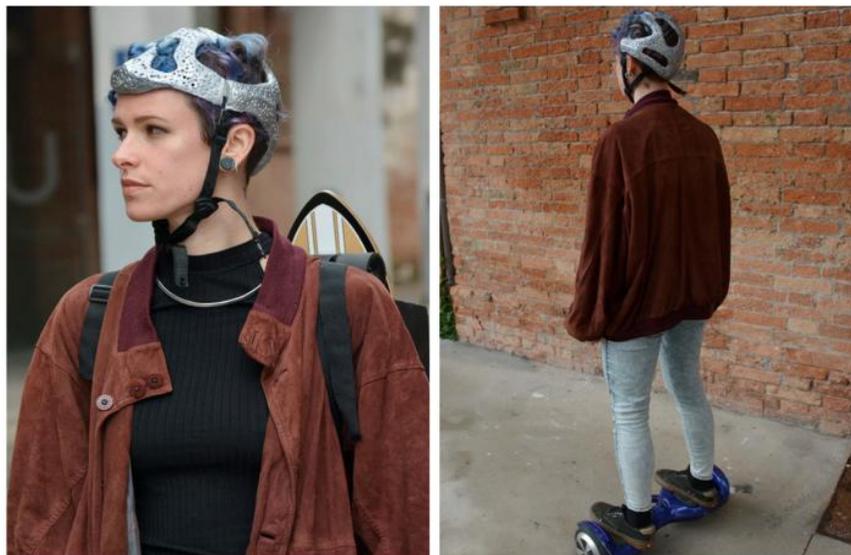


EWOLUCJA KONWERGENTNA KRĘGOWCÓW



Paleomimetyka – zastosowania i ograniczenia ewolucji konwergentnej



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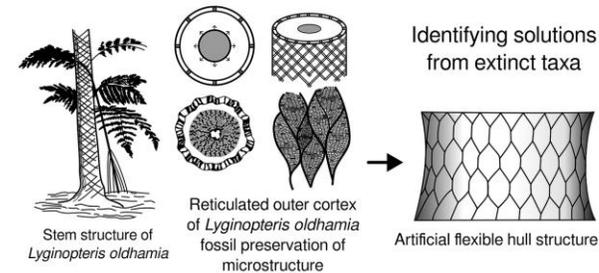


UNIwersytet
Warszawski

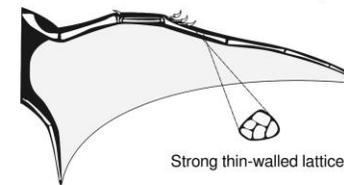
Paleomimetyka – zasady i sposoby wnioskowania

- Biomimetyka, bioinspiracje, bionika.
- Paleomimetyka, paleobiotechnologia, paleobioinspiracje.
- Paleomimetyka – „kreatywne zastosowania oparte o obserwacje systemów paleobiologicznych” (Aish et al., 2025).

The palaeobiological "library"



Form-function relationships → Identifying multi-parameter trade-offs

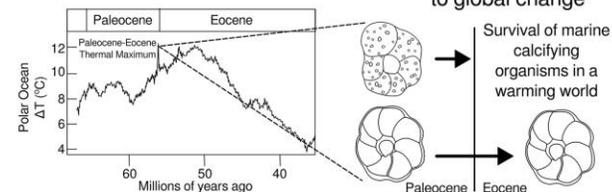


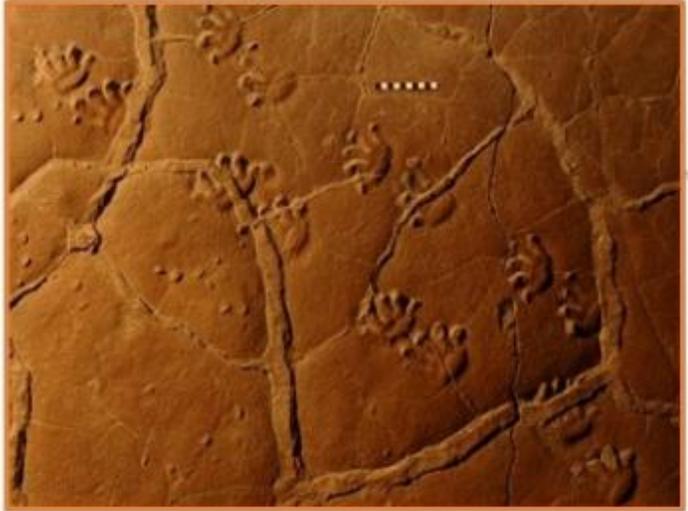
Convergent evolution → Identifying (phylogenetically-independent) common adaptive traits

Streamlined thunifform body shape



Diverse environments → Identifying solutions to global change





Fossilized skeleton

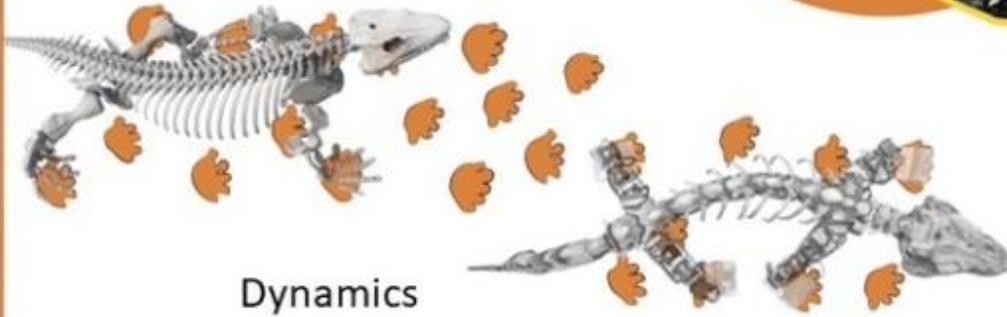


Trackways



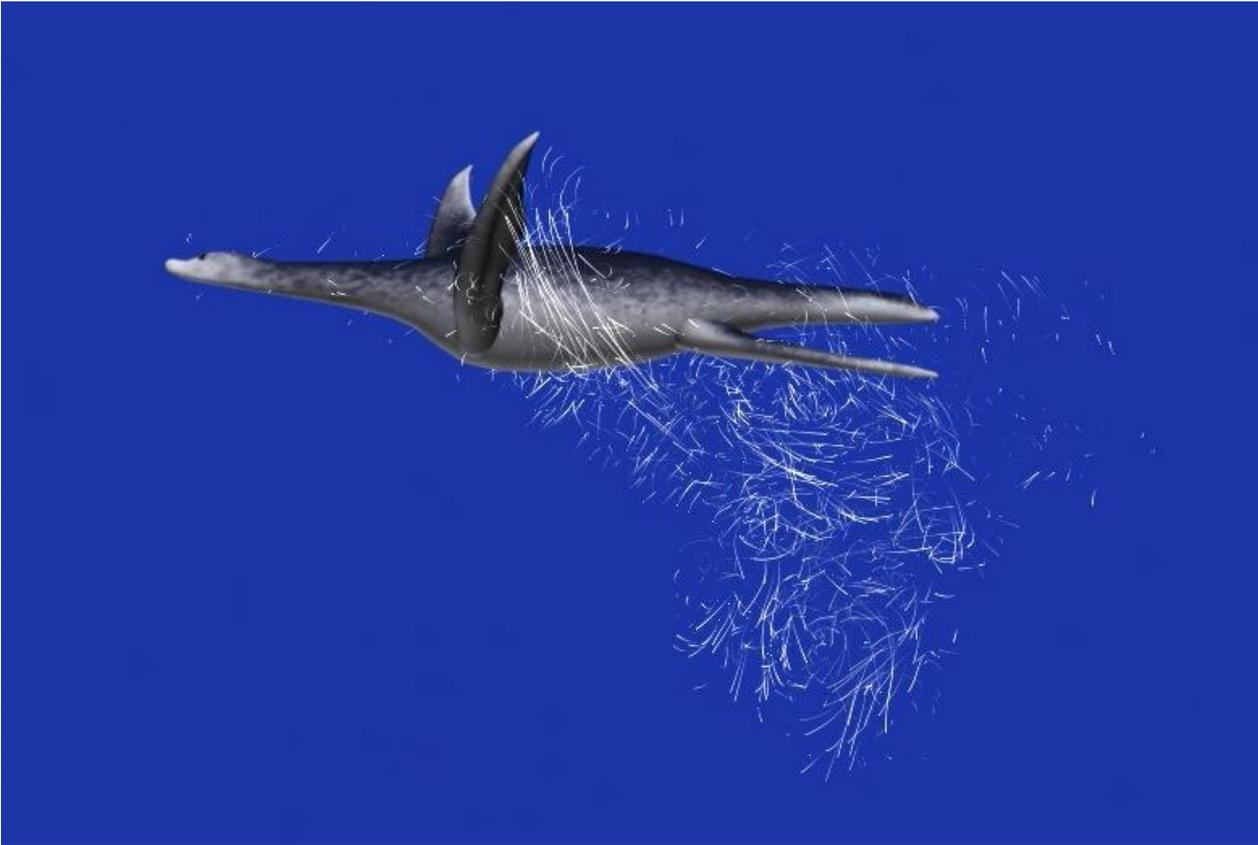
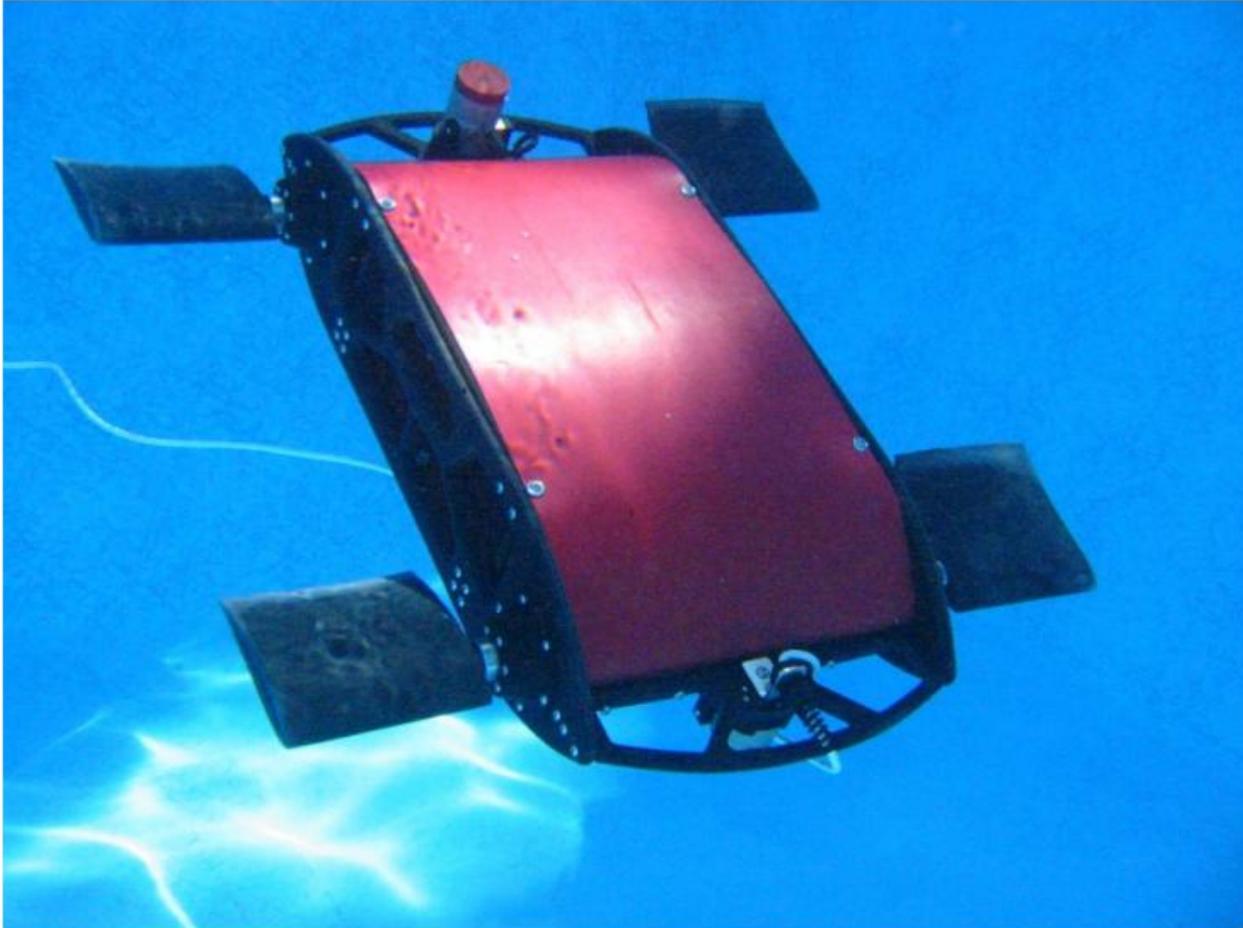
X-ray lizard

Model reconstruction



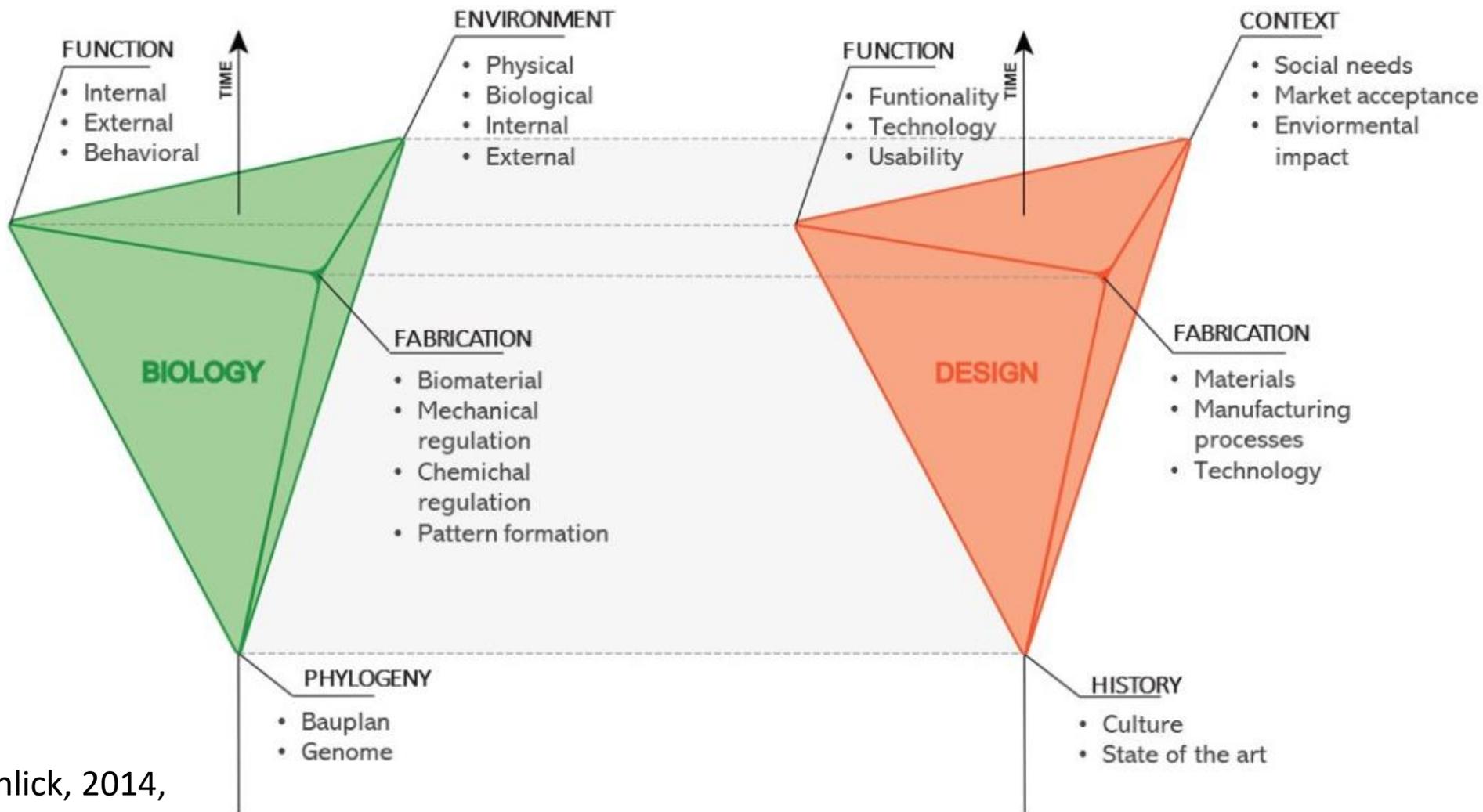
Dynamics





Perricone et al., 2022

Morfodynamika procesów historycznych (ewolucyjnych)



Struts

- Lightness increase
- Robustness increase

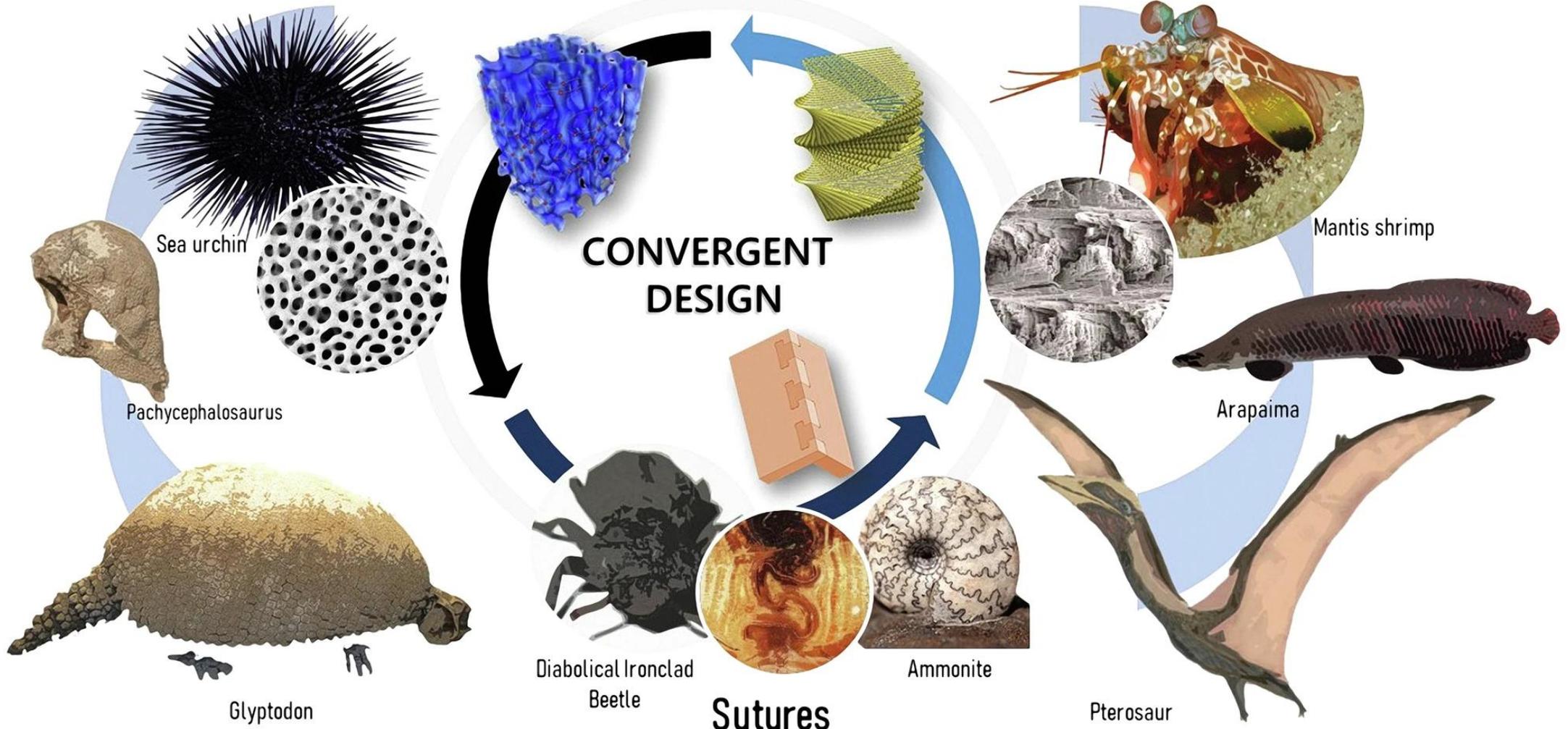
Helicoids

- Impact resistance
- Energy absorption

CONVERGENT DESIGN

Sutures

- Stress management
- Flexibility increase



Sea urchin

Pachycephalosaur

Glyptodon

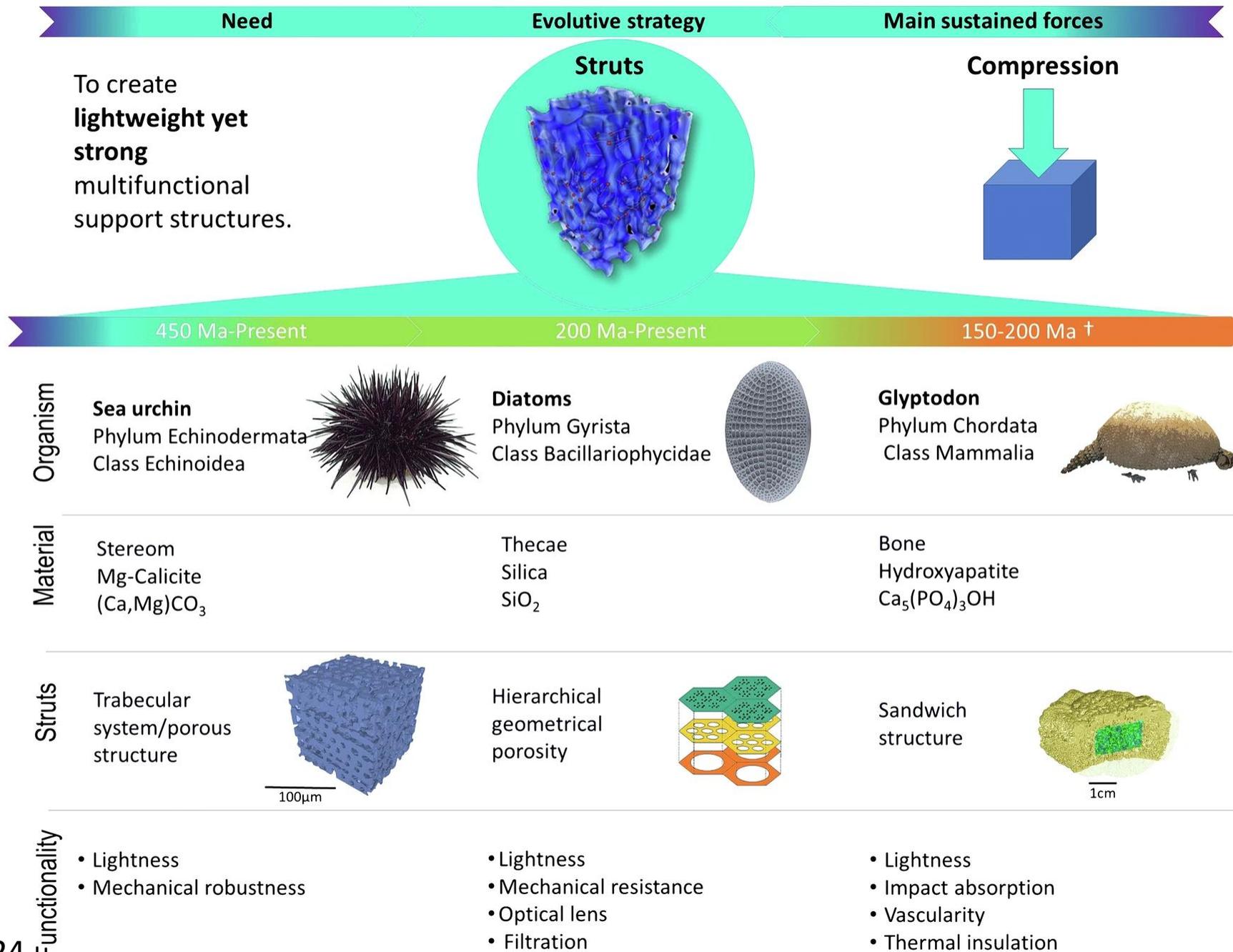
Diabolical Ironclad Beetle

Ammonite

Pterosaur

Arapaima

Mantis shrimp

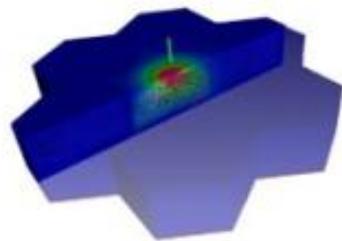
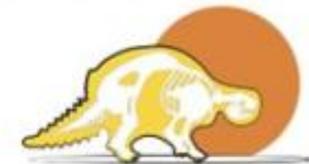
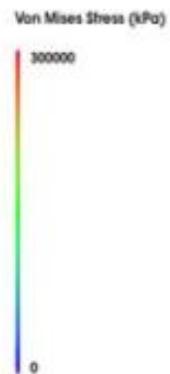




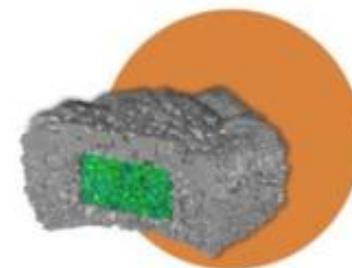
Osteoderm and
Micro-Ct
reconstruction



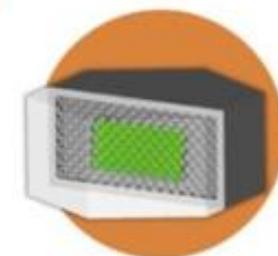
Glyptodon armour



Voxel-based
simulation



Micro-CT
analysis



Simplified model

Osteoderm
3D model



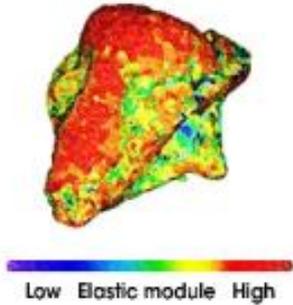
Hexagonal
pattern



3D printed
osteoderm

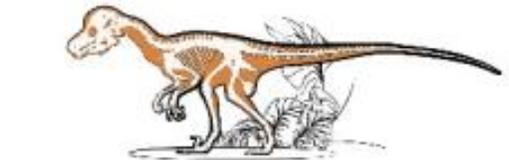
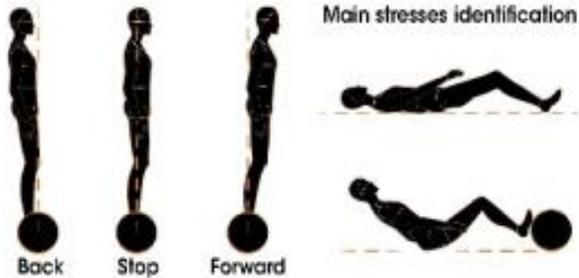
Investigation

3D scans - 3D modelling
Computational Imaging - Numerical analysis



Transfer

Modelling - Analysis and Optimisation



Design solutions



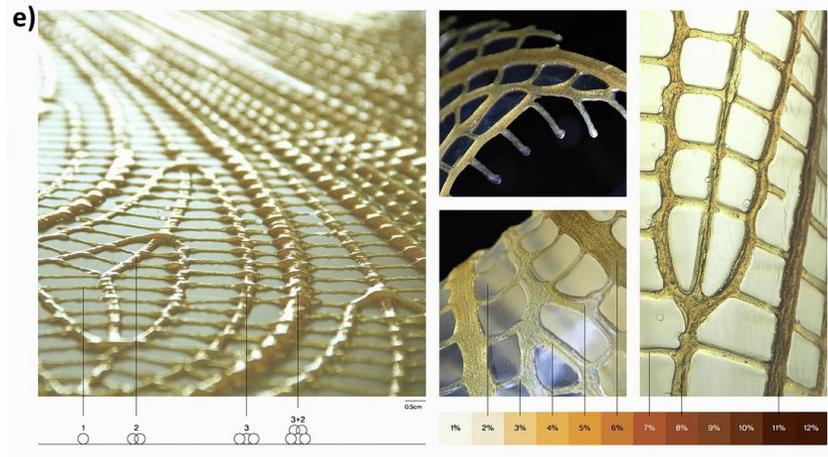
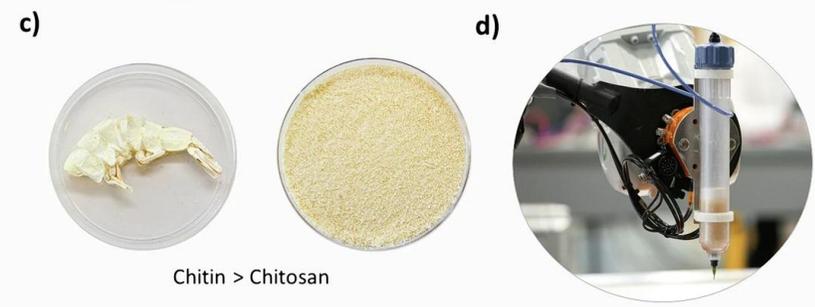
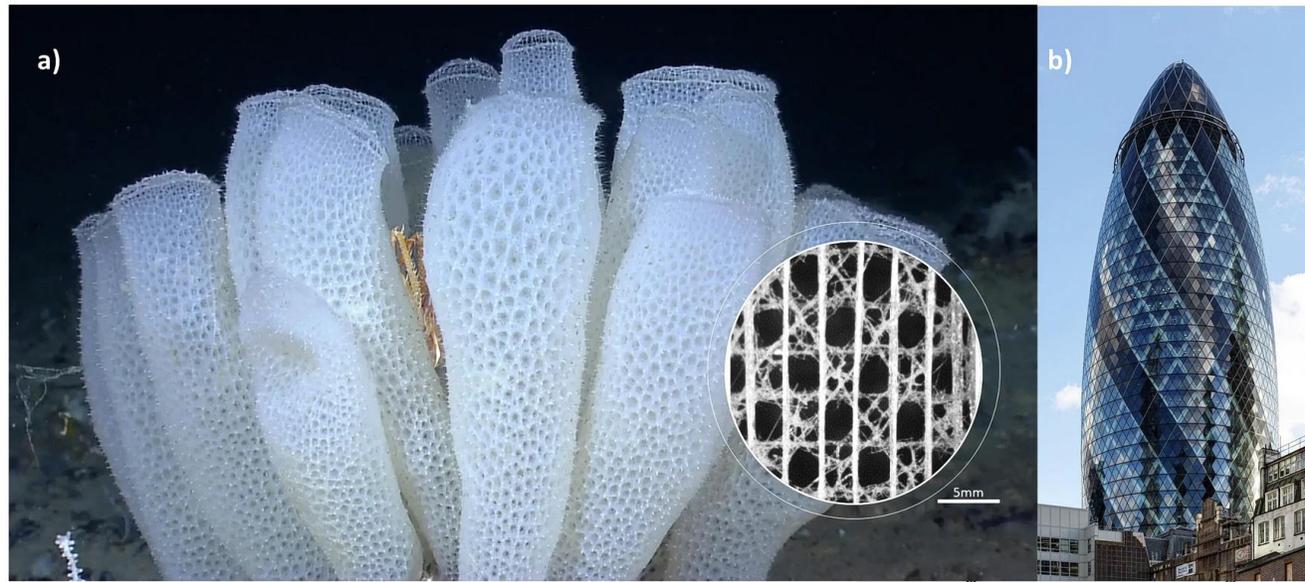
Abstraction

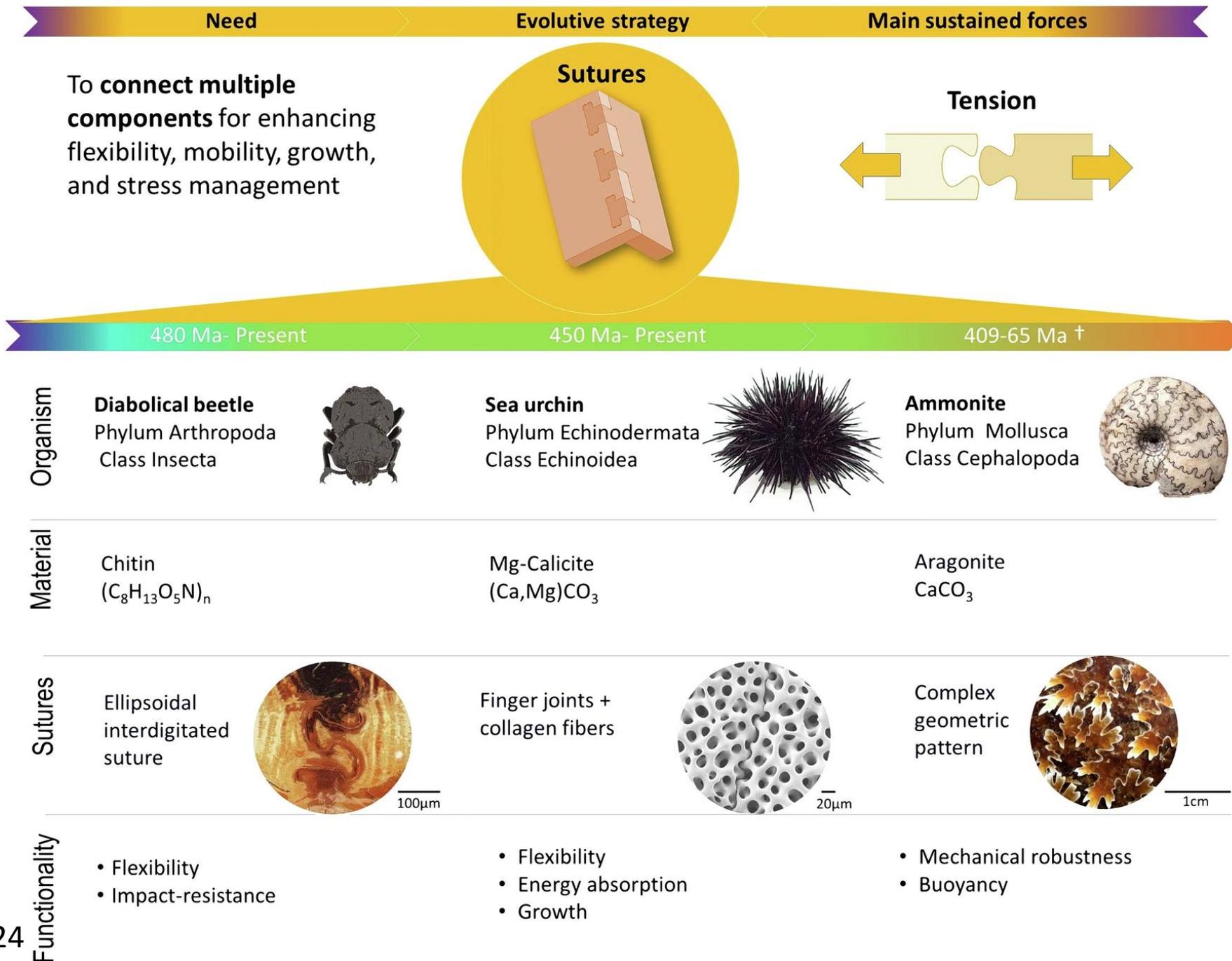
Translation of extinct biological strategies
into design strategies

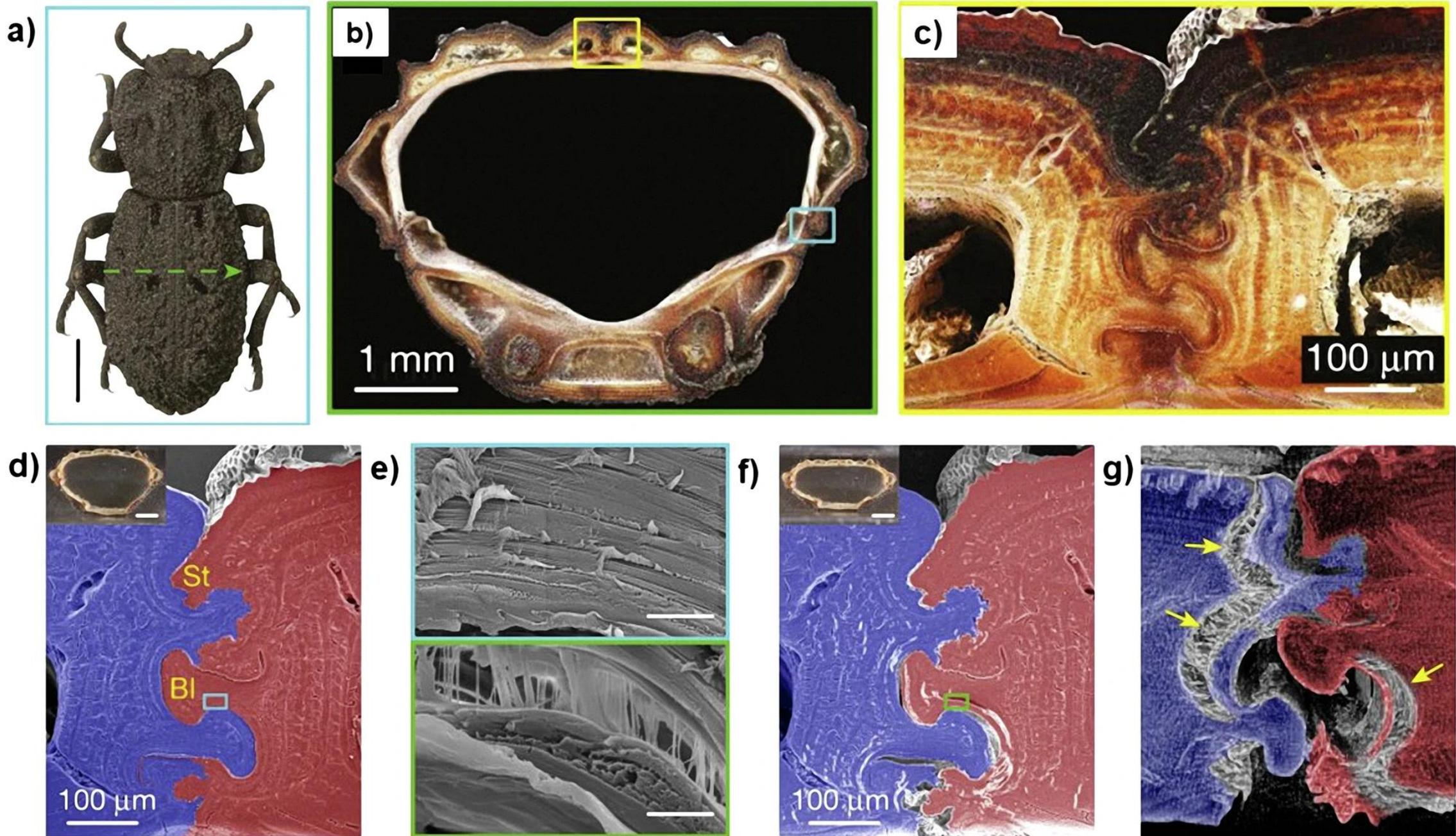
Prototyping

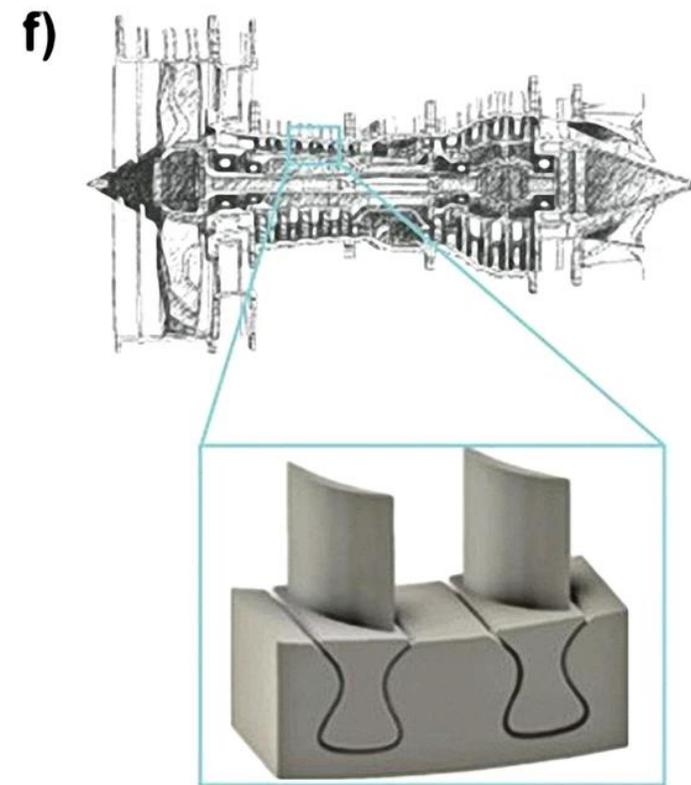
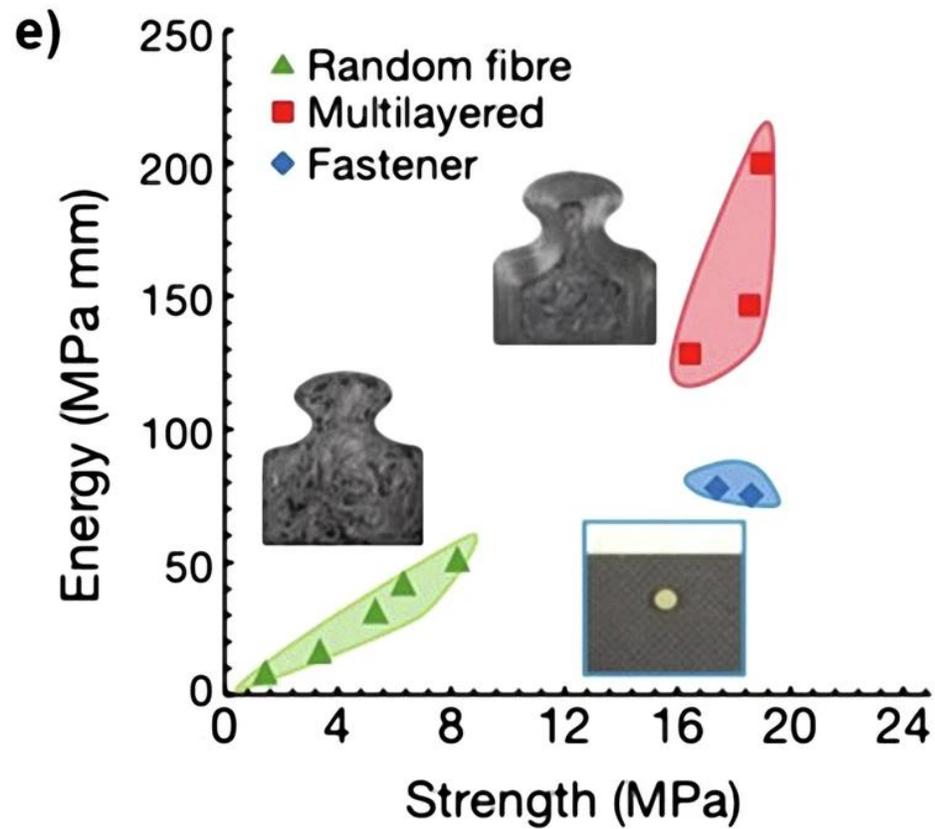
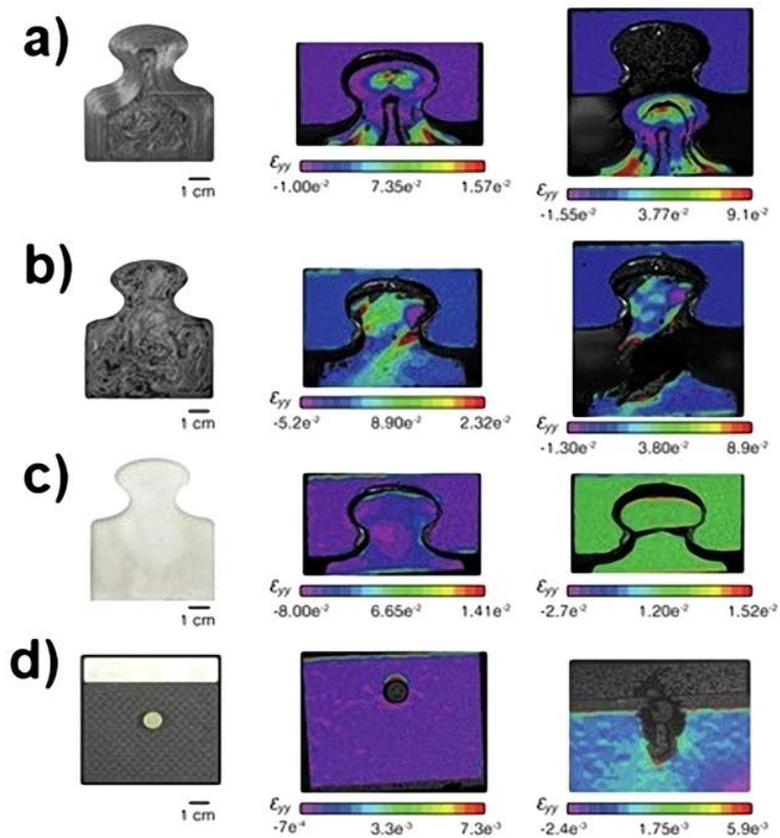
Testing and validation

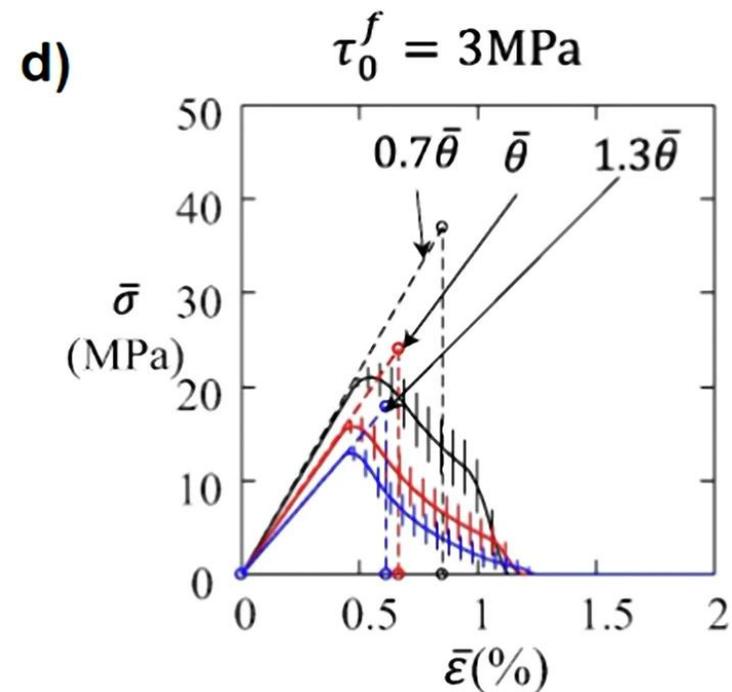
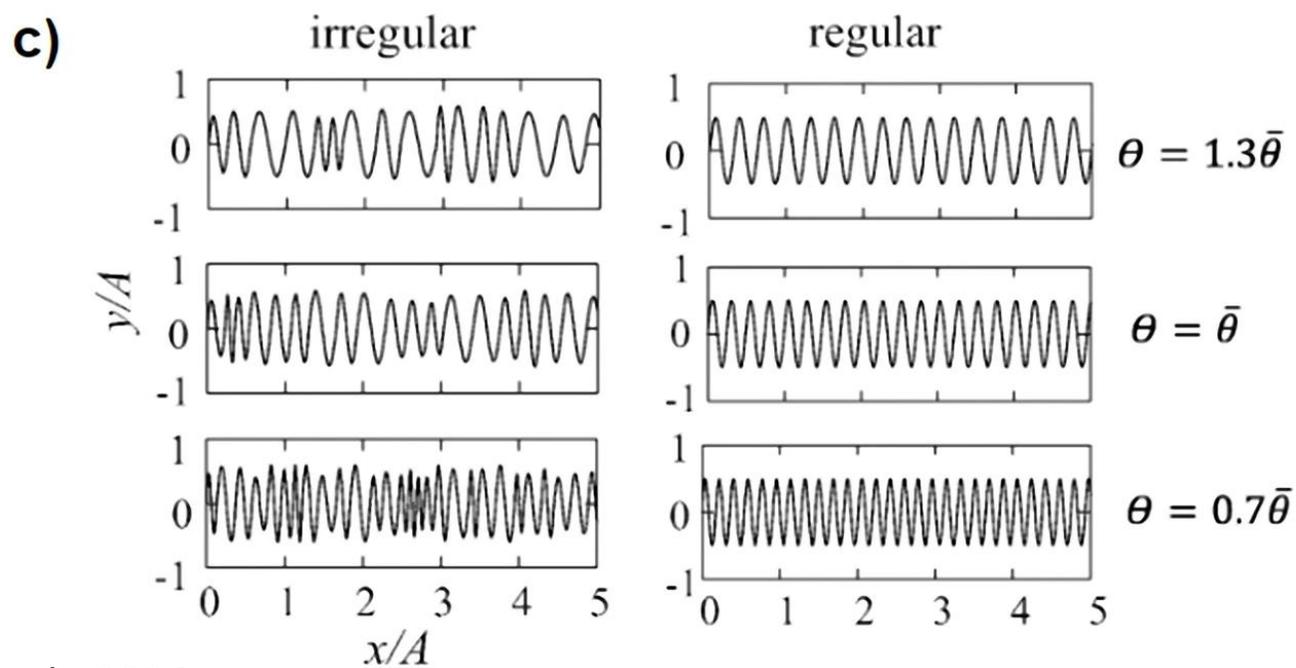
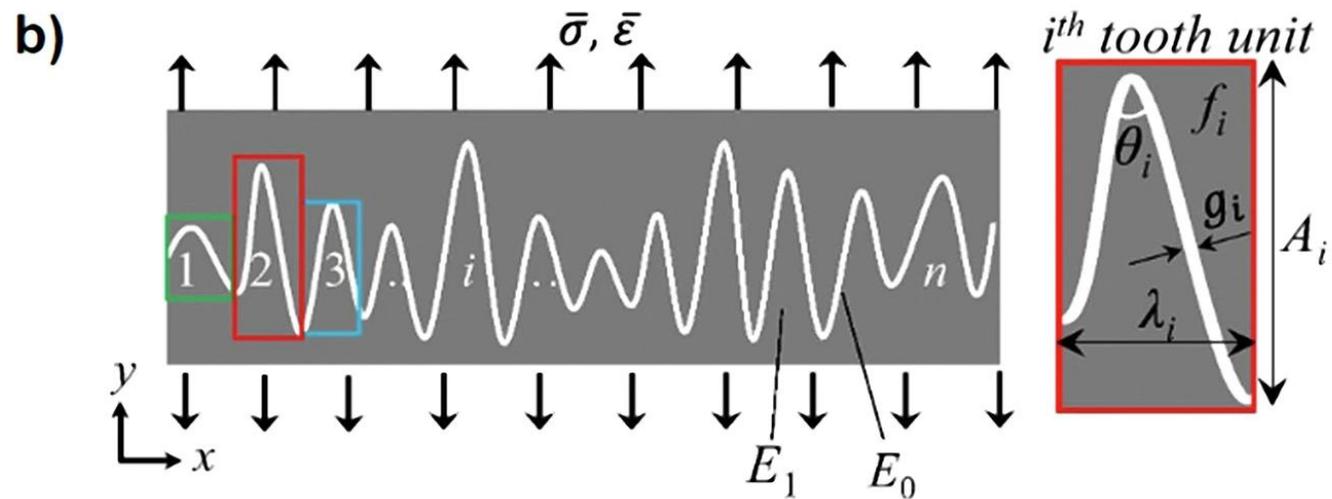
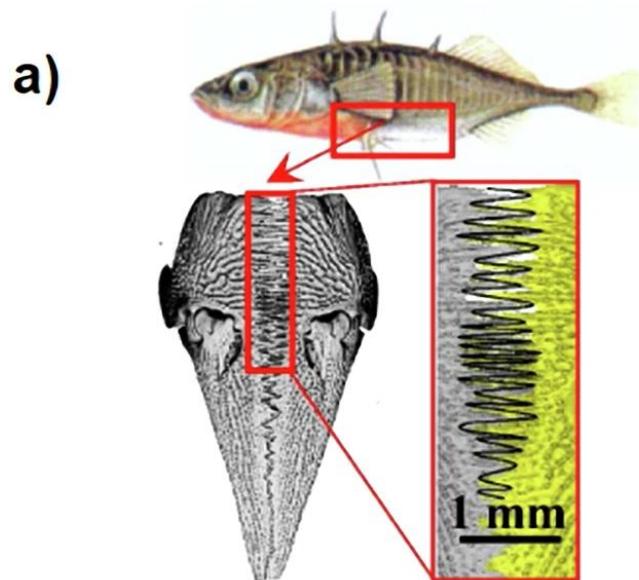


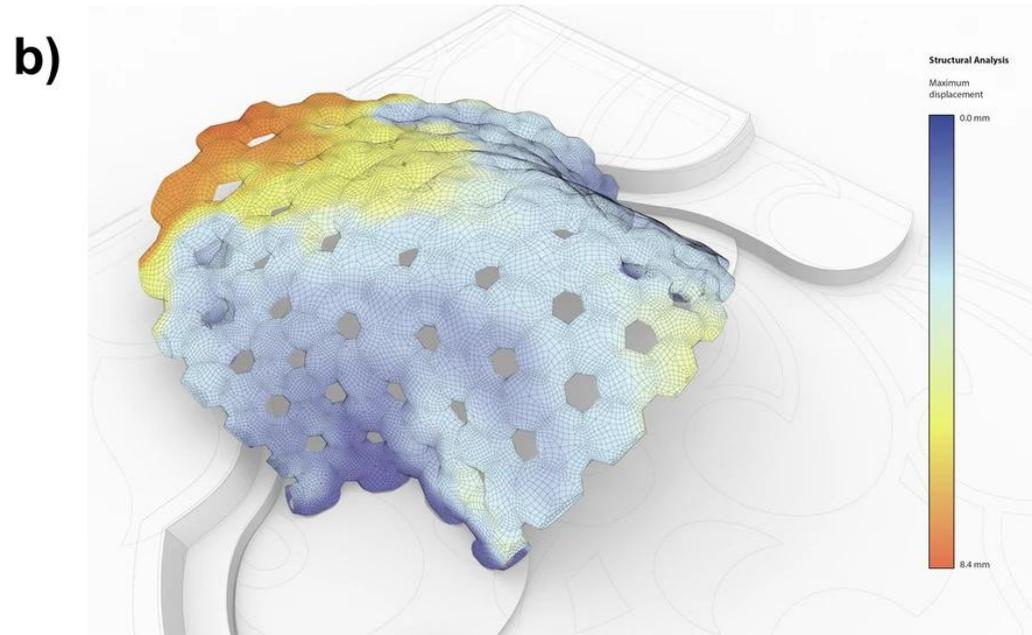
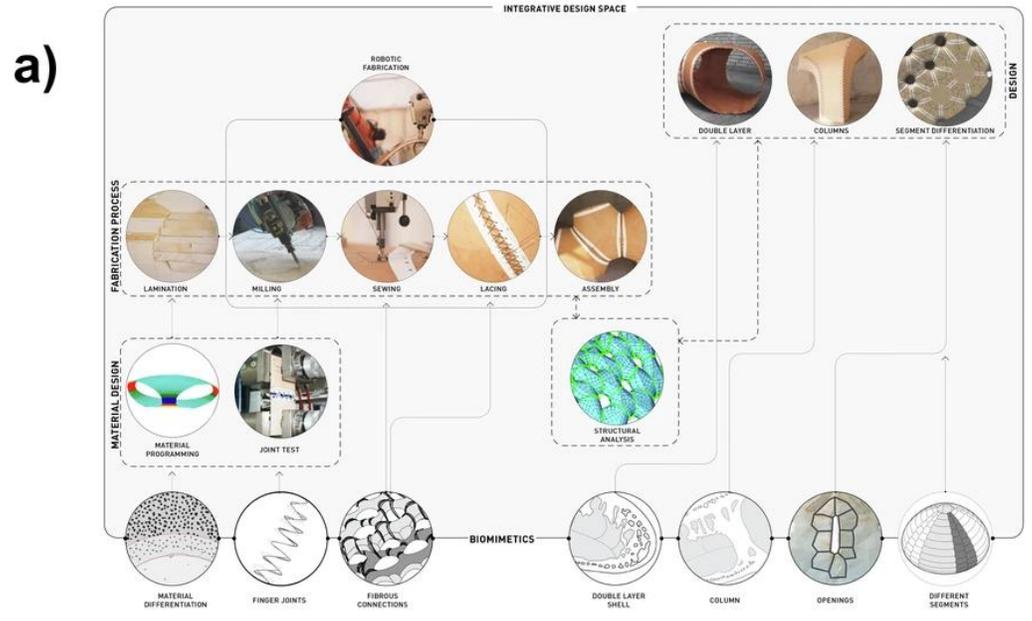


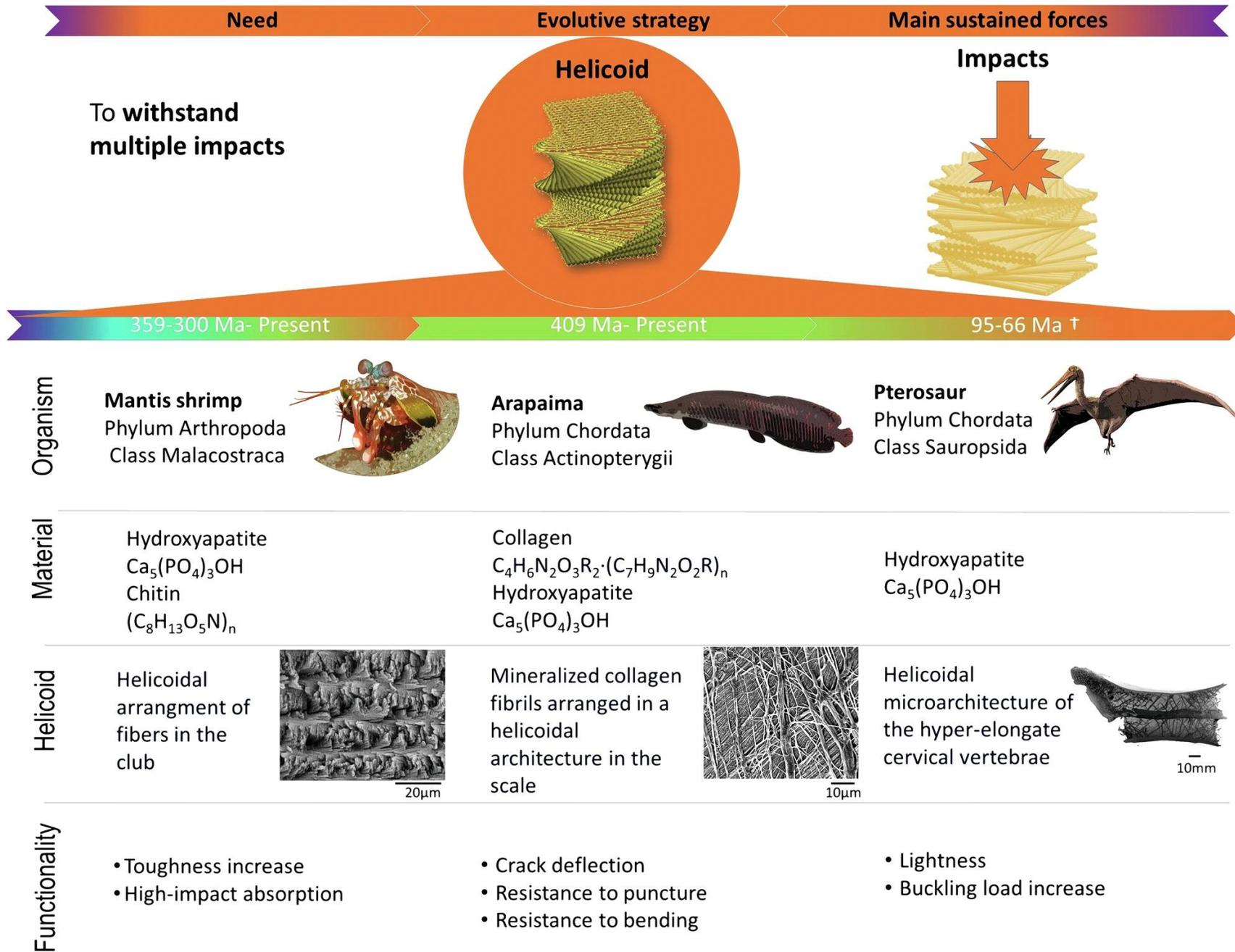


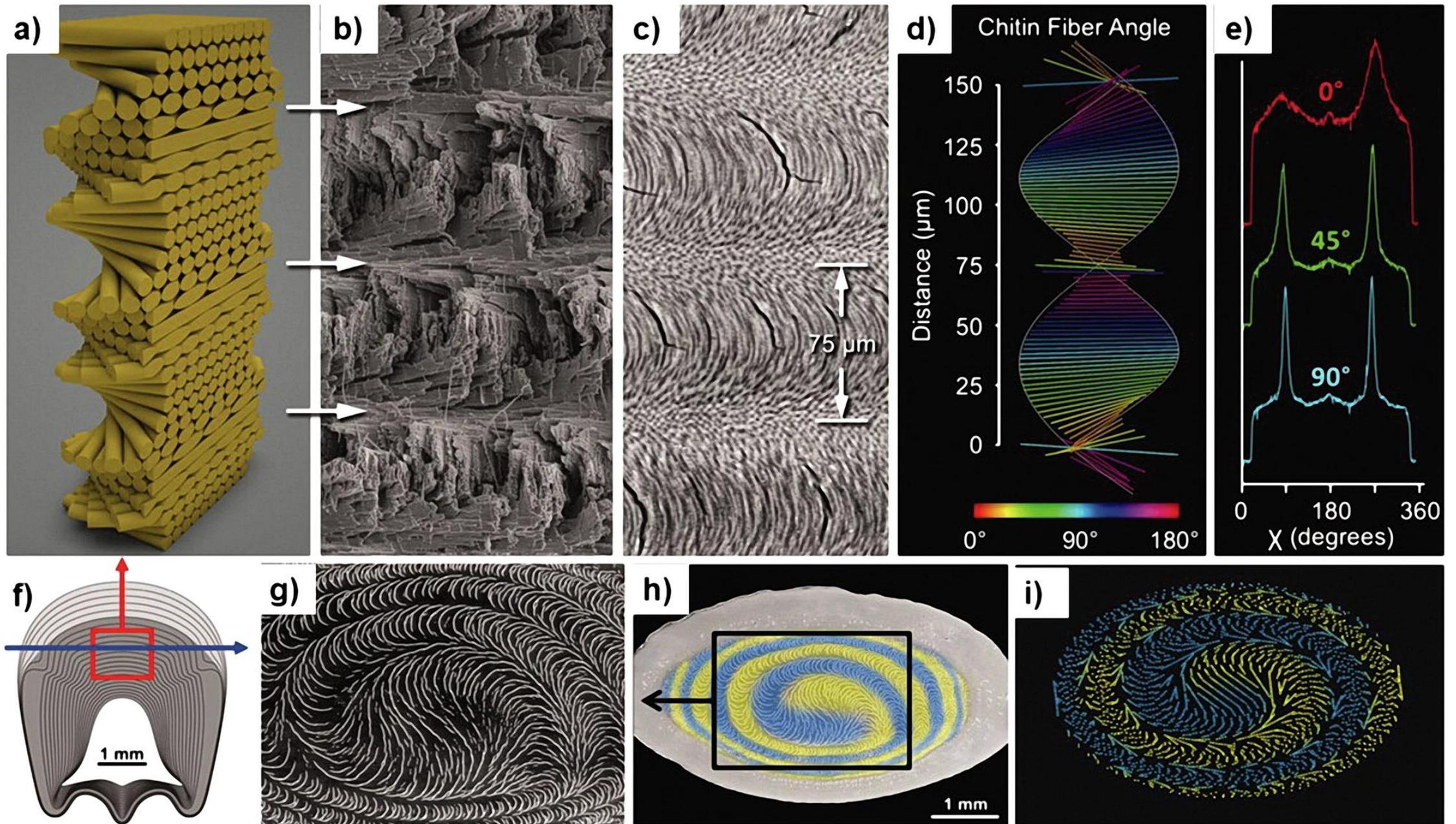


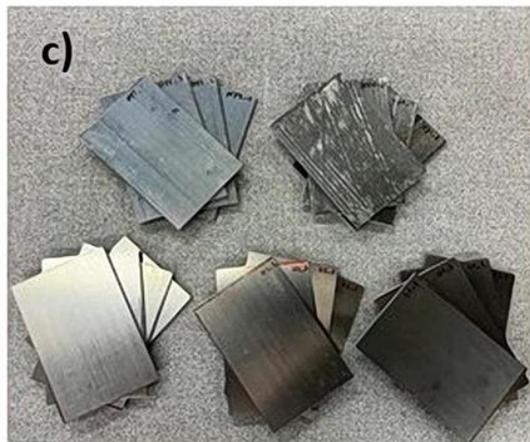
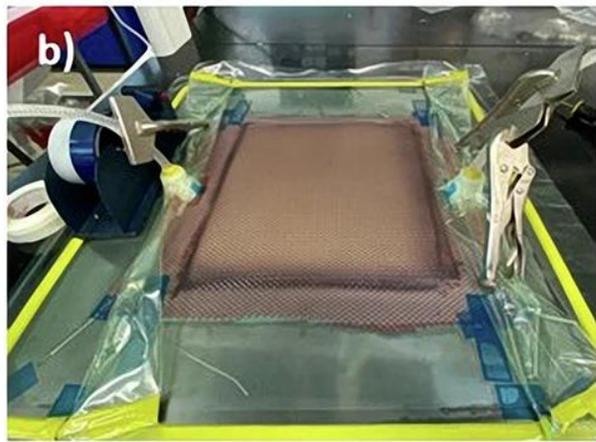
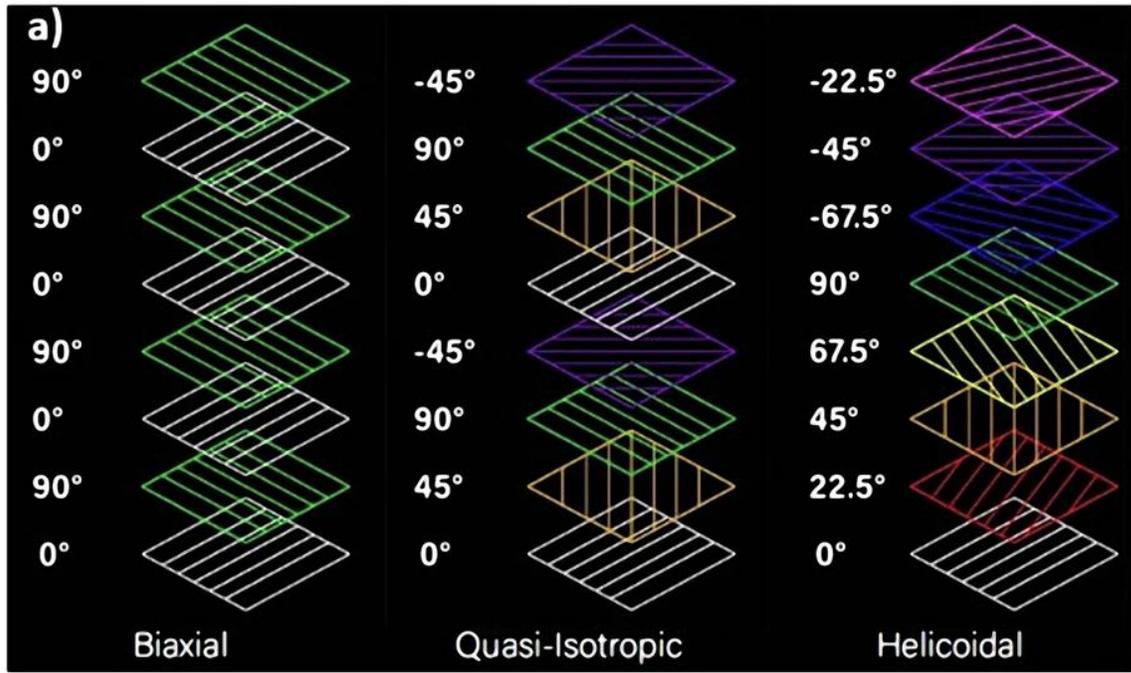












Adaptive Structural Solutions Over Time

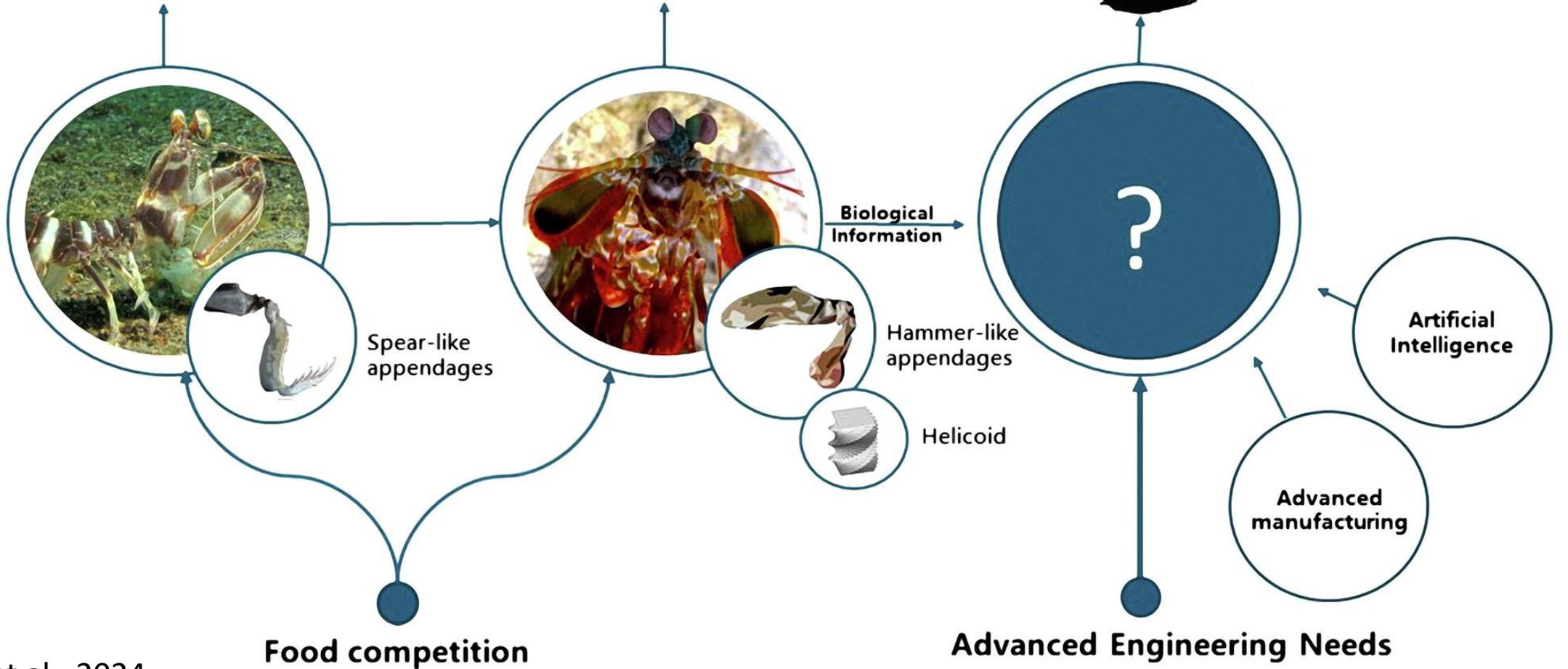
Soft-body Prey



Hard-body Prey



Extreme Structure

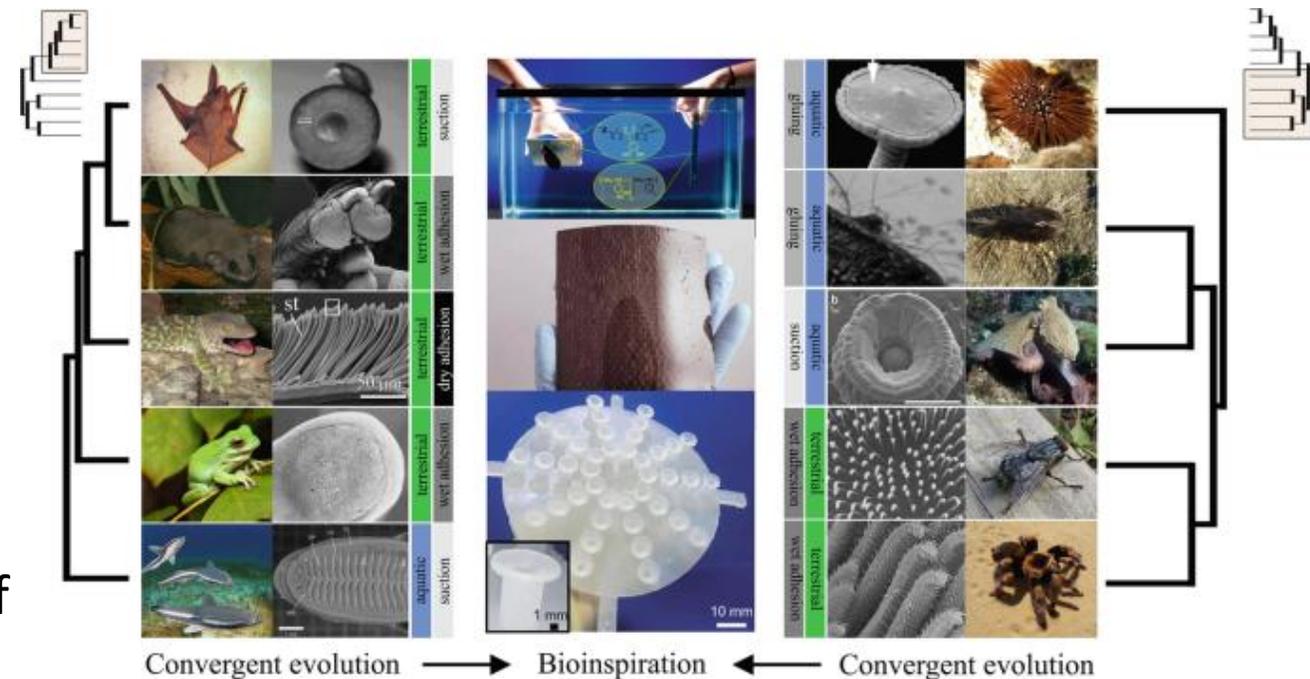


Food competition

Advanced Engineering Needs

Ewolucyjne ograniczenia paleomimetyki

- **Ograniczenie filogenetyczne** → historia ewolucyjna wpływa na przyszły przebieg ewolucji i ogranicza zdolności adaptacyjne.
- **Ograniczenie funkcjonalne** → multifunkcjonalność struktur zależy od kontekstu ekologicznego.
- **Ograniczenie środowiskowe** → dywersyfikacja do różnych warunków środowiskowych (nisz ekologicznych/stref adaptacyjnych) jest możliwa wyłącznie pod warunkiem obecności zróżnicowanego środowiska.



Broeckhoven & du Plessis, 2023