Introduction to Biomimicry
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Lecture - 11
What Are We Mimicking?

So now after the recap, what is it that we are going to do in this session? One of the most important things we normally do at the beginning of the biomimicry class, but we thought we would postpone into the second class is- What do you imitate? So right now, for the next 10 minutes, we will talk about what you imitate in biomimicry. So let me go to the presentation on, what do you imitate?

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Yes. So, what are we mimicking? We are mimicking three things. We are mimicking form, process, system. What is the meaning of imitating form? What is the meaning of mimicking form? You can see that, right? It means shape, surface or texture, macro or micro. So therefore, when I imitate, what can I imitate in biomimicry? what can I mimic? I can mimic 'form'.

It is always nice to follow up on something that we say with an example. So, what could be an example of imitating form?

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Mimicking Form - Shinkansen Bullet Train

- The Shinkansen Bullet Train was the fastest in the world, travelling at over 300 km per hour.
- However, noise was a huge problem.
- Air pressure changes produced large thunderclaps every time the train emerged from a tunnel, causing residents living nearby to complain.
- Engineers looked to nature to address the problem.

That is it, right? Do you recognize this? This is going to be there, this is going to be very soon in India too, the bullet train. The bullet train is an example of imitating form. Why? Very quickly just go through that, very quickly, and you will find that the Shinkansen bullet train was the fastest in the world. It was traveling at 300 kilometers per hour. But the noise was a problem.

People were actually complaining saying there is too much noise. And then the engineer who was designing the bullet train looked at what?

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Mimicking Form - Shinkansen Bullet Train

- While diving into the water, kingfishers make a nearly splash-less entry.
- Modelling the nose cone of the train after the beak of a kingfisher solved the noise problem and helped the train travel 10% faster with 15% less energy.

Looked at the Kingfisher. And then he noticed something very strange about the kingfisher. He noticed that when the kingfisher was diving into the water, it was making what is called a 'splashless dive'. And he saw the connection and that is

where you know you will start to understand the power of biomimicry. The connection between the, it is called abstract to emulate, right?

You will suddenly say wait, the kingfisher dives into the water without any splash. Is there an answer that I can get from the kingfisher in order to make my bullet train a little less noisy? And see what happened. Modeling the nose cone of the train after the beak of a kingfisher solved the noise problem and helped the train travel 10% faster, which was not intended, right?

That is an unintended but nice consequence, 15% less energy. So, therefore, this is a classic example. One of the things that I would advise you to do if you are teaching biomimicry, if you want to remember biomimicry, always try and find out if you can remember an example. So, this is a great example of 'what do we mimic?' We mimic the form and in this case, the Shinkansen Bullet Train is a great example of mimicking form.

The inspiration is from the kingfisher. So, what else did we learn? I am just going back to those slides. What did we learn? We are learning that what we are mimicking is 'form', 'process', 'system'. Let us see. When you say process, what do you mean? You imitate the operations or behavior of something. So, what could be an example of imitating the process?

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Mimicking Process - Eastgate Centre, Harare (Zimbabwe)

- The Eastgate Centre, an office complex in Harare has an internal climate control system originally inspired by the structure of termite mounds.
- Termite mounds (above the ground) have a system of vents and channels to facilitate gas exchange to maintain a near-constant temperature in the termite nests below the ground, using internal air currents driven by solar heat.

There you are, Eastgate Centre. Now most of you who have heard me before or most of my friends who heard me before, if you meet them and say, yeah Shiva is teaching biomimicry, first thing they will say is did he talk about the Eastgate Centre? Because it has become such a popular example wherever I go. Now the Eastgate Centre is in Harare. Harare is a very hot place in Zimbabwe.

Now there was this architect called Mick Pearce. Mick Pearce is an architect by profession and he was asked to build a mall. Building a mall is not such a great thing, right? But what is so special about this example? Mick Pearce was told not to use too much air conditioning for the mall, to minimize the amount of energy used.

Now many architects would have given up saying no what is this? You know such a hot place; how can I not use air conditioning? But fortunately for the world, and fortunately for the world of biomimicry, and fortunately for the world of energy, Mick Pearce was not only an architect, but he was also an ecologist, which meant that he was looking at a termite in this case.

And he looked at the termites. I do not know how many of you have seen a termite mound. In IIT Madras, there are several termite mounds. So, termite mounds have a system of vents and channels to facilitate the gas exchange to maintain near-constant temperature, right?

So that is what termites do to maintain near-constant temperatures inside their termite mounds. Again, go back to emulate, you will keep on coming back to it. Emulate would mean, what is it I am learning from nature? And how do I translate that nature into a design strategy? How do I translate it into an idea for solving a world problem?

The world problem that I have is I do not want to use too much energy. Can I imitate the termites and use the same principle in the Eastgate Mall? That is exactly what he did. And therefore, what he did was use the principles of the termites, the principles of termites in the way they were building their mounds to regulate temperature and use those principles in the Eastgate Mall and the results turned out to be fantastic, much less energy was used.

I would implore you to just Google Eastgate Mall. There are some beautiful videos on the Eastgate Mall. And it will help you understand the exact process that Mick Pearce used. But for purposes of this session, what we have learned, imitating, there are three things we can imitate. Imitate 'form', which is the kingfisher example, and imitate 'process' is the Eastgate example.

And the third example is imitating a 'system'. When you say system, a system you will learn later on in system thinking is 'connected elements.' Elements of a system are connected to each other, and all of them are dependent on each other. There is interdependency, and there is a connection. So, therefore, a mangrove forest, for instance, is completely connected.

Many elements in the mangrove forest, like fish, plants, etc., depend on each other. And it is a complete system over there. So, what is the example of mimicking a 'system' is this one.

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It is called industrial symbiosis. An industrial symbiosis is an ecosystem approach to industry, where one industry uses the waste of another industry as its resource, as its raw material, which means just like the mangrove forest, every one of those industries depend on each other for their raw material. It is a brilliant example of imitating process. So, what have we learned?

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Kalundborg, Denmark – Industrial Symbiosis
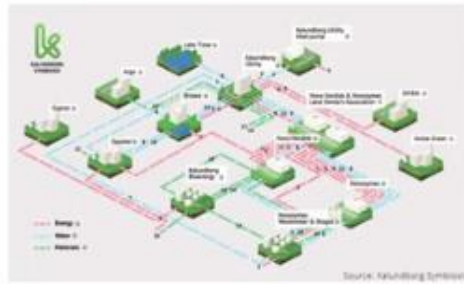
- In Kalundborg, there is a network of cooperation between a power station, plasterboard factory, the pharmaceutical plant Novo Nordisk, the enzyme producer Novozymes, an oil refinery, soil remediation company, and a waste company, and the Municipality of Kalundborg itself.
- The symbiosis is self-organized over time and today comprises more than 25 projects.

This is one more just a picture of the Kalundborg, Denmark industrial symbiosis. Again, Google it, please. It is very interesting. I do not know how many of you want to go back to your village and create something like this. Maybe it would be very interesting to find out what you can actually come up with. So essentially, that is what we have learned.

We have learned that there are three things you imitate. You imitate 'form', for example kingfisher; imitate 'process', for example, Eastgate Centre; imitate 'system', for example the Kalundborg industrial symbiosis. Kalundborg, Denmark, industrial symbiosis.