Course Name: I think biology

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Week:2

Lecture:11

W2L11_How to Read a Scientific Article?

Hi, and welcome to the class on how to read a scientific article in the iThink Biology NPTEL course. So first of all, let's begin by discussing what a scientific article really is? There are actually different kinds of scientific articles. So an article could be somebody, about somebody's work. So that could mean that somebody is doing some experiments in the lab or doing some fieldwork, making some measurements.

They have a hypothesis that they want to test out and they do various different kinds of experiments or fieldwork measurements or observations to try to test their hypothesis, for example. Then they interpret the results of their work and they come to their conclusion and they report their findings in a journal. So that is usually referred to as a research article. There are other kinds of articles, for instance, let's say I am really interested in cancer biology. I want to understand how cells migrate, cancer cells migrate inside the body.

That's just a very random example, but let's say I'm interested in that. What I can do is I can try to gather all of the previously published articles, read them and try to synthesize the information that's found in these articles and put them together in sort of a single as a single resource. And that is actually called a review. Right. So usually a review will put together all of this information as a single resource for somebody who is interested in the topic.

And the review may also suggest, say future directions for research. Other kinds of articles could be commentaries. So let's say I've read some interesting work that somebody has done and I would like to provide my own viewpoint and I think it would be useful for the rest of the scientific community. So I will actually write a commentary on the work that's been done, you know, say suggest future future outlook, other work that could be done or say, no, I disagree with the work, with this work because this experiment should have been done differently or whatever. So there are different kinds of articles.

Okay. What we will focus on today is scientific articles that are research articles, right. And many times these articles are peer reviewed. So what does it mean for article to be peer reviewed? A peer reviewed scientific article goes through a series of steps.

Okay, so the first thing that you do, as I said earlier in a research, you want to publish a research article, you conduct some experiments or you do some field work, you write some theory and then you express an idea, right? And, and once you do that, you know, you, what you do is you write it up and you submit this article. To the journal that is appropriate to your community. So for example, I wouldn't submit my, an article on cancer biology to an a journal that's called ecology letters or something, because that doesn't quite fit right.

So I would have to submit it to a sort of discipline specific journal because that's where my community is, so that's where the people who are interested in the same work that I do, that's what they would be reading. So once the journal receives this article, there's usual editor that, that looks at the article and says okay, this is of interest. I think the larger community would want to read about this, and then they send this out to peers to review the article.

What the, what do, what do I mean by peers in this case? I refer to scientific peers, right? People who are in the field and who can evaluate the work and say okay, this work that was done, these experiments were valid experiments, the design of the experiment was good. How they've interpreted the results of the experiment is good. So they have to be, these peers have to be able to make these kinds of judgments. The peer reviewers assess the work and they send out comments back to the editor. And based on the, on the sort of the revisions and the comments that the peer reviewer suggest, the editor will decide whether or not this article should be published. So that is sort of the peer reviewing process in a nutshell. It it can be quite a very, very long process. Yeah.

But not all articles really have to be peer reviewed. There are also online servers, where you can submit articles without peer review. So bioRxiv, this is an, this is a website which is called a preprint server. What this means is it's for basically the entire discipline of biology, which is, as we know by now, a very large field, right? This entire discipline of biology. if you have, if you have some work and you don't want to go through the peer review process, or you think what you've done is really interesting and you just want to put it out, you know freely for anybody to access it. You can upload your article onto the bioRxiv.

There are also other preprint servers. They're called preprints because it's before, you know, it's pre the review process and so on. Yeah, but many people actually decide that they don't want to go through the peer review process and they just put up their work and they leave it at that. Others put up their work on an Rxiv or bioRxiv, and then they also put it through a peer review process and publish it in a formal journal. So what do articles look like? So often the format of these articles is actually very discipline specific.

What does this mean? So, I don't just mean discipline as in the discipline of biology or physics, but even within the discipline of biology, it can be quite varied. So whether you work in public health or something related to the medical field, or if you work in ecology or you get ecosystems, or let's say you do mathematical modeling in biology, the kind of formats that most journals require you to write your article in can be quite varied. So today what we will look at is an article called Nature's Swiss Army Knives: Ovipositor Structure Mirrors Ecology in a Multitrophic Fig Wasp Community. So I'm looking at the article of the paper.

This article is freely available. It's been published in a journal called PLOS ONE. PLOS ONE is a, is one of the journals that is open access. That means you don't have to pay to access the journals. Not all journals are open access.

And you can see, as you see here, that it says it's open access and it's also peer reviewed. So it has, it has both advantages right. So Rxiv, bioRxiv, as I showed you before was open access because it's freely accessible, but it is not peer reviewed. And this article is available on the PLOS ONE website. Right, So if you go to PLOS ONE, if you type PLOS ONE into, into your search engine, you look in PLOS ONE, you can look for this, this particular article based on either the author names that you can see here right, or the title of the paper itself. And as you scroll through this website, you will see some commonalities across all journals. That is that you see, you see the journal name, you also see, for example, the possibility to download a PDF. That's where my cursor is right now, right.

That means, that you can also view the article offline. You don't necessarily have to be on the web to view it. And then, you know, very different journals have different kinds of sort of website designs. Once you download, if you download the PDF, it might look something like this. So this is what the PLOS ONE article looks like, Right? And this is just the first half the, half of the very first page. And what you will see is that the author names are here and their affiliations are also just below., right,

So in particular, the the authors of this particular article are all from the Center for Ecological Sciences at the Indian, Indian Institute of Science in Bangalore, right. The middle author, Lakshminath Kundanati is from the Department of Mechanical Engineering, whereas the other two authors are from the Center of Ecological Sciences. So it's also nice to see often where the work is being done, right.

And then following, the the title, you'll also see than the abstract. And in this particular abstract, you actually see that the abstract itself has a sort of substructure. It's not the case in all journals. Again, this is journal specific. So here you have an abstract that gives you background, methodology and principle findings. And it also gives you some conclusions. Now, this article that we are looking at is also available on the I Think Biology website.

You may have already seen that many of the chapters have what we call research highlights. And what these research highlights do is that they provide you a sort of easy way to start reading papers, right. So many of you who are attending this class may not be familiar with reading sort of this very rich, dense scientific particles. So this is supposed to be able to help you sort of through this process. OK, and so this, these research highlights give you a background to the area and they are embedded within the chapter that's also about.

So this, this chapter, for example, is about figs, right. You read about fig wasps in this paper. And then you can also download the paper itself. But the paper is annotated. What do I mean by annotation? So this is the same article that I showed you earlier. But this is what it looks like when you download it from the iThink Biology website. And you will see that many things are commented on right. So they're highlighted and commented on. And the reason for this is because we want to help you in clarifying doubts that you may have immediately.

So, for example, many words are defined, right? So if you click on it, you will see that, for example, mechanoreceptors are receptors that sense touch, pressure and other mechanical stimuli. So you're given, if you click on it, you're given a definition. But there are also other places where you're not only given definitions, but also where, you know, main sort of ideas that you should be catching as you're reading, right, important ideas, important messages that the author is trying to convey. Those are also being brought out through these comments.

So that's what these annotated papers are about. The idea is, is that if you go through a few of these annotated papers, you get better and better at reading scientific articles, Right. So in general, most scientific articles are divided in subsections. Usually there will be an abstract, an introduction. So the abstract gives you a, a brief summary of what the authors have done, and why they've done it, and what they found, Right? So it is, it can be quite dense. But usually, if you read the abstract, you can tell whether this is a paper that's of interest to you or not, right?

After this, there's an introduction. The introduction provides a very nice sort of background, usually if it's well written, to the topic itself. And it also introduces you to previous work that's done. So it helps motivate the subject and the work in the article itself, right. So people will usually say, you know, this has been done in this field, this has been done, this has been done, but nobody has answered, this question. And that's what we are doing in the article. So that's usually how an introduction is set up.

After this, there are methods, materials and methods, sometimes it's called. And the methods section, what it does is it gives you, it's supposed to give you almost like a recipe that tells you exactly what procedure the authors followed to carry out their experiments. And the idea is that if you read the methods section, you should be able to reproduce the same work that the authors are reporting. After this, there will be a results. And sometimes the results and discussion sections are together. Sometimes there are separate sections.

And here usually is where you will see plots and other kinds of visualizations, observations, photographs and so on, that highlight the results or whatever data people have gathered, right. And finally, the discussion and conclusion section actually tells you what the authors think of, of you know, of their findings.

Okay, so how do you read the article in the first place, right? What do you do? So first thing you should keep in mind when you're starting to read scientific articles, it can be really overwhelming.

There's a lot of text. It's very dense. It requires a lot of patience. And you should also note that usually as you get better and better at reading papers, you will develop your own style in how to read a paper, right. It's not always the case that you have to follow a very particular recipe. What we'll be doing in this lesson is more or less going through a recipe that works for most people, but it may not be the case for you, right. But it, it should at least give you a better idea of how articles are written and what is their content and so that you, you can figure out your own way of reading an article.

Okay, so the first thing that I would do is read the title, and the abstract of the paper. Sometimes it helps to read this, to do this as a group. And if you're doing this for the very first time, I would really recommend that you do this as a group. So just reading the title and the abstract. Usually, in the abstract already, there will be many words or concepts that are unknown. And you should take some time to clarify those doubts, right? So look up words or expressions or concepts that you find difficult. Look them up using the internet, ask your group members. And so that you get a feel at least, you may not understand everything in the article, but enough that you get a feel for what the article is actually about, right.

Now, let's go back to the the article that we were referring to, right?

So the title is Nature's Swiss Army Knives. Okay, so usually many articles will have a kind of catchy sort of beginning of their title so that it pulls you in to say, okay, what are nature's Swiss Army Knives? Right. Now, Ovipositor Structure Mirrors Ecology in a Multitrophic fig Wasp Community. Okay, so there's a lot of words here, right? So you need to know what an Ovipositor is. You need to know what a Multitrophic Fig Wasp Community is, right? That those are already things that you need to know what they're referring to, and maybe pause this video if you, if you can to try and read the abstract itself.

So once you've read the abstract, I recommend, often that you can skip to the materials and methods section, right. What this does is,it the abstract has already given you an idea of what the paper is about, right? Now that you have that, go and look at the materials and methods and try to make sense of what they may have done, right? Why this, why this kind of skipping I recommend is because it gives you, since you've already read the abstract, you know what they're trying to say. And then you go and look at how they've come about, how they've reached those

conclusions that they've written about in their abstract, right. But materials and methods can be very dense, right?

So you shouldn't be intimidated by the jargon. You shouldn't be intimidated by the complicated words or some of the methods you may not know. And that's okay. When you're starting out, you can just ignore some of it. It's okay that you don't understand word for word. But what you need to know, what might help is that you understand the overall goal, like the target of that particular method. Right? You don't need to focus on the detail.

For example, if they've used solutions of different concentrations, you don't need to worry about that yet, right. What you need to know is, suppose they've mentioned a method called PCR. right. Then you need to know what PCR is. You need to know that it's a Polymerase Chain Reaction, things like that. Okay, so once you've done that, by now you've already actually started making a glossary of terms that you don't understand, right. You've done that by looking at the abstract and you should continue actually doing that.

Okay. So this is an example from that same paper about the Ovipositor structure. And, you can pause the video for a minute and have a look through it. I think you'll be surprised that it's not quite what you expect about when you, when somebody is referring to a materials and methods. right? It gives you a little bit of background and then it tells you what they've done. Okay. So pause the video and have a look through. So hopefully you've had a chance to read through.

And what you will have realized is that in the first paragraph, what they've actually said, they've actually outlined is what the fix fig syconium is, right. And what kinds of things you can find inside the fig syconium, right. So you right away then define the fig syconium as the globular enclosed inflorescence, right. So you don't actually ever see the flowers of the fig tree because the flowers are inside this enclosed sort of globule right, the syconium itself.

And then it goes on to tell you about what is, what is contained inside the syconium. And in the second paragraph is where they actually start to tell you what they've done, right? They say the fig wasp community, Ficus racemosa is from South India. Right? And they tell you that they've looked, they found them in the Indian Institute of Science campus, Bangalore, Karnataka. And they've given you the latitude and longitude. So as I said, you should be able to reproduce the exact experiments that they've done. So that means that if you go to this exact location, for example, if you put it into your maps app on your phone, you should be able to go back to exactly where they found those fig wasps, right? And then they tell you about what they found in the community, and also how they have chosen the specific wasps that they, that they've studied. Okay, so this is just a little overview of the kinds of things you might expect in materials and methods. You will also find that in most papers, people use different kinds of methods to try to prove the same point.

The idea is that you have several lines of evidence to support your conclusion, right. Okay, now that you've covered materials and methods, I then recommend that you go on to look at the figures. Okay, figures, figures, figures and figure captions. So if you look at the figures, so remember, you've not even read the paper yet, right. But you have the abstract, you know what they're trying to do, what they've concluded, you know how they've done it by reading the materials and methods. And now what you want to do is try to figure out what they're testing, what method did they use? What are they presenting, Right? Usually it will be in the form of a graph, or a photograph or some observations. And what is the conclusion from this? Yeah.

Okay, so let's look at a figure again from the same paper, right. So this is the figure. And it gives you a kind of bolded sort of summary of what this figure is about. It's ovipositor sclerotisation using light microscopy. So since you already have a background and that you've read the abstract and the materials and methods, you'll see that these are images of ovipositors from fig wasps, right. And just by looking at the figure, you see very clearly that the ones in panel L, M and N are definitely a little bit darker, right? So even if I don't know what this really means, what is this darkness? What I can do is try to find within the text where they refer to figure two for the first time.

That's what I highlight here, right? So in the results, in the very first paragraph, they say the degree of ovipositor sclerotisation increased from the early arriving gallers to the later-arriving parasitoids with negligible sclerotisation (i.e. darkening). So this is where it says it, right. That means that wherever it's darkened, right, this is sclerotisation. So this darkening, now we know what it means. And we also know that different species have different sclerotisation. Ok, now that you've looked at all the figures, now you can read the whole paper because you have all of the main ideas, right. You know what they're trying to do, what they've what you know, what they're trying to say, rather, right? What point they're trying to make. You know the evidence that they've provided to support their ideas because you've looked at all the figures. You know how they've done it because you look at all the methods, right. Now, once you've done this, though the paper may have addressed several sub questions, right?

For example, in the figure that we saw here, they have looked at sclerotisation of these ovipositors. So that is one thing they're just saying. The the sort of question they've asked and answered in using this figure is to say, what is this sclerotization of the ovipositors from different species? But what is the overarching question? What is the major problem the the authors are trying to address? That is something you should keep in mind.

And that comes about by looking at every figure separately. Ok, so after you've read a paper, it's actually a good idea to try to summarize your reading to a peer and try to make them understand what you've read, right. And once you try to do that, whenever you that's why I said earlier that it's a nice idea to try to do this with a peer, because what this does is it gives you a, a way of testing your own knowledge, right? Because your peer may come back and ask you a question.

No, I didn't understand what you're saying here. And then it will test your understanding. And if you don't get it, you can go back and check the paper.

So now if you look at the discussion, so this paper has a discussion section. Sometimes it's called conclusion. Sometimes it's combined with the results. Right. Let's have a let's have a read together of this discussion. It's saying the gross morphology, as well as the ultrastructure of the ovipositors of the wasp F. racemosa showed adaptations that mirrored their ecology and mode of oviposition. Ok, so what is the saying? Can we translate it to ourselves, right. They're talking about the gross morphology. So the shape and size and the ultrastructure, meaning the actual if you look at the ovipositors very closely, right. They actually show adaptations, meaning that they have somehow evolved, let's say, that match their ecology and mode of oviposition.

Okay, so if you wanted to write a summary or even discuss a summary or present it to your class or something like this, how would you do it? So here's a suggested format. You might give an introduction, right? So use background information that gives context. So in this particular article, you would have to introduce figs, fig wasps, what ovipositors are, the life cycle of the fig and so on.

So you, you would be explaining the history behind this, this entire question. And then you ask, Okay, what are ovipositor structures like? Are they adapted to their environment or not, right? Then you might use subheadings. So look at each figure separately and explain to your peers or in your writing or in your summary report, explain to your peers what experiment was done for this figure and for these results. And finally, in the conclusion and discussion, you want to assess the paper and say, what was the major question that was addressed? And then you can also ask yourself, do you think that the author's claims are valid or not, right? You can say they're saying X, Y, Z, but I think if they did this one more experiment, that would definitively prove their claim, Right.

So that's what that’s, what we mean by critically addressing or critically evaluating the paper. You can also think about what the authors have missed out on, or you can think about why what the authors have done is a really nice, clever idea, right? Then you can think about what could be done next. So you've answered one question. And usually when you answer one question, it opens the doors to many more questions. You can also think about what could be done next. So these are all things that you can actually discuss as a group when you're reading a paper. All right, so now that we've gone through this, I hope you will go back to the iThink Biology textbook and have a look at the research highlight on ovipositors. Okay, thank you. That's all for today.