Lecture - 12
Function and Strategy

What you are going to now learn is a very critical aspect of biomimicry. You are going to learn only three words; can you believe it? I am going to spend about 10, 15 minutes for those three words. But these three words are important to you because without understanding these three words, there is no point in doing biomimicry.

Because in biomimicry, whatever you do in the future from now on, all these three words will keep coming back, so why not learn them well. And you are going to be surprised, maybe even bored, saying you already know these three keywords. So, the learning is going to be fun and easy. Anything that is easy is going to be fun, okay? But you just give me your attention please, 10 or 15 minutes.

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FUNCTION
WHAT something does – a purpose or outcome

Spectacles

FUNCTION – Spectacles:
- To correct the wearer's vision
- To protect eyes (e.g. sunglasses, safety glasses in labs, while playing squash)
- To enhance or alter wearer's appearance (e.g. fashion)
- To view specific visual information (e.g. 3D movies)

That is what you are going to learn. You are going to learn the word called function. Function very simply described is what something does. What is the function of spectacles? What is the function of a chair? What is the function of a book? What is the function of a dustbin? What is the function of a laptop? What something does? Or a purpose or outcome. So, what should be the outcome?

What is the outcome of the chair, the laptop dustbin, etc.? So, in this case, what is the function of spectacles, to correct the wearer's vision, very simple. So, this is very important for design, right? When you design stuff, you do not say I want to make a chair. You want to say I want to make something that keeps, that helps people balance, helps people be seated, helps people to be comfortable, right?

So, then the idea of a chair may come to you. The first thing you ask before you start to design is what do I want my design to do? The verb, the action, to do, has to happen. Or what is the purpose of my design? What should be the outcome of my design? Here, the outcome of the spectacles is to correct the wearer's vision.

If you make spectacles that simply look nice but do not correct the wearer's vision, some people may accept it, but that is not the real purpose of a pair of spectacles. So, to correct the wearer's vision, to protect the eyes, many times, you need to have spectacles that protect your eyes, right?

For instance, when you are playing a game of squash, when you are doing some welding, or when you are out in the sun, you want to protect your eyes because it can hurt your eyes. Many of us will want to wear spectacles because we want to look good, which is why we spend so much time in a spectacles shop, right?

So much time because we want to look good, we keep looking at the mirror, someone we actually ask other people- am I looking good? And we want to look good. So, I would enhance my appearance. And of course, this is something that all of us have experienced. The first time I went to this 3D movie, I felt very silly, because they gave me these glasses, huge, ugly glasses, and I had to put them on.

And I looked around, everybody was putting it on. And therefore suddenly what I did was I took it off, but I could not see anything on the screen. So, I put it on quickly back again, right? So, therefore, if you want to use something specific, you use spectacles. So, the function is what something does. I am sure it is very clear to you now. The next word is very important.

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FUNCTION AND STRATEGY

FUNCTION	STRATEGY
WHAT something does – a purpose or outcome	HOW something accomplishes a function – through a characteristic, mechanism or process

Spectacles

FUNCTION – Spectacles:	STRATEGY – Spectacles:
To correct the wearer's vision	Lenses of appropriate power are held in place in front of the wearer's eyes

The next word is strategy. I cannot just have a function, right? I need to also have a strategy to accomplish that function. So it can either be a mechanism or a process. What is it in the case of the spectacles? The case of spectacles is lenses of appropriate power. So that if you go to a lens factory, you will find people making different types of lenses depending on the power that the wearer needs. So, 'strategy' is how that function is accomplished. Very easy. Now, look at the next one.

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FUNCTION AND STRATEGY

FUNCTION	STRATEGY
WHAT something does – a purpose or outcome	HOW something accomplishes a function – through a characteristic, mechanism or process

Polar bear's fur

FUNCTION – Polar bear's fur:	STRATEGY – Polar bear's fur:
To keep the bear warm	Fur has layer of guard hairs that absorb infrared radiation to prevent heat loss

Look, we have a new friend over here. So, we know what is function. We know what is strategy. But now what are we learning? We are learning that there is a beautiful polar bear. And she has fur and the function of the polar bear's fur is to keep the bear warm. Beautiful, right? Imagine if we were planning a trip to a very cold place.

How much shopping, and how much care we would take in selecting the right winter clothing. And therefore, for the polar bear, that fur is very critical. The function of the polar bear is to keep the bear warm all the time. It goes back to the survival of the polar bear. And what is the strategy? This is where biomimicry becomes terribly interesting.

Because, even before we created winter clothing, nature has already created clothing for the bear. And nature has not only created clothing, but nature also has a built-in strategy that stands the test of time right, completely. Look at the power there. And therefore, the learning how this happens becomes critical to us. So what is the strategy for the polar bear's fur?

It has a layer of guard hairs. You can read it; you can go into details. I am not going to explain that now. But right now, you must understand that every function must have a strategy. The strategy here is there is a layer of guard hairs that absorb infrared radiation to prevent heat loss. So, the strategy, therefore, satisfies the function. You have learned function; you have learned strategy. You will keep on coming back to this again and again and again.

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Function and Strategy – in Nature

FUNCTION
WHAT an organism or living system must do in order to survive

STRATEGY
HOW the organism or living system attains or performs the function – through adaptations (i.e. characteristic, mechanism or process)

LOTUS LEAF

Look at function and strategy in nature. Now it is very simple. So,' therefore, there is function. What is 'function' in nature? What an organism or living system must do in order to survive? What it must do in order to survive? Strategy is how the organism or

living system attains or performs the function. How does it do it? So, it could be a mechanism, process, adaptation, or whatever.

And here we have a picture of the lotus leaf. And we are going to look at the next slide. But before that, let me get my laser pointer.

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So simple it is becoming, right? We are learning function; we are learning strategy. We are looking at the lotus leaf. You see small droplets of water, but it is not wet. Therefore, the function of the lotus leaf is to stay clean. And how does it achieve that function? The strategy is a methodology to achieve the function.

The lotus leaf contains microscopic bumps that reduce the contact area between the water and the leaf, I must have said it millions of times in my life already. This makes the leaf hydrophobic. That is water repellent. So, the water rolls off the leaf and carries dirt particles with it. So double purpose, right? The water rolls off and the dirt particles are carried away. And look at the beauty.

The beauty of having a function, and using a strategy to achieve that function. You know I am smiling so much because I am so excited when I learn that I can no longer look at a lotus leaf as an ordinary lotus leaf. My whole perspective now is I am looking at an engineer and a very brilliant engineer. And an engineer who does not mind sharing information with the whole world.

All I got to do is to pick up the information, free of cost, which is why the smile and the excitement.

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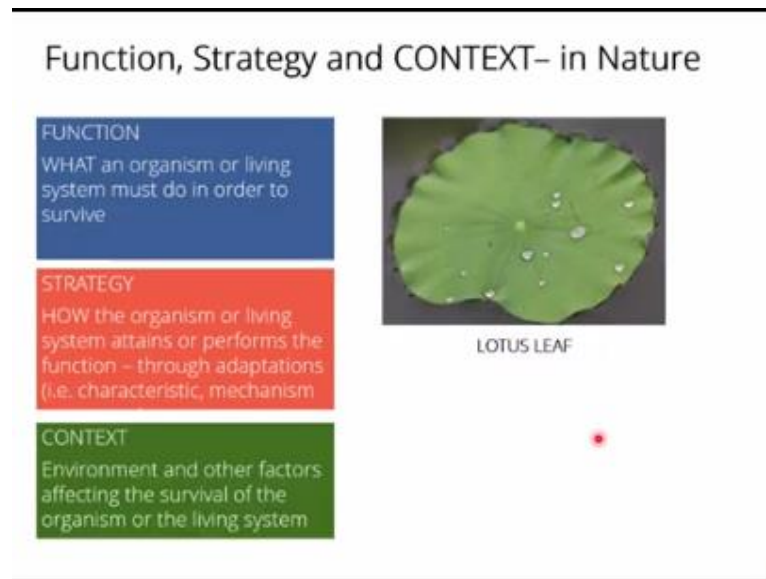
Now we are learning a new word. What Shiva, two words are not enough? No, two words are not enough. The third word is important to complete the learning. So, therefore, a function is what an organism or living system must do in order to survive, brilliant! Strategy is how the organism or living system attains or performs that function, mechanism, or process. We know how it does it, hydrophobic and all that.

But it does it in a particular context, in a particular environment. And it is important when you learn from biomimicry to understand all these three things so that you can mimic the strategies. Because unless you look at the context, if the strategy works in a particular context, it may not work in some other context.

So, you will have to ask what is it that you want to do. And you will have to be very specific about what is the context you want to do it in so that you can look at the strategy from nature. The context for the lotus leaf here is the environment and other factors affecting the survival of the organism or living system. In this case, it needs to be surrounded by a water body, right? And therefore, look at the next slide. It is now becoming easy.

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Function, Strategy and Context – in Nature

FUNCTION
To stay clean

STRATEGY
- The lotus leaf contains microscopic bumps that reduce the contact area between water and the leaf, which prevents water from adhering to the leaf.
- This makes the leaf hydrophobic – i.e. water repellent. So the water rolls off the leaf and carries dirt particles with it.

CONTEXT
Water bodies, pools, muddy lakes, marshes

LOTUS LEAF

That is it. All three things are explained here. Just with a lotus leaf, you know it is important to learn anything that you want with one example, one powerful example. In this case, the example you will remember for the rest of your life is this slide. Whenever you have a doubt about function, strategy and context come back to this slide and you will start to understand.

Therefore, the function of the lotus leaf is to stay clean. The lotus leaf contains microscopic bumps etc. The leaf is hydrophobic, strategy. And the context here is water bodies, pools, muddy lakes, and marshes. That is the context. So, this strategy is achieved only there.

So therefore, when you are doing your innovation, you have to be able to understand and ask yourself what is the context of the lotus leaf that I am imitating, so that you can replicate or you can imitate that context, imitate that strategy in that particular context. So, therefore, the polar bear's fur may not work or will not work in conditions that are not similar to what the polar bear faces, right?

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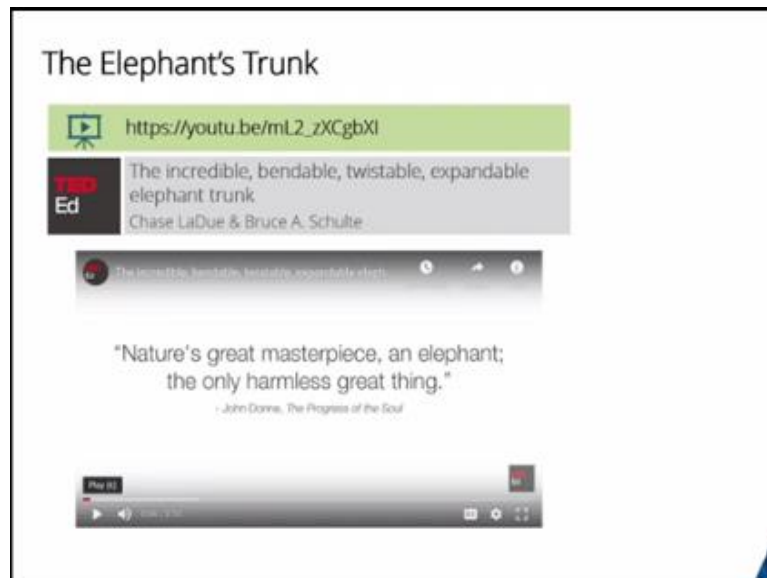
Function, Strategy and Context - in Nature

So final slide. Function, strategy, the context in nature. 'Function' is cactus spines. Function of cactus spines is to reduce water loss because you know desert and all that. It needs to conserve water to reduce water loss. The strategy is cactus spines are actually modified leaves and I am just reading the strategy so that it gets into your head.

So, after you remember the lotus leaf, you also remember one more example, the cactus leaves. The cactus spines are actually modified leaves. Spines have a smaller surface area than normal leaves and thus limit the water. So, this is the strategy of the cactus spines. And the context is important. The context is hot deserts, arid climates, and unpredictable rainfall. So, what you have learned are three important words function, strategy, and context.

Remember the examples, right? Spectacles example. The polar bear is one more example. Lotus leaf, one example. And cactus spines are one example, right? Okay. So, what you need to do is, whenever you need to remember function, strategy, and context, just come back to these slides. And remember, these three words will keep coming back in everything that we do about biomimicry.

So, we are going to look at function and strategy with an example from the natural world. And the example we are going to take is that of the elephant's trunk.
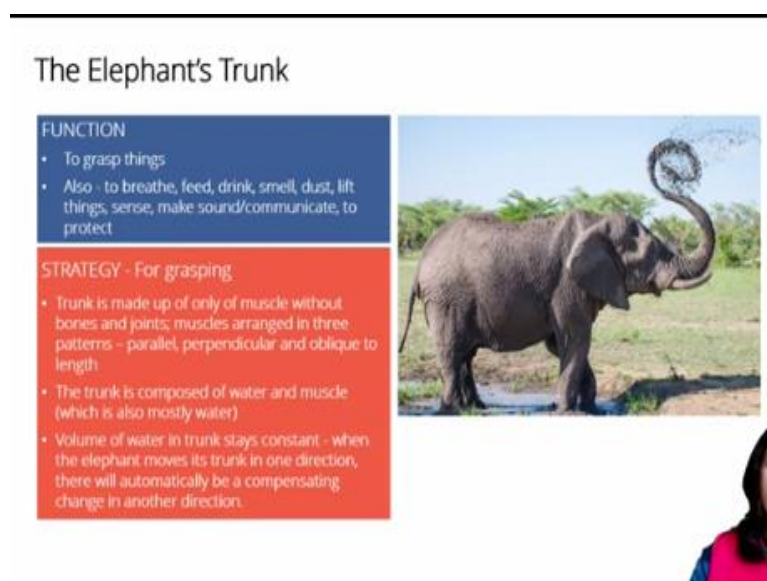
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The Elephant's Trunk

https://youtu.be/mL2_zXCgbXI

The incredible, bendable, twistable, expandable elephant trunk
Chase LaDue & Bruce A. Schulte

"Nature's great masterpiece, an elephant;
the only harmless great thing."
- John Donne, The Progress of the Soul

You see the link to a video here, the video explains beautifully, what the functions of the elephant trunk are. Now I read once that the elephant trunk is so versatile, that it is strong enough to uproot a tree, and at the same time precise enough to pluck a delicate flower. So, think about that. The wide range of uses that an elephant's trunk has. And this video takes you through the functions of an elephant trunk.

The link to this video is also posted below this recording. So, you can stop this recording, look at the video and come back.

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The Elephant's Trunk

FUNCTION
- To grasp things
- Also - to breathe, feed, drink, smell, dust, lift things, sense, make sound/communicate, to protect

STRATEGY - For grasping
- Trunk is made up of only of muscle without bones and joints; muscles arranged in three patterns – parallel, perpendicular and oblique to length
- The trunk is composed of water and muscle (which is also mostly water)
- Volume of water in trunk stays constant - when the elephant moves its trunk in one direction, there will automatically be a compensating change in another direction.

So, what is the function of the elephant's trunk? A function is the purpose of something. Now in the natural world, it is what an organism does in order to survive. So, one function of the elephant trunk is to grasp things. Of course, as the video has

told you, there are other functions as well, like using it to breathe, feed, sense things, communicate, etc.

But for this example, we are going to take the function of grasping things. What is the strategy that it employs in order to accomplish that function? So that is what a strategy is, right? What it does to accomplish that function. The strategy is explained here in brief. For grasping, what is the strategy? The trunk is made up of only muscle without any bones or joints.

The trunk is made up only of muscle and of course water. It is what is called a muscular hydrostat, a bit like the human tongue. And the volume of water in this trunk remains constant. So, when there is a change in shape in one direction it compensates for that by changing its shape in another direction as well. And that is what the strategy is of the elephant's trunk in order to be able to grasp things.

Now, this is a very brief explanation of the strategy of an elephant's trunk, or rather the strategy that the elephant's trunk uses in order to accomplish a function. We urge you to look at more examples so you will be oriented towards understanding function and strategy better. Because function and strategy are a very critical part of understanding biomimicry and practicing biomimicry. And you will soon see why that is so important.

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So, to get you started on doing this, you can do an exercise on function and strategy. Of course, you can also record this in your biomimicry diary. Every week we urge you to record something or the other in your diary as you learn biomimicry and practice biomimicry. This week look at function and strategy. And look at the function and strategy of these two organisms, snail and kingfisher.

Look at the function of the kingfisher's beak and the snail's shell. Remember, they could have more than one function. And there could be multiple strategies that they use in order to accomplish those functions. Go ahead, look them up. Find out how function and strategy work in each of these cases. This will be really useful for you as you start practicing biomimicry.