Asking Nature

Once you have defined your challenge clearly and identified what you solution needs to do, the next step is to 'ask nature.' Nature has over 3.8 billion years experience in problem solving, and human's have been learning from nature for millennia. By the end of this step you will have:

- Understood how nature delivers a range of functions.
- Identified specific functions in nature which can help you.
- Explored functions in nature that are similar to your design solution.
- Considered how these functions can be built into your design solution.

STEP THREE – function junction

How does nature deliver functions? What sorts of functions does nature deliver?

To learn from nature we need to understand a bit more about how nature functions. If you are doing this activity with your teacher, they will lead the activity for you. If you are do this on your own, follow the guidelines below.

1. Find a space outside; park or garden is fine.
2. Select 5 functions at random from the list in Annex 1 (these are functions in nature).
3. Search your outside space and identify examples of how nature provides these functions.
4. Complete the table below.

Function	**How does nature provide this?**	**How does it work?**
e.g. Protection	*Bark of a tree; hard shell encasing a snail.*	*Tree grows bark, which is thicker at the base.*

Functions: In biomimicry a function refers to an organism's adaptations which help it survive. For example, the purpose of bear fur is to keep warm, in technical terms its function is to conserve heat (insulation). A leaf is made to biodegrade, so one function of a leaf is to 'break down' after use. Human products also have functions; a kettle has the functions to both contain water and heat water (modify its physical state). In brief, a function is 'what it does.'

STEP FOUR – asking nature

Once we have seen how nature delivers different functions, we can start exploring how nature delivers functions which are relevant to our design challenge.

a) Asking good questions. If we ask nature 'how to design a bicycle helmet?' it cannot answer. But if we ask 'how to absorb impact' nature has lots of answers. So firstly we need to make sure we are asking questions nature can answer.

Look back at the functions you wrote at the end of STEP 2 (Stage One); these are the functions your design needs to perform to address your challenge. We need to turn each one into a question:

> How does nature……(store water)?
> How does nature…… (move energy)?

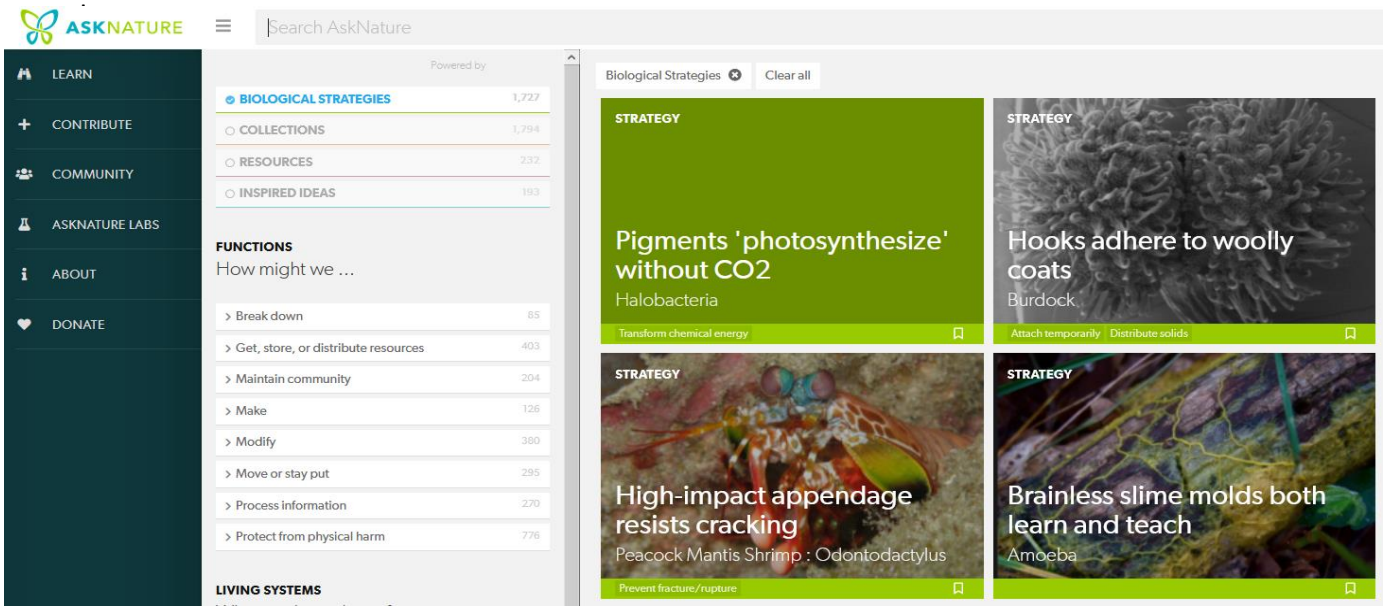
These are good questions which nature can answer. Avoid questions which are too specific or human-focused such as:

> How does nature……(build houses)?
> How doe nature……(produce chemical free paint)?

Write your functions as questions below:

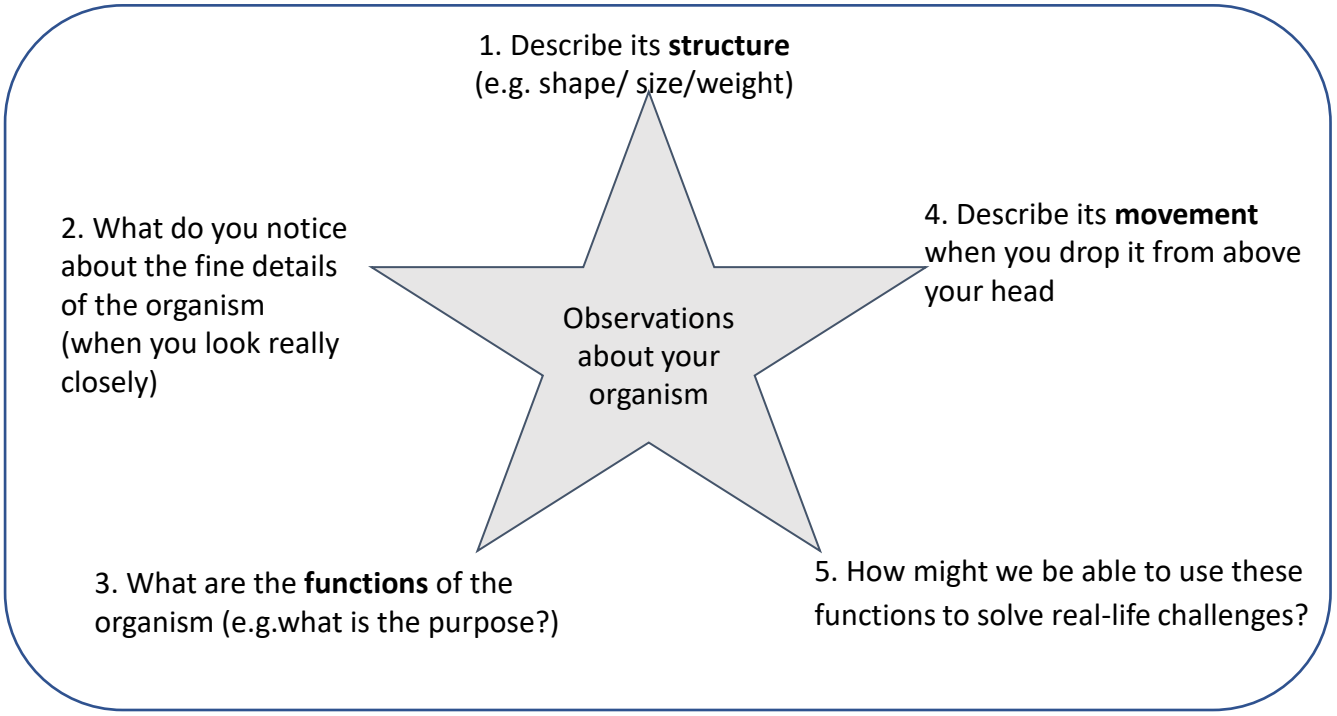
How does nature…….

b) Exploring nature online. Now we have questions which nature can answer, we can start exploring nature. In the next section, we will explain some ways you can explore nature first-hand. However, there are some fantastic websites which can really help you. The most important is www.asknature.org. A great place to start is the section 'biological strategies' and then search for the functions which interest you. Use the table in section 'd' to record your



c) Exploring nature first-hand. Getting outside and making your own observations is another excellent approach. A local park, garden or school grounds will be ideal.

Select one of the functions you are interested in. Search in your natural environment for examples of how this function is delivered. Record detailed observations; the observation star below provides focus.



Completing the table below might also be useful to organise your research.

Feature or Attribute	**What function does this feature provide?**	**How does it work?**	**What can we learn from that?**	**Can we apply this for a different purpose?**

IMPORTANT: at this stage, do not get too worried about finding an 'answer' for your chosen challenge. It is better to find lots of potential solutions to inspire you, and not start taking decisions until the next step.

d) Connecting up the pieces. Once you have explored lots of examples in nature, and found functions relevant to your design challenge, now you are ready to ask which inspirations from nature are the best fit for you.

This part can be challenging. The easiest way to mimic nature is to copy its shape (form). But it is helpful to think about other ways we can mimic nature.

> **Form** – mimicking the shapes and structures found in nature. A good example is the shape of the Kingfishers beak mimicked in the bullet train design.
>
> **Process** - emulation of a series of operations or behaviors that create a material or produce an effect. An example is the mussel which is able to attach to rocks underwater; an amino acid found in the mussel has been used to inspire a glue which works underwater.
>
> **System** - involves creating an integrated system that efficiently manages material and/or energy in an ongoing cycle the way natural systems do. An example is found in the circular economy, where waste from one process is used in another and products are designed to be 'made-again.'

To help you further, think about the strategy each organism uses to deliver each function. Organisms meet functional needs through biological strategies. This is a characteristic, mechanism or process which performs the function for them. In the bear example, fur is the strategy for delivering insulation. In a kettle, electrical energy is transferred into physical heat which modifies the temperature of water. In brief, a strategy is 'how it does it.'

Use the table below to organise your thinking and evaluate your best ideas.

Working mechanism (how does the function of the living thing work?)	Is the operating mechanism applicable in other situations?	Is the working mechanism easy or difficult to imitate?	Can it contribute to a sustainable solution in tour design challenge?	Rank you best ideas.
Leaves use sunlight together with water and CO_2 to produce energy.	*Yes, it has already been copied to produce solar energy.*	*Yes, this has already been done.*	*Yes, we will need to research the best model of solar panel to use.*	

Annex 1 - Function Junction Cards

Attach	Dynamic design	Move 'fluids' (air, water, etc.)
Balance	Enduring sources of energy	Optimize (e.g. strength and material, information and time)
Bottom-up manufacturing	Flexibility	Orient
Buffer (e.g. from impact)	Grind	Pack into a small space
Collect (e.g. water, sunlight)	Grip	Power without pollution (i.e. clean sources of energy)
Collect raw materials (i.e. without mining)	Heat up	Protect
Communicate	Hold onto	Raw materials without mining (i.e. from the air, from groundwater)
Connect	Insulate	Recycle
Cool down	Information instead of material	Resilience
Cooperate	Life-friendly chemistry (i.e. chemistry that is safe for living tissues)	Restorative
Coordinate	Manage	Stabilize
Create color	Manage interactions	Stabilize soil
Create conditions conducive to life	Manufacture at ambient temperatures	Stick together
Create Flow	Maximize (e.g. resources)	Store
Decompose	Minimize (e.g. weight)	Streamline
Detect	Move	Strength
		Withstand wind