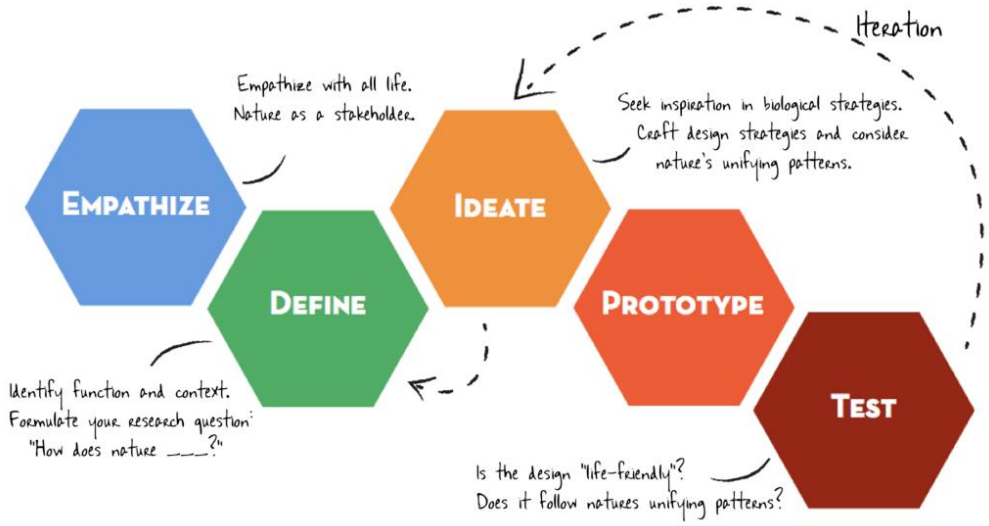
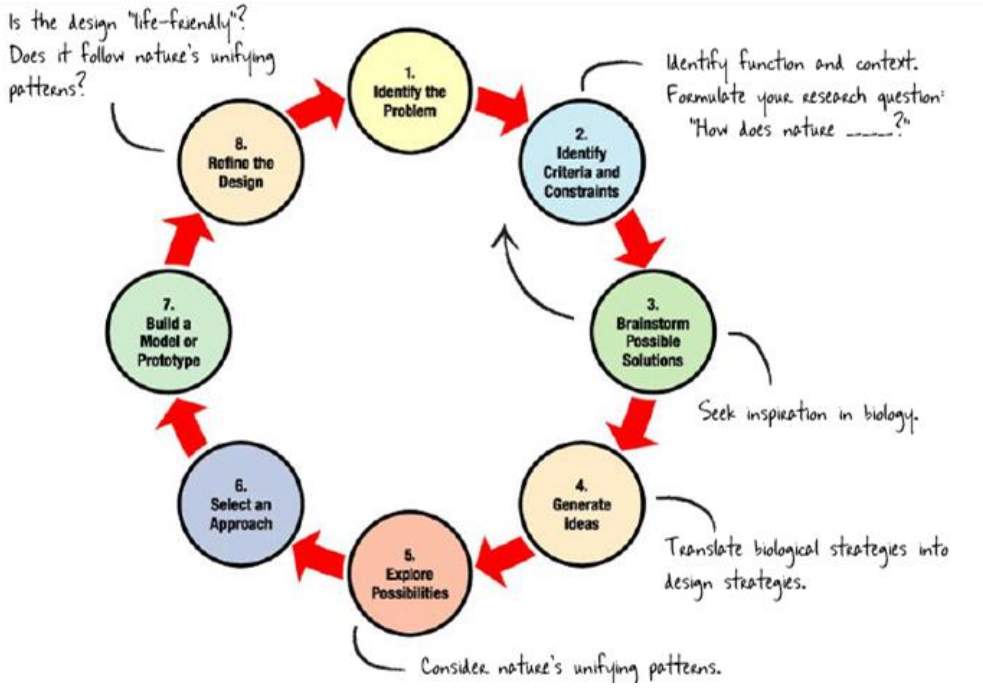
Applying Design Thinking in a Biomimicry Context

How this happens…

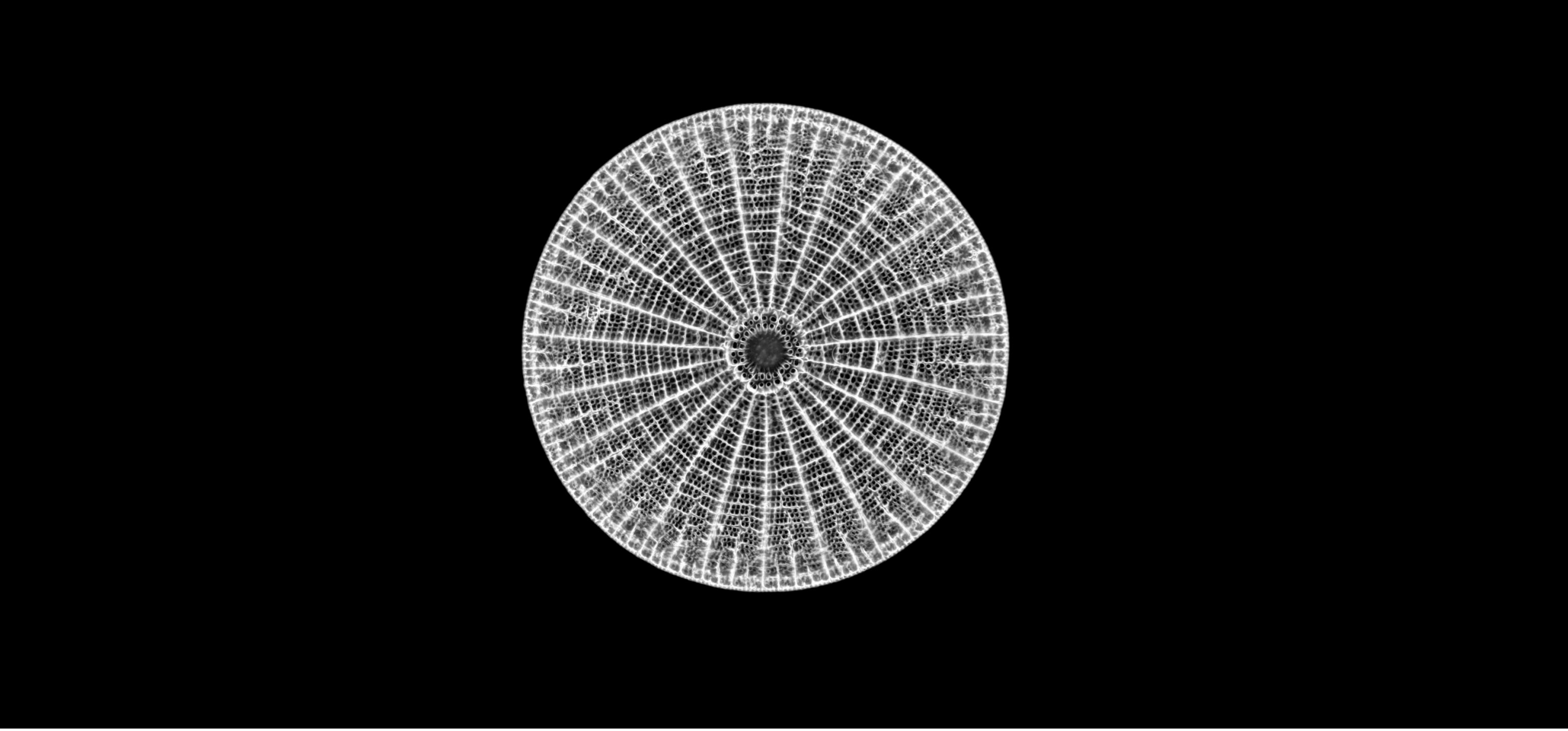
Stanford's Design Thinking Diagram - Annotated



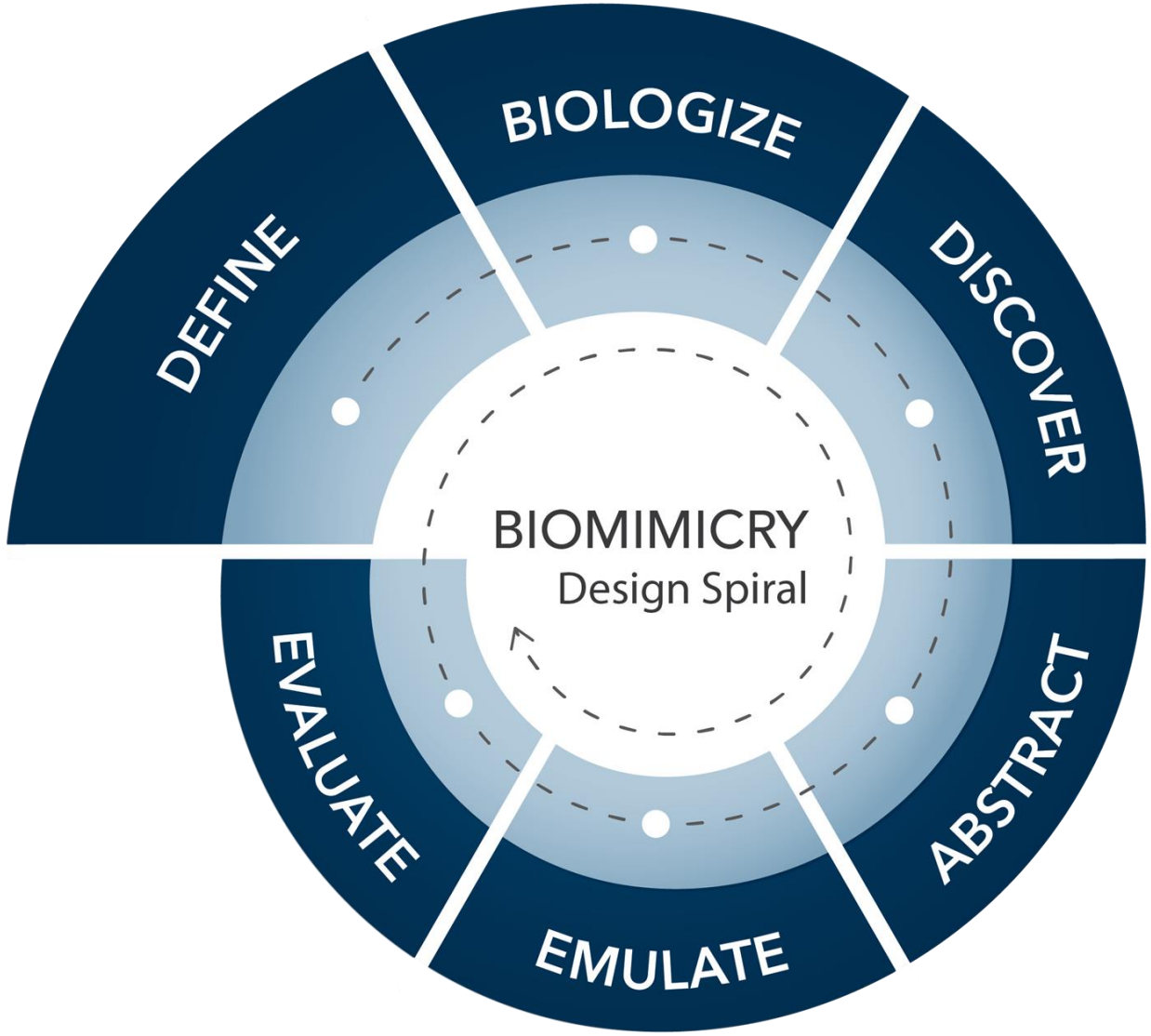


NASA's Engineering Design Process - Annotated

Let's not reinvent the wheel…



Expanding into a “new” adjacent space



Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Biomimicry Design Spiral

(from The Biomimicry Institute's Toolbox)

DEFINE
Challenge

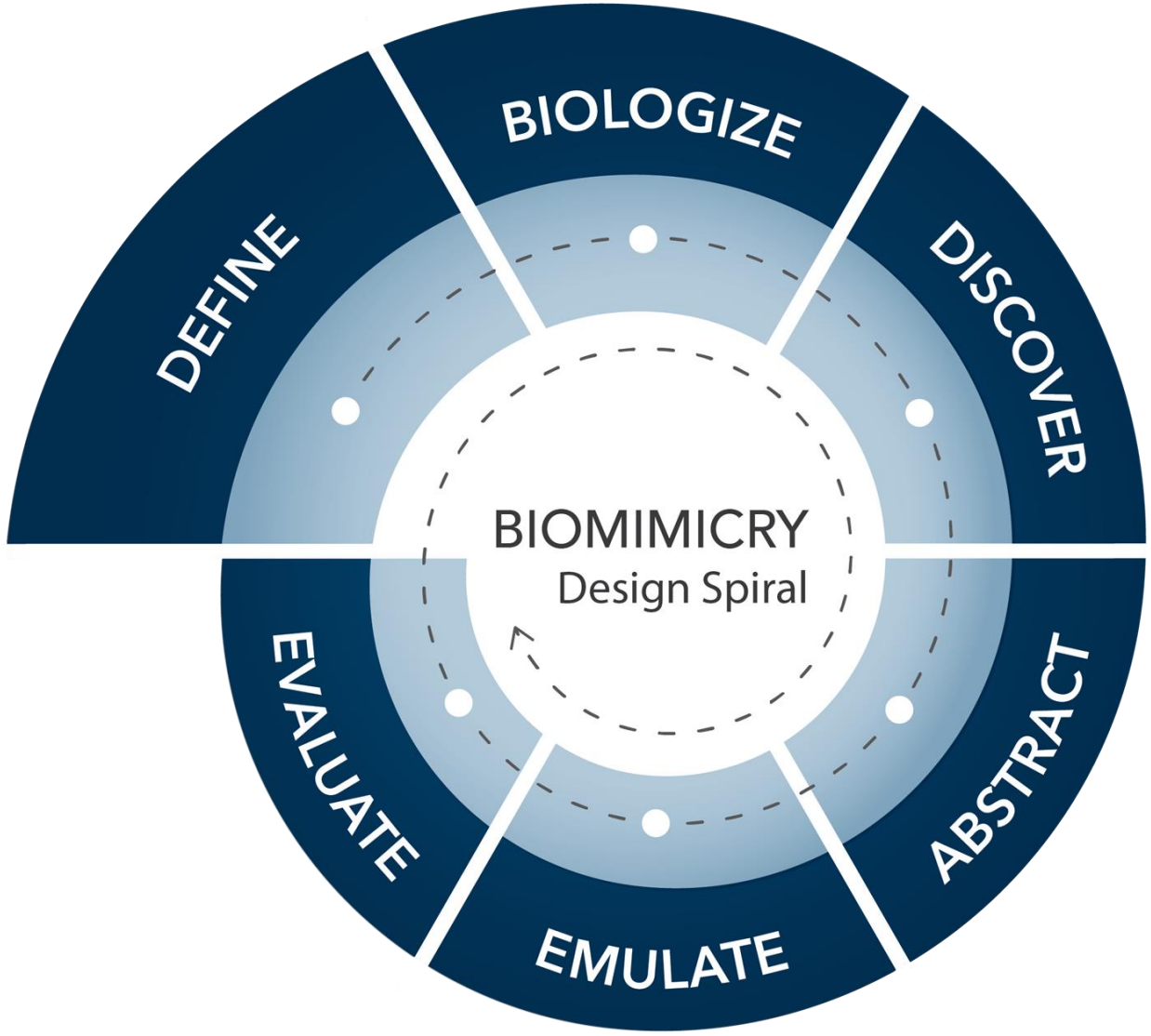
BIOLOGIZE
Function & Context

DISCOVER
Biological Strategies

ABSTRACT
Design Strategies

EMULATE
Nature's Lessons

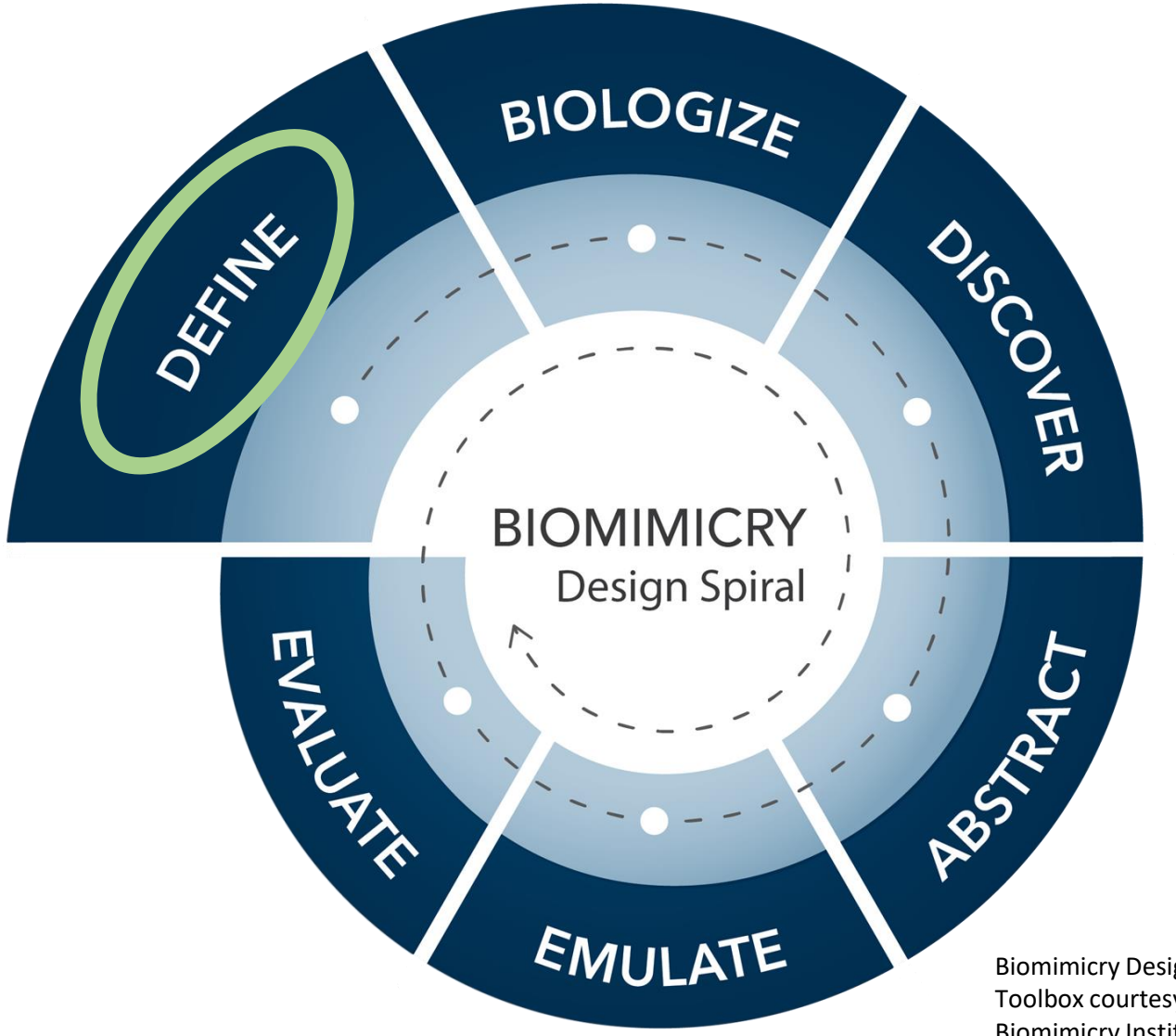
EVALUATE
Fit and Functionality



Biomimicry Design Spiral

“If I had one hour to save the world, I would spend fifty-five minutes defining the problem and only five minutes finding the solution.”

— *Albert Einstein*

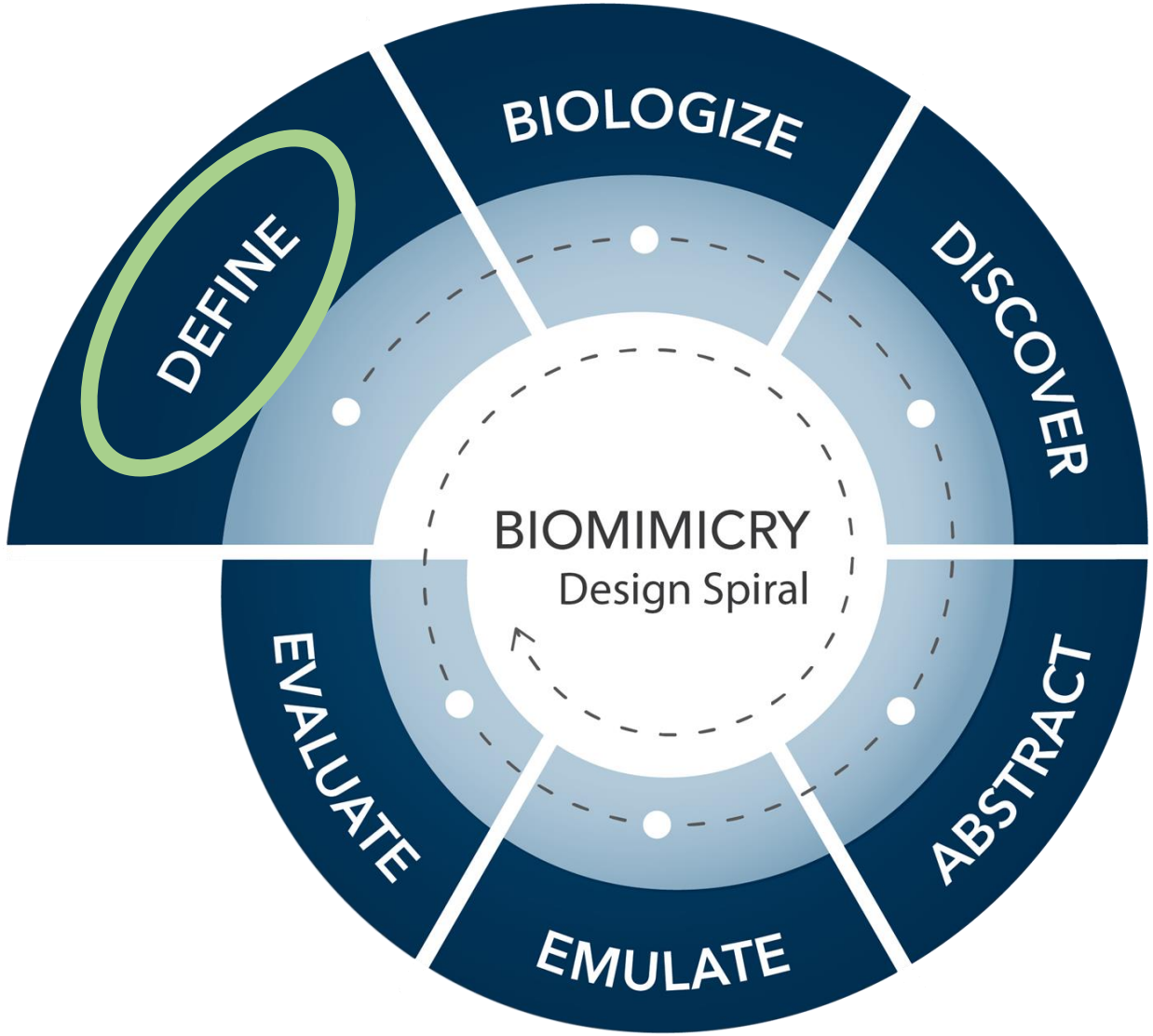


Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Define the challenge

Guidance for Defining the Challenge

1. State the challenge as a question
2. Remember to consider context
3. Take a systems view and look for potential leverage points



Define the challenge

Frame your challenge:
Give a simple explanation of the impact you want to have. (Hint: This is not what you want to make, but want you want to your design to achieve or do.)

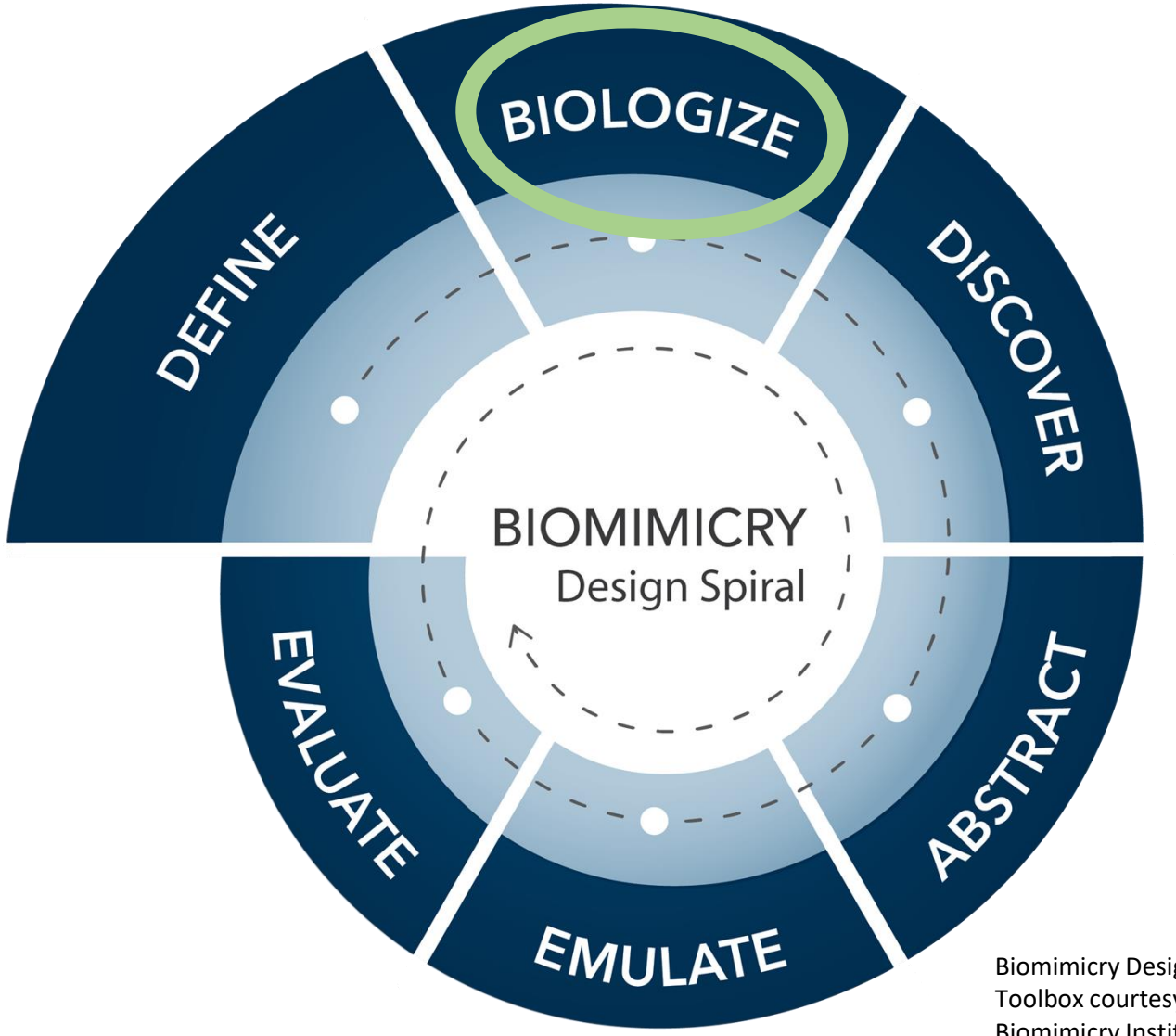
Consider context:
Describe some of the contextual factors that are important to the challenge. (Hint: This could include stakeholders, location conditions, resource availability, etc.)

Design question:
Using the information above, phrase your challenge as a question:
How might we
_____?

Test the question:
Is it too broad? Your question should give a sense of the context in which you are designing as well as the impact you want to have and what/who it benefits. If it doesn't, it may be too broad.
Is it too narrow? Your question should be somewhat open-ended to ensure you haven't jumped to conclusions about what you are designing. If your question is very specific, it may be too narrow.

Try again, if necessary:
How might we
_____?

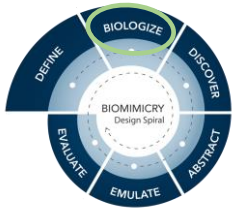
Toolkit: 02_TBI Define Worksheet



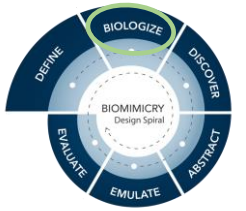
Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Biologize the challenge

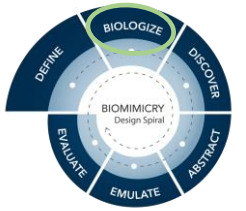
Function is the bridge between biology and design



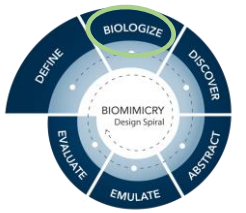
How does nature keep cold?



How does nature create glue?



How does nature keep things in place?
Interface TacTiles



Rather than thinking about what you want to make, ask "What do I want my design to DO?"

1. Ask "How does nature?" questions.
2. Think about analogous life functions and contexts in nature.
3. Consider multiple possibilities.
4. Flip the question.
5. Don't rush!

Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Biologize the challenge

Function and context

Biologize Worksheet

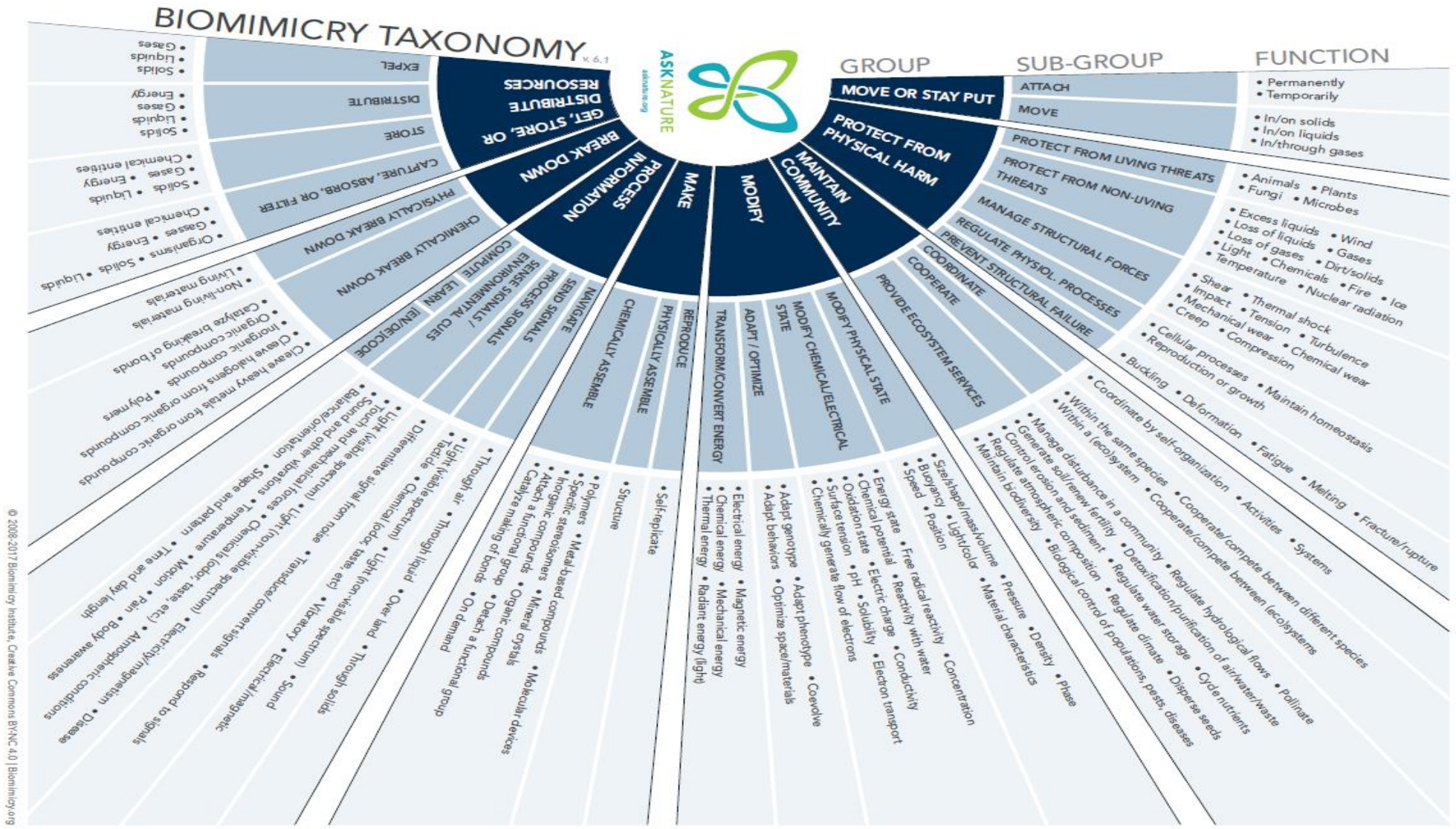
Design question:
Write down the design question your team developed using the Define the Challenge worksheet:
How might we…?

Identify related biological functions:
Think critically about the functions at the heart of the outcome/impact your design question is getting at. Consider including relevant opposites or tangential functions that may be worth exploring. Hint: Refer to the **Biomimicry Taxonomy** for more examples of biological functions.

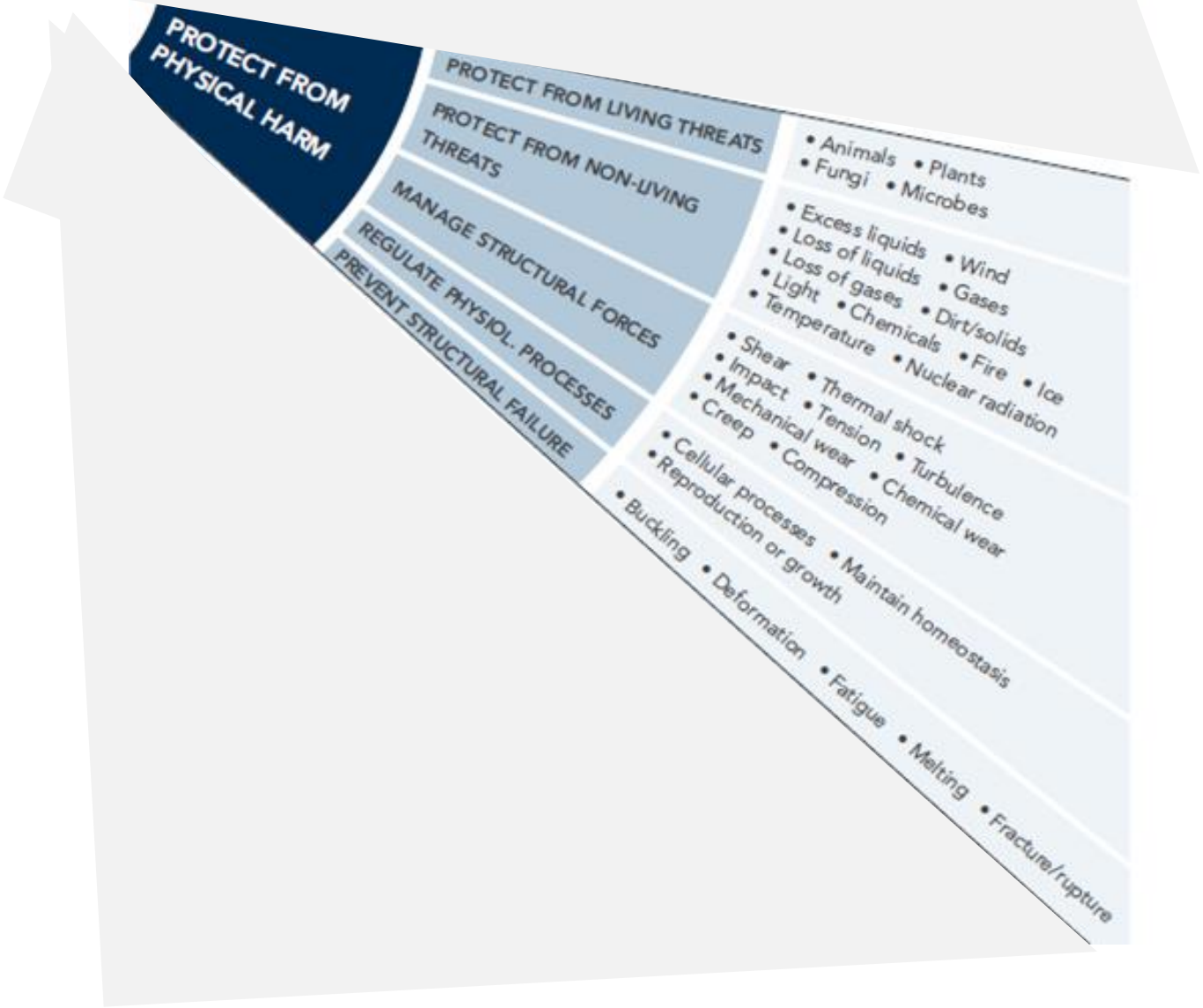
Define relevant contextual factors:
How can you use biologically-relevant terms to describe the context in which your design must function?

Biologized Question(s):
Now, restate your design question as one or more "How does nature..." questions that emphasize function and include relevant context. You may find there are multiple ways to "biologize" your question.
How does nature…?
How does nature…?
How does nature…?

Toolkit: 03_TBI Biologize Worksheet

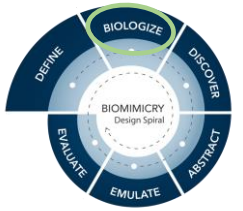


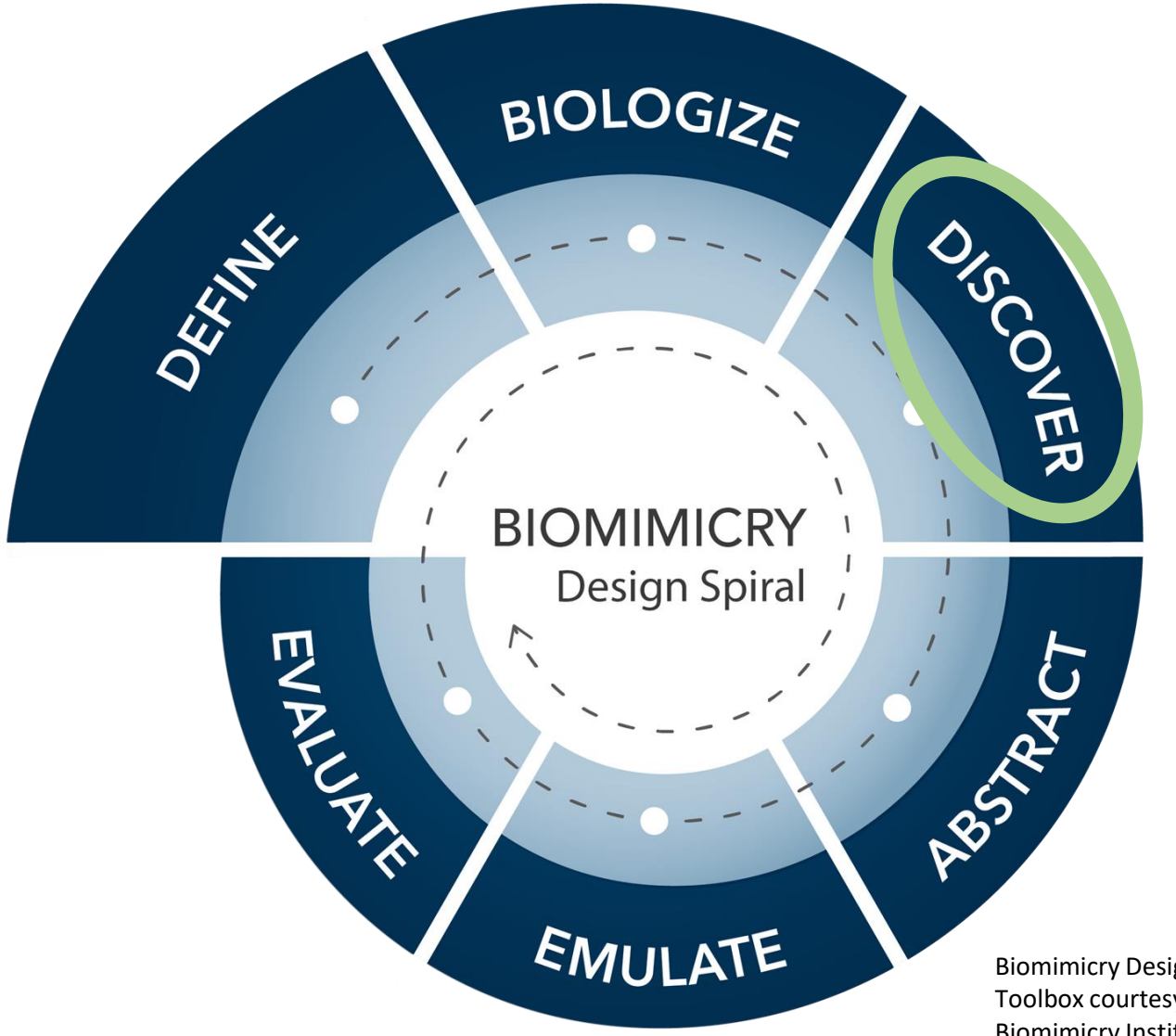
Toolkit: 04_TBI Biomimicry Taxonomy



Biologize the challenge

Function and context





Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Discover biological models

1. Go outside and look around.
2. Keep a nature journal.
3. Explore AskNature.
4. Read scientific literature.
5. Talk to biologists and naturalists.
6. Track your sources.

Biomimicry Design Toolbox courtesy of The Biomimicry Institute

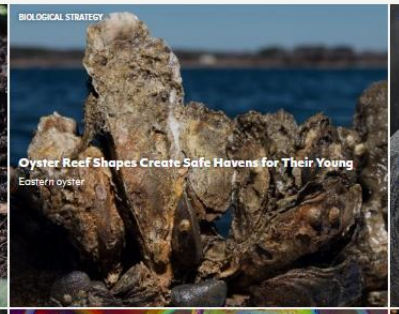
Discover biological models

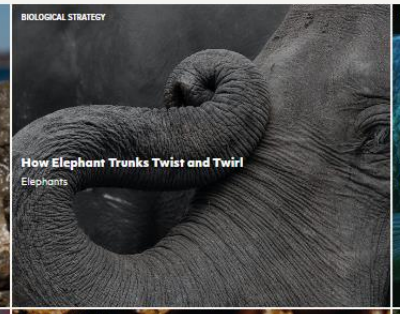
Remembering function AND context

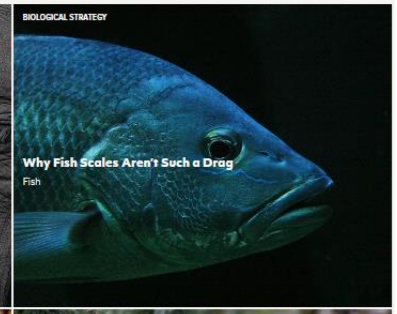
FUNCTION

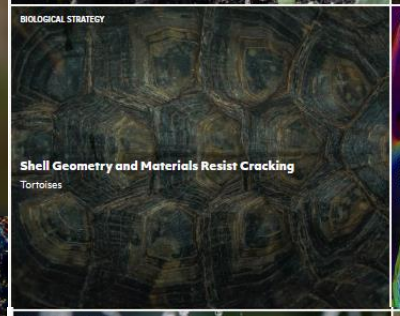
Manage Structural Forces

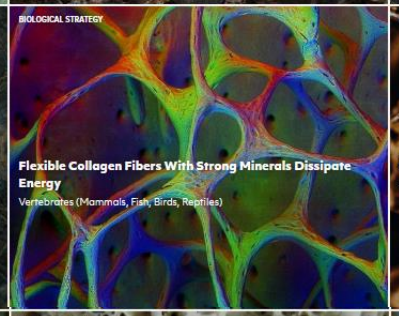
Everyday, living systems are subjected to structural forces. These forces include impact, tension, compression, chemical and mechanical wear, and more. They come from the living and nonliving environment—sand blowing across a desert, the ground that a jumping organism lands on, a gull's beak trying to get into a crab, and so on. Rarely is a living system subjected to just one force at a time, so they have developed multiple strategies to fend off or minimize these potentially damaging or lethal forces. These include strategies such as developing hard outer surfaces as snails do; using shape and material to dissipate a force's energy as toucans do; and flexibility to move with, rather than stay rigid against, forces like turbulence. When a living system is stressed beyond its ability to support a structural force, it uses related...

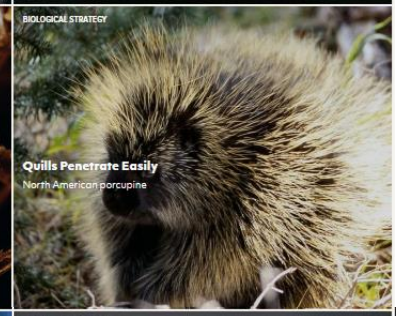


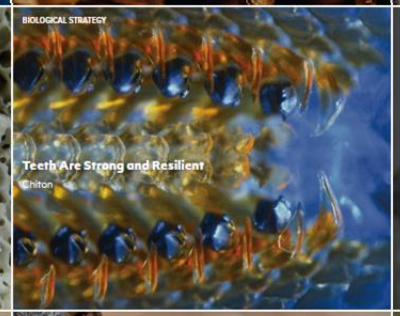


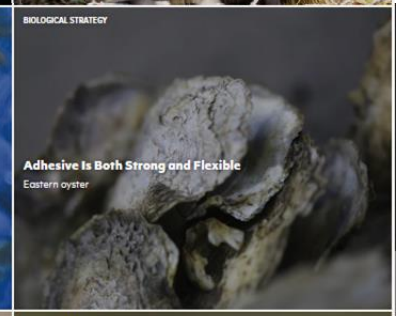


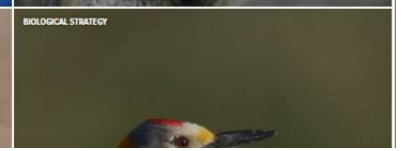






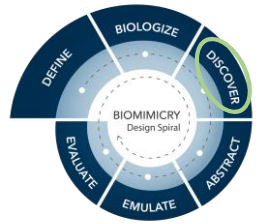


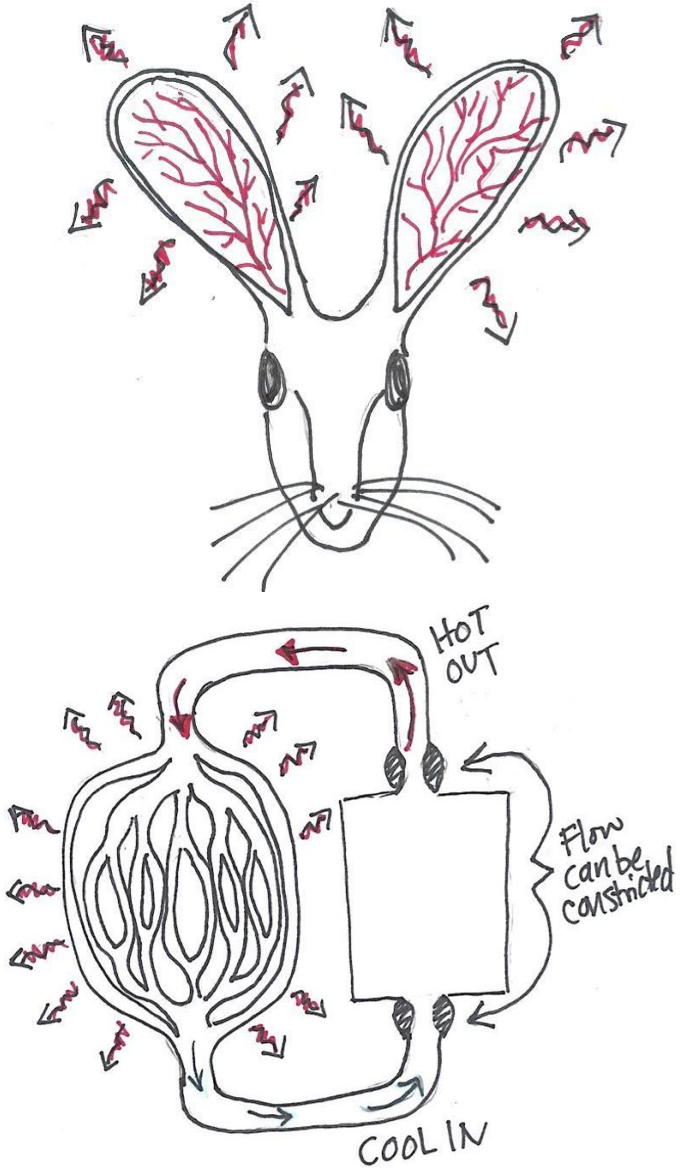


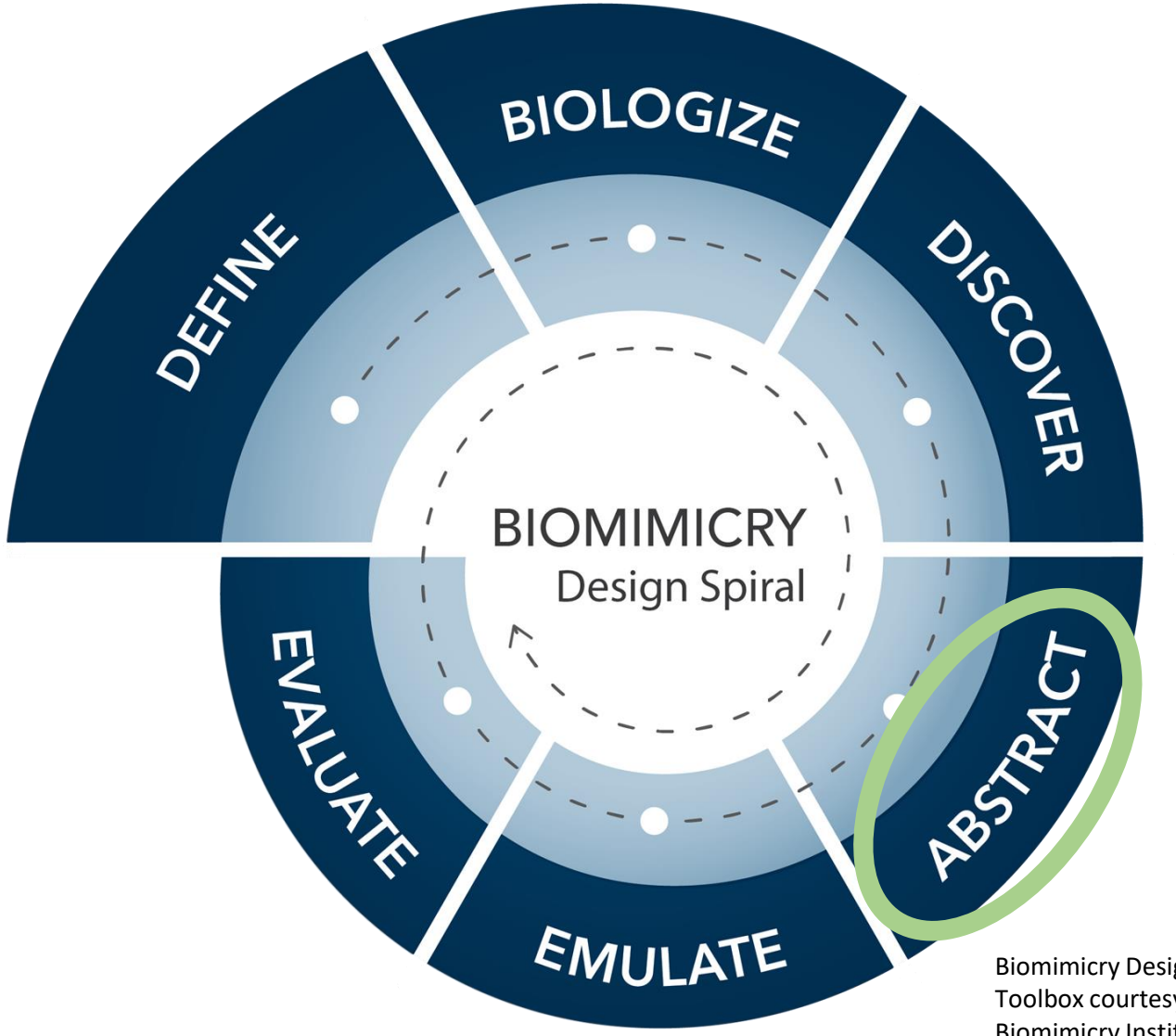


Discover biological models

Remembering function AND context

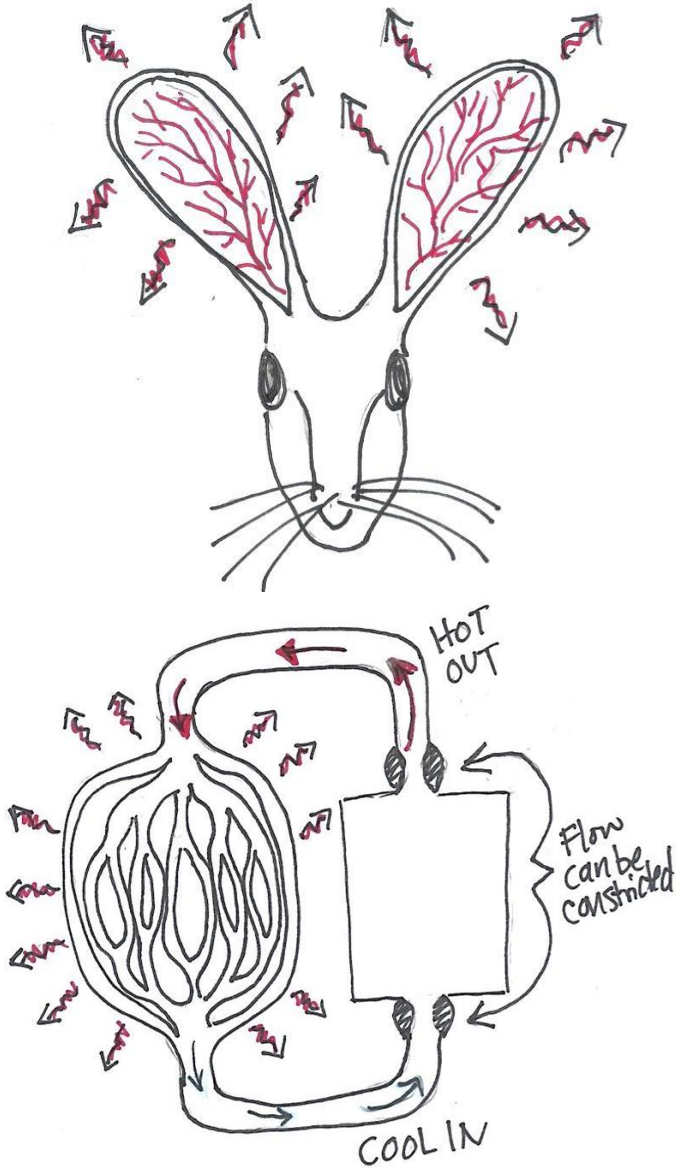






Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Abstract design strategies



1. Summarize the biological strategy.
2. Draw the biological strategy.
3. Identify keywords and phrases.
4. Write the design strategy.
5. Draw the design strategy.
6. Review the design strategy.

Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Abstract design strategies

Rahul Pandit, via Pexels

Abstract a Biological Strategy Worksheet

What are the functions of your hand?

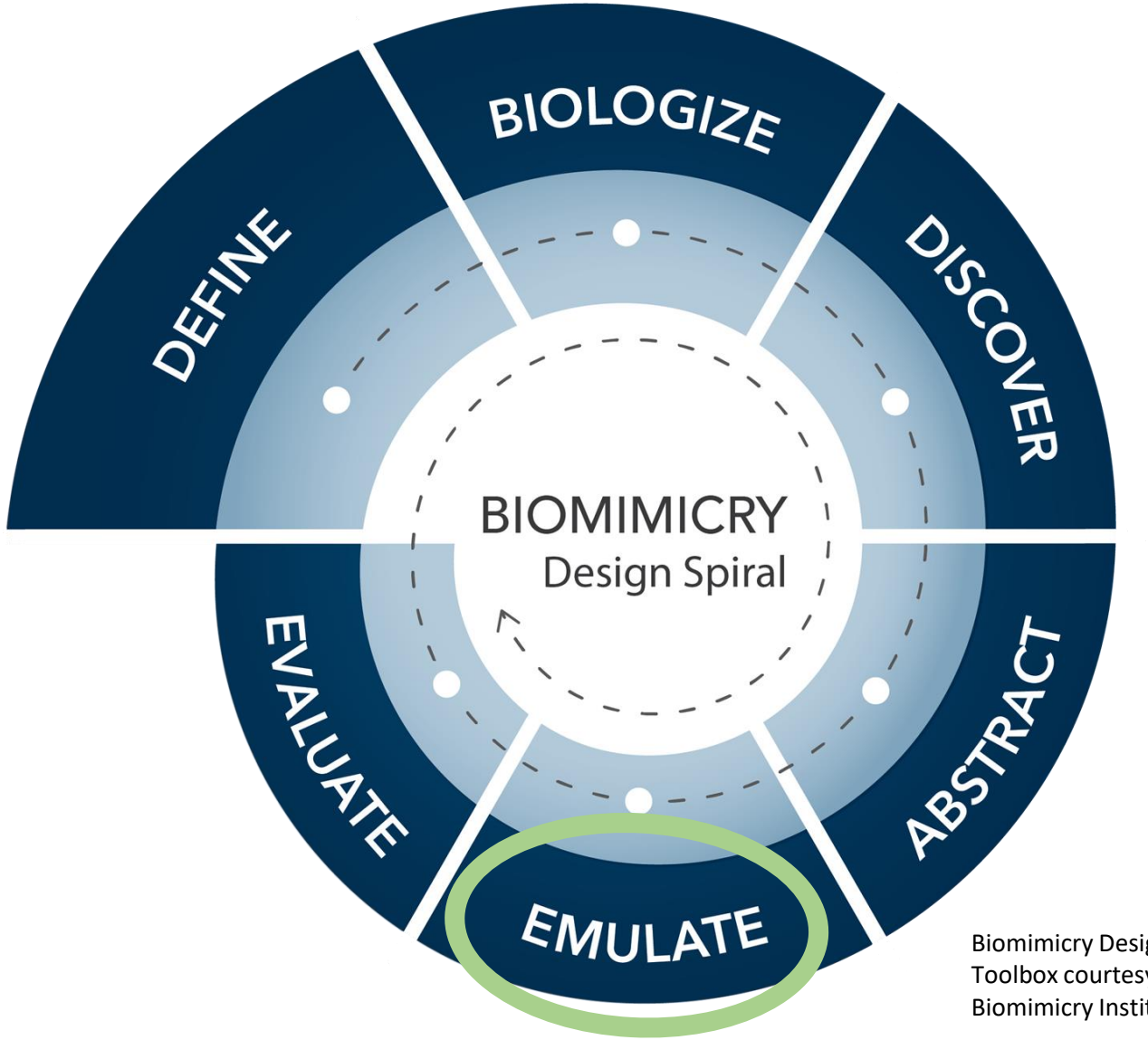
Pick one function (e.g. grasping objects) and write a description of how the hand meets that function. (That is, write out the biological strategy.)

Draw the biological strategy.

Abstract the design strategy. Separate out the words and phrases above that best explain the strategy. (Tip: underline or highlight the key phrases.) Use these words to write a design strategy that strips away the biological terms, replacing them with terms that a designer in your field would understand.

Finally, draw the design strategy. Caution: Draw the design strategy without drawing it as a design or as a solution. The design strategy is a launching pad for brainstorming. Don’t jump to conclusions about what your design will be.

Toolkit: 05_TBI Abstract Worksheet



Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Emulate nature’s lessons

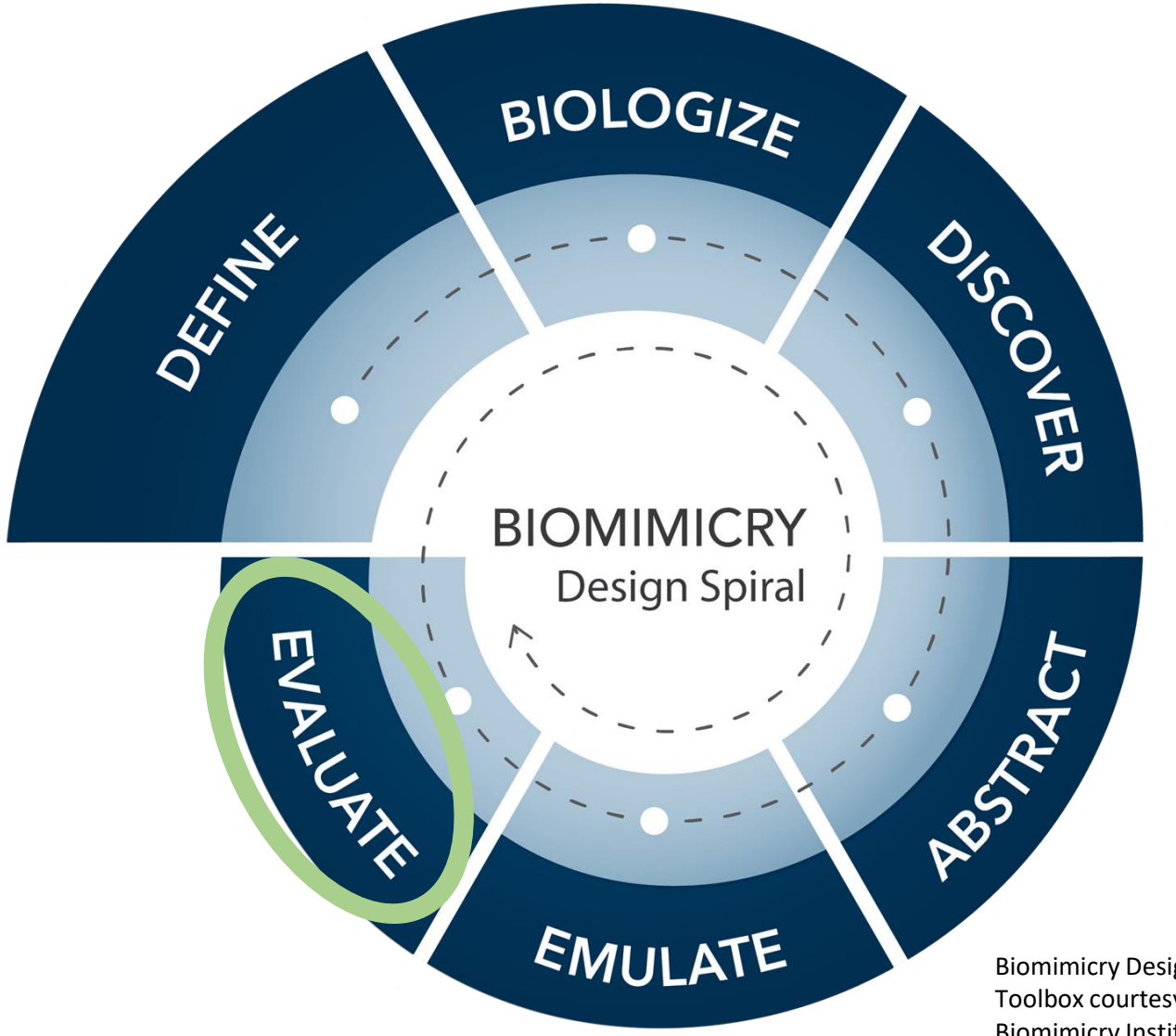
Emulate Guidance

1. Make it visual.
2. Revisit your design question.
3. Explore lots of ideas.
4. Consider nature’s unifying patterns.

Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Emulate nature’s lessons

“I have not failed, I’ve just found 10,000 ways that won’t work.”
— *Thomas Edison*



Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Evaluate fit

Against original challenge, technical/business feasibility, planetary boundaries

“I have not failed, I’ve just found 10,000 ways that won’t work.”
— *Thomas Edison*

1. Consider the whole system.
2. Identify feasibility constraints.
3. Evaluate against nature’s unifying patterns.
4. Make a prototype.
5. Talk to people!
6. Repeat, repeat, repeat.

Biomimicry Design Toolbox courtesy of The Biomimicry Institute

Evaluate fit

Against original challenge, technical/business feasibility, Earth