of injury. So, one of the classical oxidizing materials like bleach for example. Then you have this kind of symbol that actually will find that this is a very, very toxic material.

So, it can cause very toxic material like it can be a poison or it can be life threatening, so it is led 50 is going to be very low, then you have this kind of symbol, which actually says that the chemical is corrosive in nature, which means it could be a strong acid or strong base. So, this is you can actually follow through some of these sigmaaldrich catalogs. And that actually will tell you, and I have given you a link here that actually if you follow, it will actually going to tell you that how the MSDS actually will look like.

So, if you click this link, it is actually going to take you to the sigmaaldrich website and it is actually going to tell you a prototype of the MSDS document and that actually is going to have all this information.

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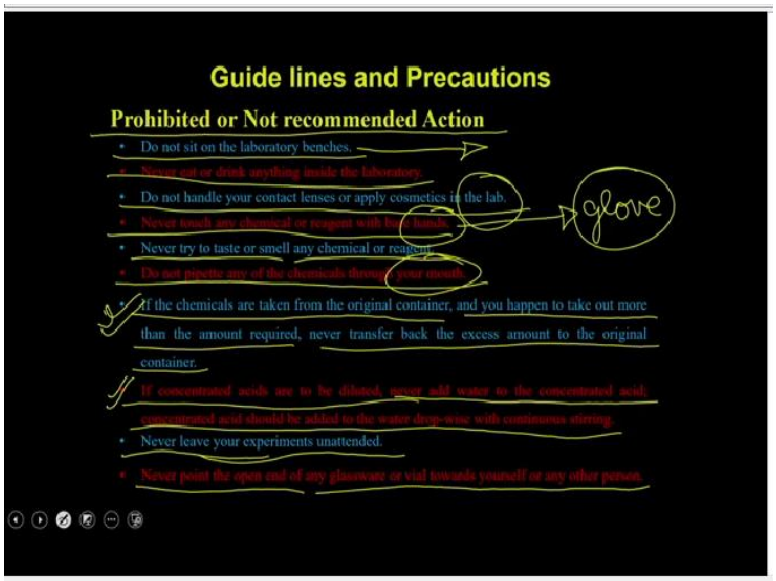

Then these are the prohibited or not recommended actions. So, let us see what are these options. First option is you should not sit on the laboratory benches because these benches are meant for performing the experiments. If you sit on these laboratory benches, you are not only exposing yourself to the chemical what has been spilled on these benches, but also it is actually going to cause the hindrance to others to work.

And in some cases it may not be good enough. Never drink or eat inside the laboratory. So, because the laboratory whether it is a biological laboratory or the chemical laboratory or any other kind of laboratory is always having different types of chemicals. You are always using different types of biological samples like patient samples or the microbes. So, if you take the food or you drink the water inside the laboratory you are actually indirectly exposing yourself for these chemicals or to the microbes.

Do not handle your contact lenses or apply cosmetics in the laboratory. So, when you are in a laboratory you do not handle your contact lenses, means you should not put a lot of makeup because all these makeup or all this kind of material suppose you are putting a lot of creams and all that is actually are kind of a fire hazard. So, if there will be an accident, the chances that you may get more injury than if you do not have these.

Never touch any chemical or reagent with bare hands. So, as I said, you know you always have to wear the gloves before you open the container or you have to perform the experiments. Never try to taste or smell any chemicals or reagents. So, you have provided a provided a material safety data sheets and that actually gives you the complete information about what is the material, how it look like and all that kind of informations.

So that is why there is no need to taste or smell these chemicals because that actually is going to expose you to the toxic chemicals or the toxic fumes, what is being produced from these chemicals and that is not good for your health. Never pipette any of the chemical through your mouth. So, that anyway we are going to discuss in detail that you should never do a mouth sucking or the with the glass pipettes.

If the chemicals are taken from the original container and you are happen to weigh out more than the amount required never transfer back the excess amount to the original container. So, that is very, very important thing that for example if I required 100 mg chemicals and by chance by mistake when I took out the first scoop and I taken out 120 mg of the compound okay. So, in that case you cannot just pour that 20 mg because you need only 100 mg for preparing certain chemicals or certain solutions.

So, you cannot just put that 20 mg back to the original stock that depends on the cost of that particular chemical. So, in case the cost is very low and you can be able to bear that you can throw the 20 mg of that compound then it is fine. Otherwise if it is very costly and you are actually want to you know save that particular chemical then you should not put that into the original container instead you just keep it in a eppendorf.

Put it into a separate container and whenever you are going to make the solution next time use this 20 mg first and then you can take out the extra powder from the original stock. Because why it is important that when you are transferring it back and you are putting it leftover chemicals back into the original stock, you are actually contaminating the original stock, because when you are transferring it, it possible that you may add some more extra chemicals.

And that is may you know, because there are many sources through which you may get the chemical like if your spatula may not be clean enough, your other you know eppendorf what you are using to weighing is may not be very clean and sometimes these eppendorf happened also have the some of the chemicals which are leaching out from these eppendorf. So, that is the way you actually going to contaminate your original stock.

So, if you contaminate your original stock, whatever the experiment you will do subsequently are going to have that contamination into the picture. If you concentrated acid are to be diluted, never add water to the concentrated acid, concentrated acid should be added to the water drop wise. So, this is very important and that anyway we are going to discuss in detail when we are going to discuss how to prepare the solutions.

So, never you are going to add the water into the strong acid because that is a way where you are actually going to create exothermic reactions and that is not recommended. Instead what you are going to do is you take the water and add the acid drop wise, same is true for the base as well. Never leave your experiment unattended for while you are doing an experiment you have to be around. So, that in case something happened to your experiment.

In case some accident happens, it get blast or you know other kind of fire hazards or some spillage, you should be around so, that you can be able to take care of the situation. Never point the open end of your glassware or vial towards yourself or any other person, which means when you are opening a container, you should always open a container in such a way. So, that the face or the mouth has to be away from your face.

And it should not be towards some other person as well, because in case you are opening a vial and there is a gas or with or the pressure is being built inside the water will go into spoil or the liquid is going to spillage, spill outside. And that is spill can be on your face you might have experienced when you are opening up, you know soda bottles, like for example if you open a soda bottle and if you open it towards your face, the all the liquid will fall onto your face.

That is why when you open the any kind of chemical bottles, you do not know what could be the pressure inside. That is why it is important that you should open it keeping the vials mouth away your body and it should not be towards somebody else as well.

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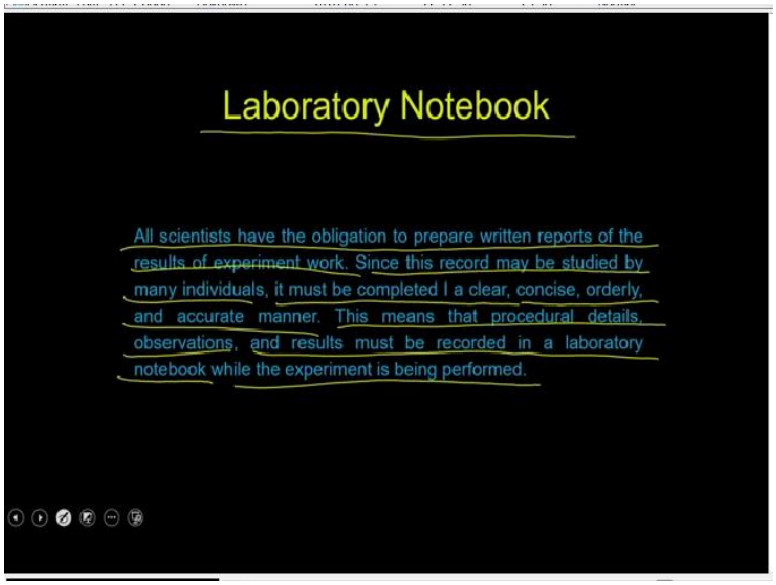

Now apart from that the good lab practices also say that besides whatever we discussed so far the recommended as well. is not recommended material, you also should maintain your laboratory notebook, which means the laboratory notebook should be self explanatory, it should have all the details what is required. So, laboratory all scientists have the obligation to prepare the written report of the results of the experiment work.

Since this record may be studied by many individual it must be completed in a clear concise orderly and accurate manner. This means that the procedures are details, observations and the result must be recorded in a laboratory notebook while the experiment is being performed okay. So, in a laboratory notebook you are going to have the 4 major items, one is introduction, second is observation, the third is result and discussion and the fourth is the literature archive.

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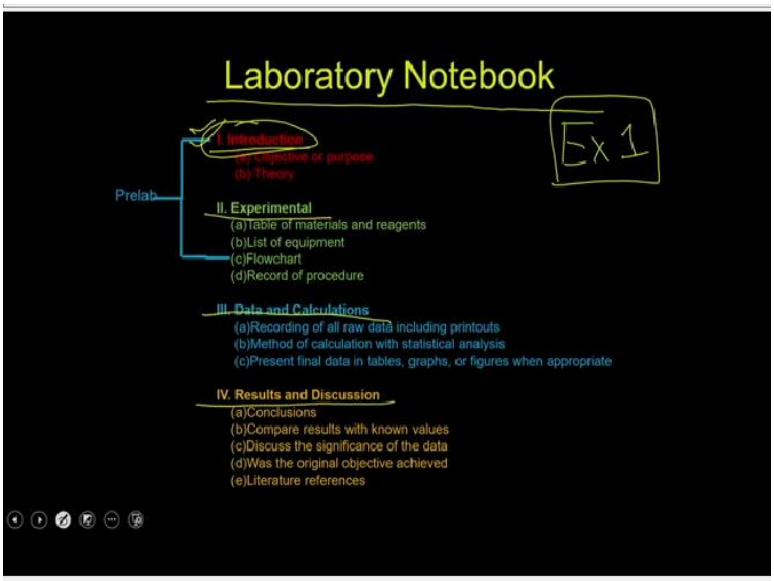

So, let us see what are the material is required to have the laboratory notebooks. So, in a typical laboratory notebook you could have the introduction. So, suppose I am starting an experiment 1 and before I should start I should have all these columns, I should have an introduction sections, I should have an experimental section, I should have a data and calculation section and then I should have a result and discussion sections.

So, let us discuss each and individual item and let us know what are the things you have to keep in this particular section and so that your laboratory notebook should provide the accurate and reproducible information for others to follow.

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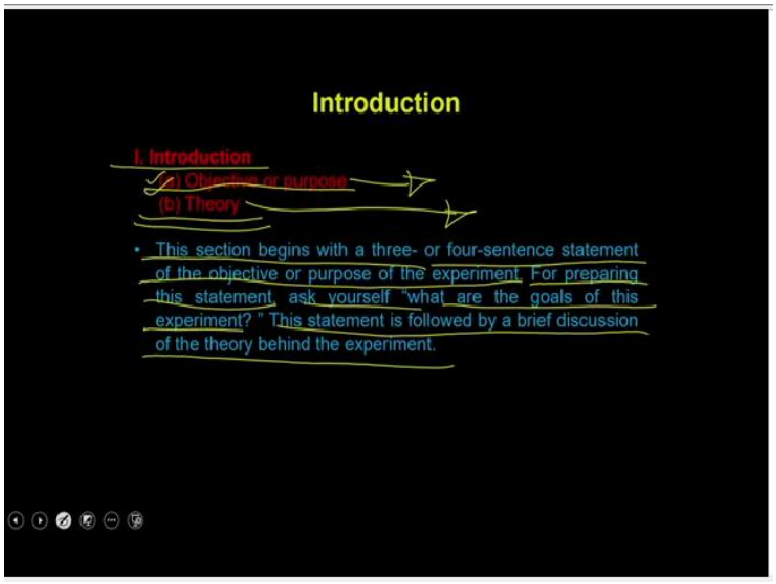

The introduction, the introduction is required before you even start the experiments, because the introduction will have 2 sections, one is called the objective or the purpose of the experiment and the other one is as call as the theory of the sections, which means you should know what is the objective of your experiments which means what objective you are going to achieve if you are doing these experiments.

So, suppose I have an objective to understand how a people are seeing you know through eyes for example, I want to understand the you know, how to people are actually observing or how people are actually perceiving the light stimulus okay. So, for that particular type of object, so, that is going to be my objective that I have to design an experiment to understand how the people are perceiving a light is stimulus, okay.

So, that is the objective number 1, number 2, on what theory I am going to follow this. So, for example, I know that light is made up of different, different small, small light, small particles, which are of different wavelength. So, these wavelengths are associated with different amount of energy. So, this kind of theory I have to first accumulate before I design an experiment, because if I want to explore this kind of questions, I have to have an objective.

And then I should have a theory because on this theory only, you are actually going to design an experiment and then accordingly you are going to acquire the different types of equipments, you are going to acquire chemicals and so on. So, this section begins with the 3 or 4 sentences statement of the objective or the purpose of the experiment, for preparing this statement, ask yourself what are the goals of these experiments.

This statement is followed by a brief discussion of the theory behind the experiments, which means every experiment is based on the pre-existing literature, every experiment is based on some logics and every experiment is based on a particular type of theory.

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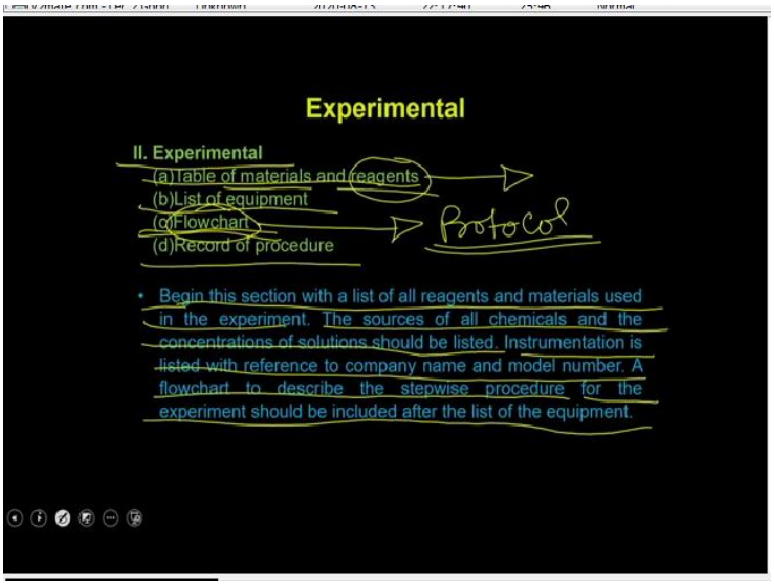

Now, the second is the experimental part. So, in the experimental part, you are going to have the table of the material and reagents. So, once you design the experiments and once I designed the experiment, I should first note down what are the materials are required, what are the reagents are required. So, that I should collect these materials and should prepare the reagents what is required and I should also go through with the literature and collect all the recipes.

What is required to prepare these reagents and all these has to be documented into my notebook and then I have to prepare a list of equipment required. So, that I should arrange all these equipments and I should ensure that they are in working conditions and all the equipments are available for the usage. Then you have to prepare a scheme or the flowchart which is actually going to be a part of the protocol which means you should go through with the protocol understand each and every step.

What is the requirement of that step, what are the precautions you should take while you are doing these experiments and that you will do when you are preparing a flowchart and then you record the procedure which means you are actually going to document the procedure in which you are actually going to add the chemicals or you are actually going to perform the experiments. So, this section begins with the list of all reagent and material used in the experiments.

The sources of all the chemicals and the concentration of the solution should be listed. The instrument is listed with the reference to the company name and the model number. A flowchart is described to stepwise procedure for the experiment should be included after the list of the equipment required. Because that is very important that you should provide the equipment, you should provide the model, you should provide the company.

Because those who are going to perform or going to reproduce this experiment should use these same set of equipments.

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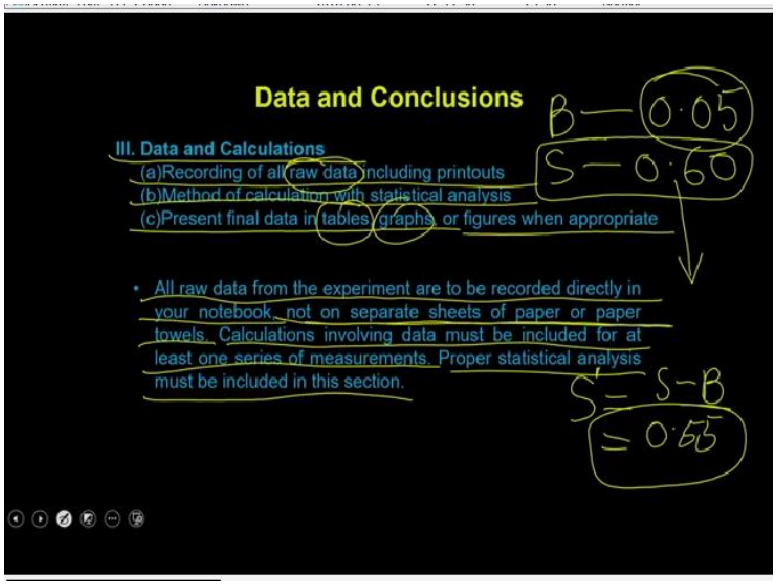

Then the third is the data and the calculations. So, you have to record all the raw data including the printouts, then you have to method of calculation with statistical analysis. And then you have to present the final data in the form of the table, graph or the figure, whatever will be appropriate. So, this section is very important that you should record all the raw data; you should keep the raw data ready for others to follow.

And you should do all the calculations, you should promote all these equations into your data register. So, that people will be able to use those equations and will be able to do back calculations to check that you are not making any errors. So, all the raw data from the experiment are to be recorded directly in your notebook, not on separate sheet of paper or the paper towel.

It is very important that you should not record these raw data into you know, slip pads or rough papers because, you know, you have to record all the raw date raw data on to your data registers. So, what is mean by the raw data is like I am doing a protein estimation, so when I did the buffer, I got a reading of 0.05 okay and then I did the sample. So, that sample is gave me a signal reading of 0.06.

Now, this is the rough raw data actually, but if I want to do a corrected data, what I will do is, I will going to calculate S prime and that is going to be S - B which means I am going to correct the background information which means I am going to have the 0.55 which is actually a corrected information. So, this is actually going to be a corrected experimental value which is different from raw value.

Because raw value you have to put into your data register or the notebook and the blank also you have to put and that is how you are going to do a calculation to calculate the calculated values or the experimental value. And these calculations are very important for others to verify that you have done the things properly. If you are going to note these on separate sheets, paper or paper towels, it could be possible that you may lost those paper towels or separate notebooks.

And then that information may be lost. Calculation involves data must be included for at least one series of measurements, proper statistical analysis must be included in this sections.

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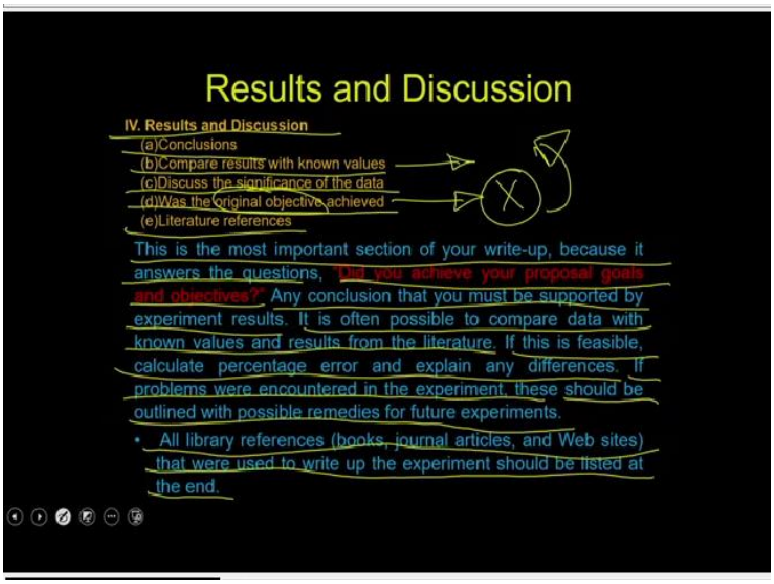

And then it comes the results and discussions. So, result and discussion comes with the conclusions, then you compare your results with the known values, you calculate the discussion of the significance of the data, you are going to ask the question whether the original objectives are being achieved or not or if it is not been achieved, then what could be the reason, can I verify some more experiment and see whether the experiments.

And then you are going to a literature search. So, this is the most important section of your writer because it answers the questions, did you achieve your proposal goal and objectives. Because, once you are going to done with the experiments, you are going to get the data then you are going to analyze that data and that actually is going to give you the final results. So, final results are actually going to analyze that.

And then you are going to compare that with the existing literature. You are going to compare it and say whether the objectives are being answered or not or whether the objectives are partially been answered, but you still have the unresolved questions. So then you can actually you know designs additional experiments and that is how you can be able to answer the question whether you have achieved the objectives or not.

Any conclusion that you must be supported by the experiment result, it is often possible to compare data with the known values and result from literature. If this is feasible, calculate the

percent error and explain any differences. If problems were encountered in the experiment, these should be outlined with the possible remedies for the future experiment. So, in some cases, it could be possible that experiment may not work, it may have some troubleshooting.

It may have some you know problems because of that you could not get the desired results. So, in those cases, you should also note down the troubleshooting, then you put those troubleshooting into the picture and then you again repeat the experiment and see whether the results are being achieved or not, whether the objectives are being achieved or not. Ultimately, all these you have to do a library reference.

And all these references has to be sited at the end of your writing. So, that the people who are going to follow your experiment and the writer should be know that okay these are the citations on based on which the experiments are being planned. These are the citations he has used to compare the data for what he got from the literature and these are the data what he has or these are the literature what he has used to compare the experiments with the you know, known literature.

And that is how he has concluded that this experiment is working or not working or these are the additional modifications are required or not. So, all these are very important.

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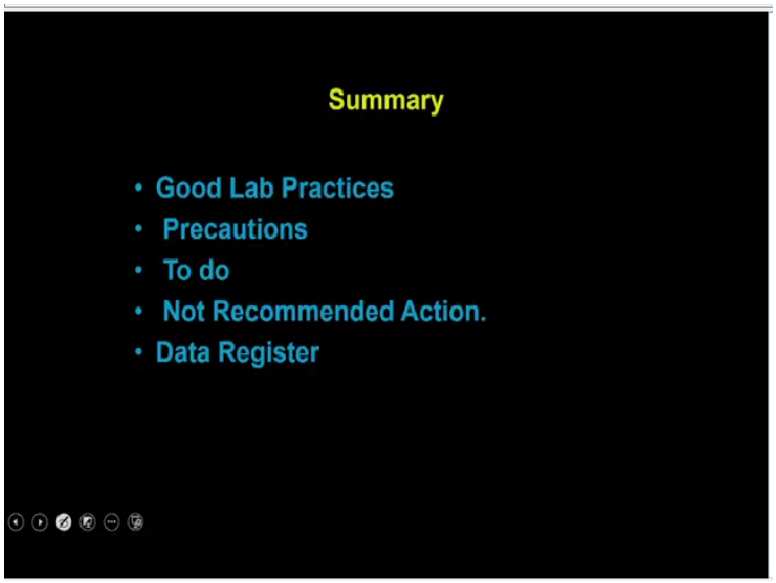

So, this is all about the good lab practices. In summary, what we have discussed we had discussed about the good lab practices, how to be remain in the lab, when you enter into lab, what are the action you should take and what other precautions you should take and what are the action you should take when there will be an accident and fire hazards, when you open you know or when you start opening a chemical.

What are the informations you required and what that information can be used to avoid the exposure as well as the other kind of accidents. And lastly, we have also discussed about the notebooks or the data register and what are the components are required to document the experiments in your data registers. So, with this I would like to conclude my lecture here. Thank you.