

**Introduction to Biomimicry**  
**Prof. Shiva Subramaniam**  
**Department of Multidisciplinary**  
**Indian Institute of Technology-Madras**

**Lecture - 04**  
**Nature's Unifying Patterns - Introduction**

You know when I started learning biomimicry, I think it was about three or four days into the course I was learning it. There were two ways I was learning it from a website. And I had also attend, you know, enrolled in a class, which was, and I, after I learned what is biomimicry, why biomimicry, how does one mimic, all those things I thought that is what it is right?

I said oh, I have learned biomimicry. So this class had three sections. So Section one was over, section two was over, section three I thought was just going to be a revision of section one and 2. And when section three happened I cannot even describe the feelings I had okay. I was completely taken aback. Of course, I was a little bored. I said what is this? I thought biomimicry is over.

But then when I started looking at what is in store for me to learn, I said this cannot be true. Because in the first instance, I got completely transformed by knowing that you can learn from nature. The second instance, I got completely transformed by knowing that this is the way nature designs. That these are what are called the design principles of nature.

That when nature makes something, she uses the following principles, and all these principles are mind-boggling principles. All these principles are so important in saving the earth. I think in the future, I think and that is why you must listen to what I am going to say, with lot of involvement because I think in the future, when you make something, the investor who is going to invest some money into your product or process, he will probably insist that your product or process satisfies all these principles.

Actually, when you come to a portion on evaluate, this is what you will learn. So what you are going to learn now, what you are going to learn now is called nature's unifying patterns. So in your mind, what do you think, what do you tell yourself? You tell

yourself I am learning how nature designs. What is it that nature does when it does design? And why should you learn it?

You should learn it because number one, all these designs, all these principles go to save the environment, to keep everyone safe. And second, you will understand that if you make something, if you make a product or process using many of these principles, versus someone who does not use these principles, the person who is giving you money to make it, he will choose between you and the other person.

He will say he is going to give the money to you for investing because you have followed these principles and none of them harm the environment. I wish someday all these principles become mandatory before something is done.

**(Refer Slide Time: 03:45)**

**NATURE'S UNIFYING PATTERNS**  
*"Design Principles" of Nature*

1. Nature uses only the energy it needs and relies on freely available energy.
2. Nature recycles all materials.
3. Nature is resilient to disturbances.
4. Nature tends to optimise rather than maximise.
5. Nature provides mutual benefits.
6. Nature runs on information.
7. Nature uses chemistry and materials that are safe for living beings.
8. Nature builds using abundant resources, incorporating rare resources only sparingly.
9. Nature is locally attuned and responsive.
10. Nature uses shape to determine functionality.

Reference: [decentrality.org](http://decentrality.org)

NPTEL

The slide features a background image of a coral reef. In the bottom right corner, there is a video overlay of a man with glasses and a blue vest, pointing towards the slide content.

So what you see in front of you are the 10 principles also known as nature's unifying patterns. I am taking the liberty of saying design principles because that is the way I understand it, right? And I am not going to get into all of this. What we will do is over the next eight weeks, we will explain two or three every session so that you are not overburdened with these principles.

But be nice to just sort of you know, just use this time to, you do not have to learn it, you do not have to learn it by heart and all that. Just use this time to understand the import, the effect that each of these principles can have, okay? So, and if any of you can actually say why, in your own words, why is this important?

Or if a present product is there in your room if you can say, how can I improve the product using any of these principles, you know, you are going to make your first what one crore rupees. Yes, I am not joking, okay? Just look at these principles now. So the first one, nature uses only the energy it needs and relies on freely available energy. No need to explain.

I am not going to explain it anyway now. I am just reading it out so that it gets embedded in your mind. Nature uses only the energy it needs and relies on freely available energy. Nature, therefore, does not, is not wasteful as far as energy is concerned. Nature recycles all materials, which is a problem all of us have, right? Our inability to recycle all materials.

Nature is resilient to disturbances. The word resilient is so powerful. You know once I had to draw my logo and one of the exercises maybe we will do, and at that time I had gone through several struggles in my life. So at that point in time, when I was asked to describe myself, I described myself, my life as a tennis ball, because the tennis ball bounces on the wall and comes back, bounces on the wall and comes back.

So a tennis ball is what is known as resilient, getting back up from disaster. So nature is resilient to disturbances. Nature always has a way of coming back to life. And there might be actually a leadership lesson over there, right? There might actually be a big lesson on how can we learn from nature in order to be resilient. Nature tends to optimize rather than maximize, right?

How many times do we build room after room in our house? When we actually what we really need is very little space. So, therefore, this is a lesson for every one of us, when you know if we can say less is more is a very nice way to describe this. Just think about and I will keep coming back to this again and again because these are brilliant life principles.

Nature provides mutual benefits, you know. So it is such an altruistic nature for nature, right? That if I do something for you, you do something for me. There are actually some

great videos by David Attenborough, on nature. And one beautiful, just look at, I do not want to spoil the fun for you. Just look at this video on the sloth bear, right?

Just go to YouTube, nature David Attenborough sloth bear. It is a beautiful video, you will understand the mutual benefits immediately. Nature runs on information, right? So for instance, many plants protect themselves the minute they get information, right? So therefore we will have to look at a little more detail as to what is the information that nature gathers and how does it use that information.

Nature uses chemistry and materials that are safe for living beings. This is brilliant, right? So, therefore, most of the things that we make, remember when Mrinalini was talking to you about the color and the dyes. Why is it that slide was important?

Because when we make color, we pollute the entire you know, there are cities in India that have been completely polluted because of industries that pollute the water, pollute the land. And many of these chemicals are toxic. You cannot even use that land after some time. You cannot even use, the water is actually discolored. I mean it is of a different color. It is not even like water.

That is because we are so used to producing toxic chemicals but nature does not do that. Nature builds abundant resources incorporating rare resources only sparingly. How much right, how much of rare resources do we just waste, right? So actually, if you look at the sentence, you can say, for nature, something that is abundant, is actually gold, is like gold for us.

Nature is locally attuned and responsive. Nature does not go all the way to Rajasthan to get marble to build a house in Chennai. Nature looks around and does not go very far. Nature uses the materials that are around it, around what it wants to build, and uses those materials. And finally, nature uses shape to determine functionality. Many times you will find that the shape of a tree also serves as its function.

We will come back and learn each of these in detail. And you will start to understand that when you start to design you can use many of these principles, right? And just to sort of reinforce what we learnt.

**(Refer Slide Time: 09:58)**

---



### Nature's Unifying Patterns



- Fundamental lessons from nature that should be considered as part of every design process
- Essential to biomimicry – distinguish it from bio-inspired design
- Help to create more sustainable solutions



---

So therefore what is, what are the nature's unifying patterns? How do you describe them? What you learned was 1, 2, 3, 4, 5, 6 patterns. What you are learning now is what are they? How do you describe them? Fundamental lessons from nature that should be considered as part of every design process. Can you believe that?

I do not know how many of you are designers here, how many of you are product designers, how many of you are making fabric, how many of you are fashion designers? How many of you are making things that maybe it is time for you to look at this and ask yourself, whether there is a new thing that you can learn about designing.

Essential to biomimicry distinguish from bio-inspired design, because bio-inspired design may not use all these principles. This is very essential to all of biomimetic innovations, and inventions. And of course, I do not think I should even have written the last line, because that is exactly what it is, right? 3.8 billion. You cannot survive for 3.8 billion years old if you do not design for that time period.

So, therefore, what are we learning? We are learning that nature has 10 design principles. Each of them is used by nature in order to design something. Every one of them helps to help live a sustainable life and helps to save the earth. So that is the design principles or the unifying patterns of nature. What you need to do now is start to think about which one you want to learn in a more detailed way.

You must learn all of them but you know, it is important to find out in your work, which one applies very aptly. And then slowly get to know each of these design principles.