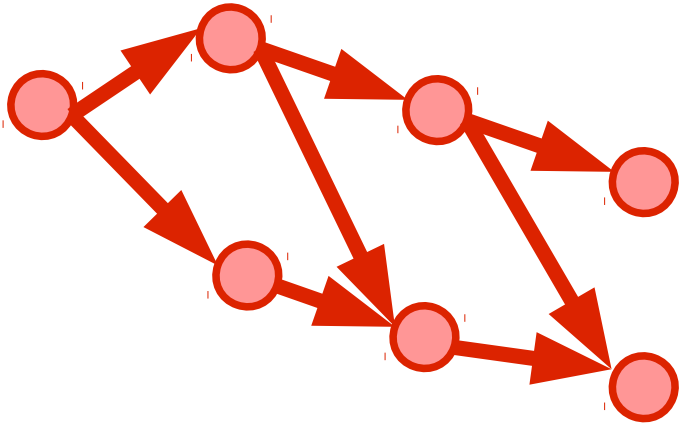
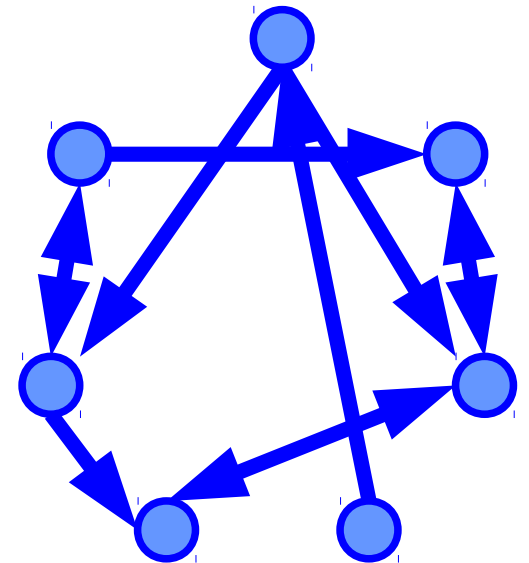




Algorithms In Nature

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Algorithms

“Algorithms are just computer talk...”

Algorithms are a set of instructions to be performed to
accomplish some task.

Muḥammad ibn Mūsā al-Khwārizmī

Algebra

Arithmetic

Astronomy

Cartography

The number Zero

and Algorithms



Morphogenesis

Morphogenesis

from the Greek

Morph – shape or from

Genesis – origin or creation

Morphogenesis

from the Greek

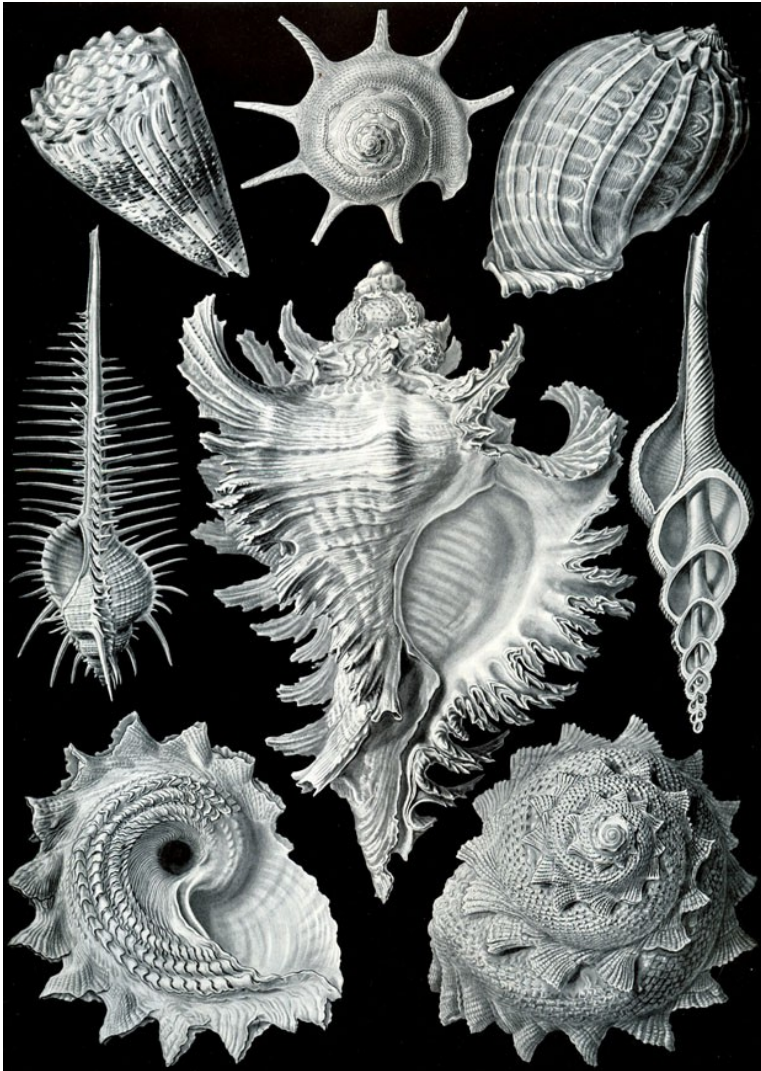
Morph – shape or from

Genesis – origin or creation

Origin of the form

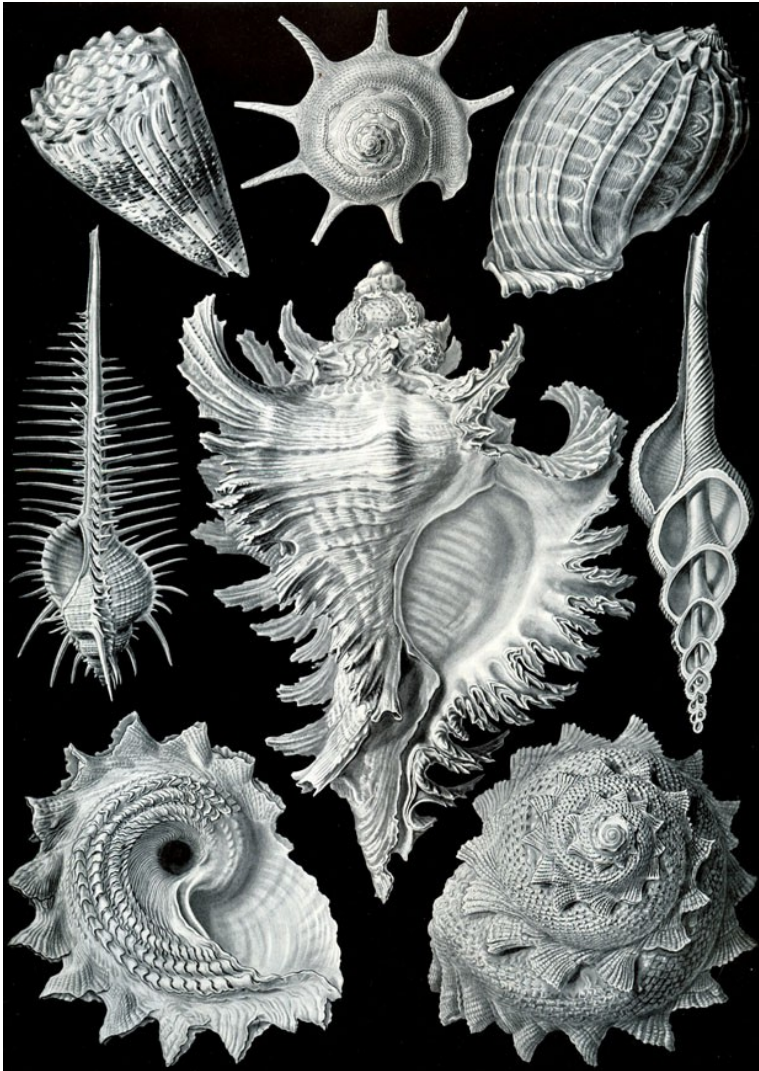
Sea Shells

Where do sea shells come from?



Sea Shells

Where do sea shells come from?

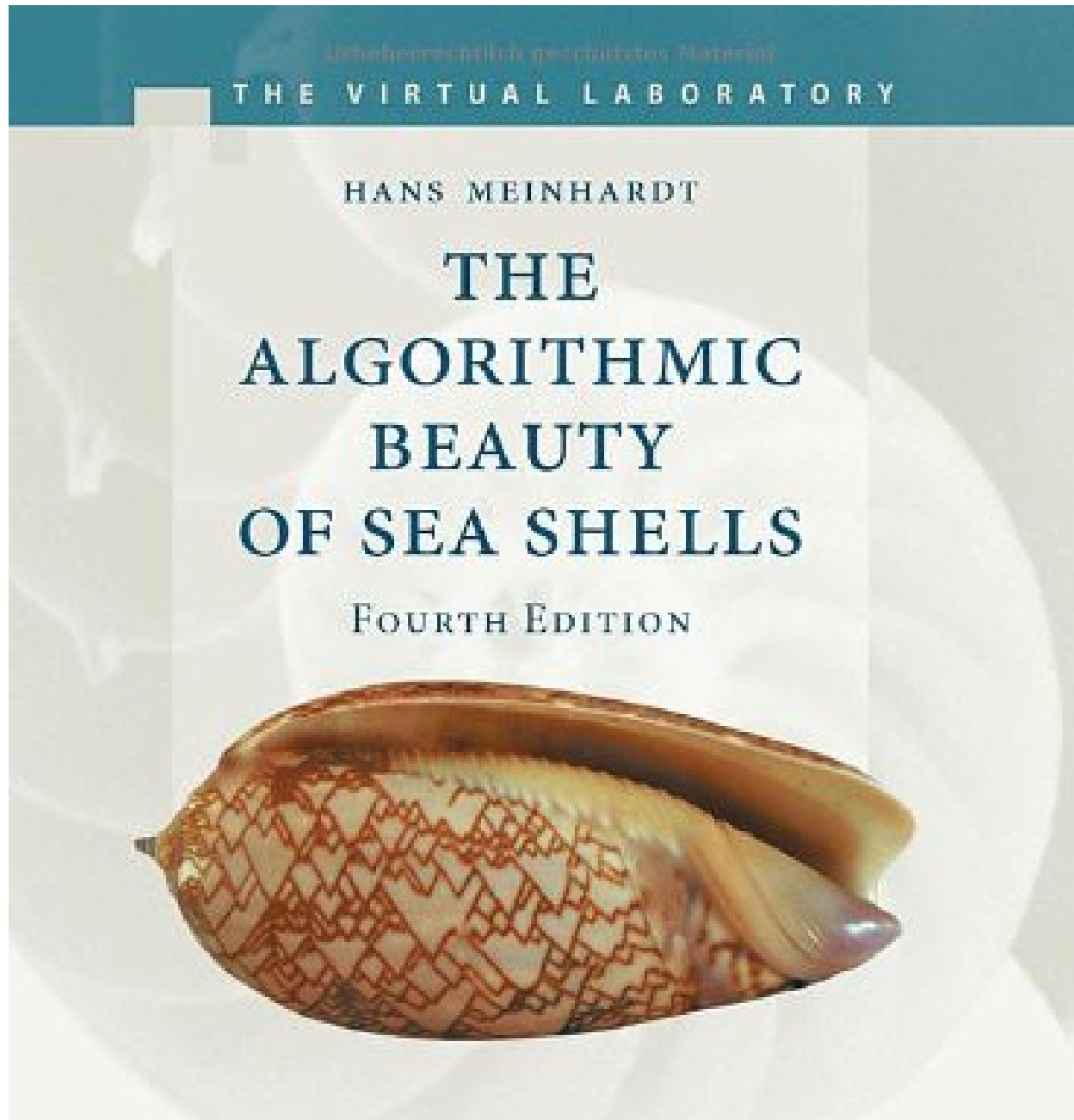


The outer layer protecting molluscs or other sea creatures.

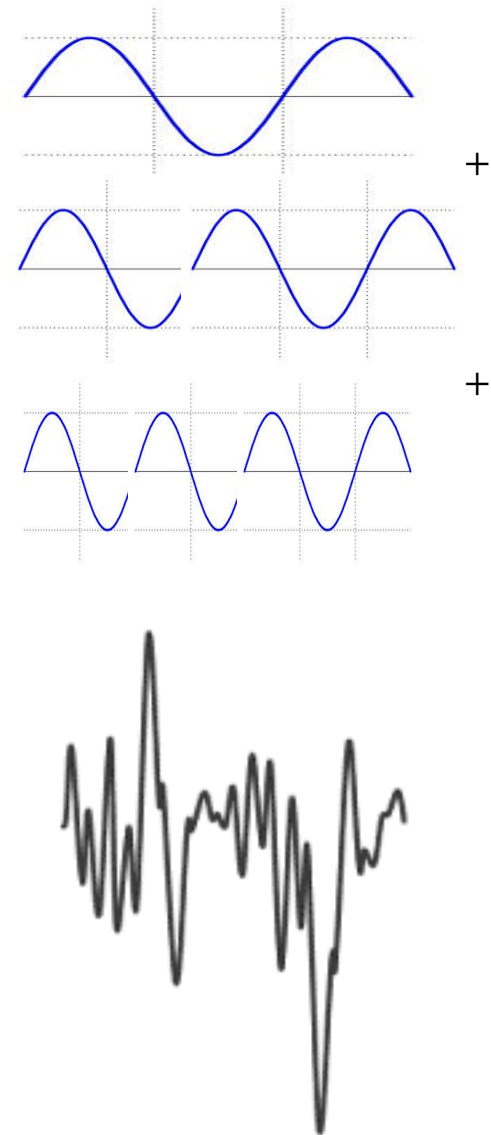
Creature has died and rotten away (or eaten)



Sea Shells

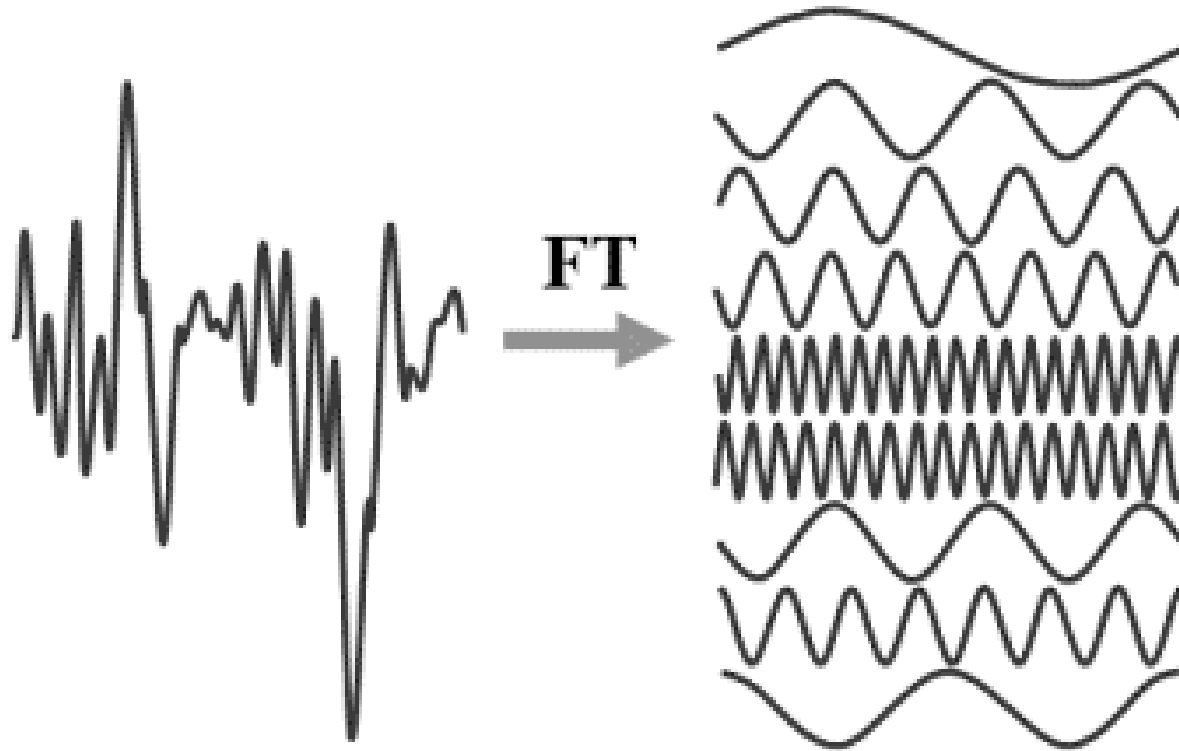


Sound



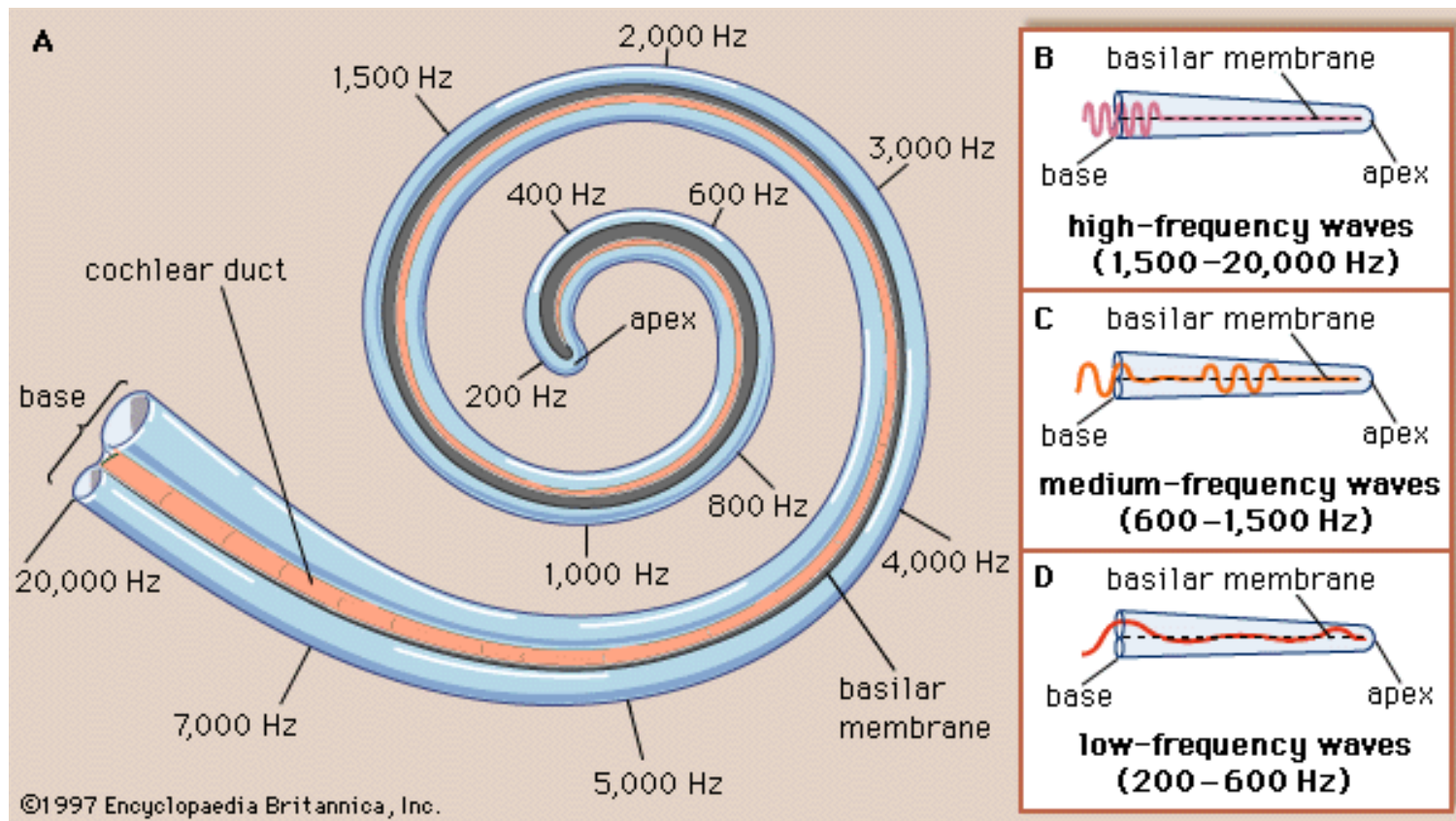
Fourier Transforms

An algorithm for decomposing complex waves into component frequencies



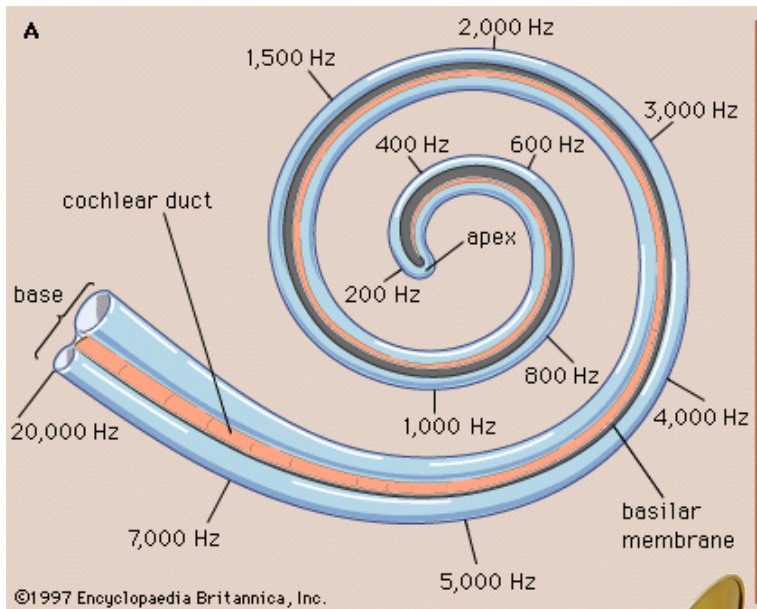
Cochlea

This is all done in the ear



Cochlea - Morphogenesis

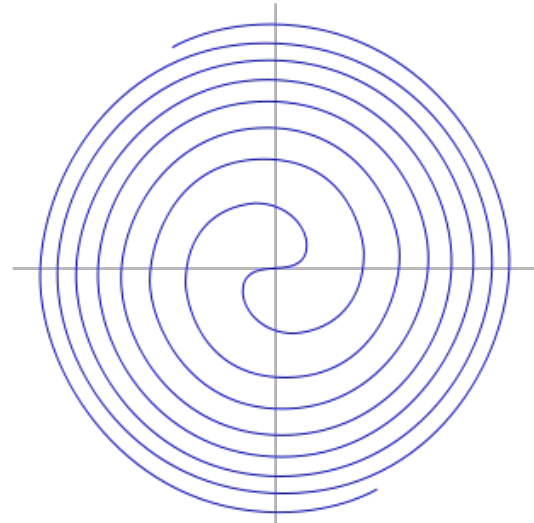
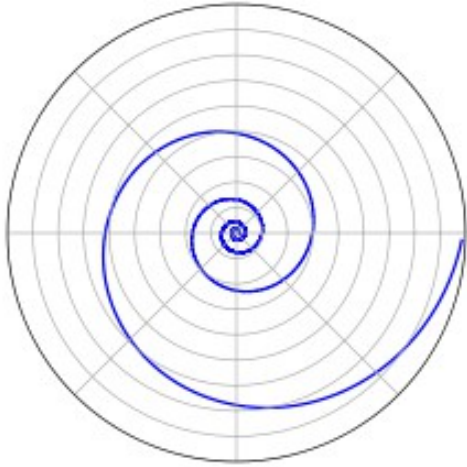
Recognise this shape?



http://en.wikipedia.org/wiki/File:French_horn_front.png

<http://en.wikipedia.org/wiki/File:NautilusCutawayLogarithmicSpiral.jpg>

Morphogenesis - Spirals



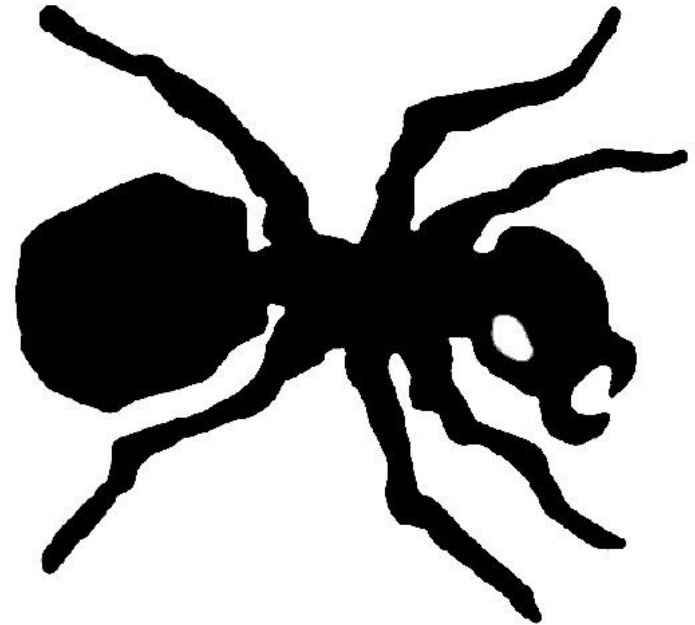
Ants

Ant live in complex colonies

Tiny brains

Achieve tremendous feats

Work together:
synergy



Tower of Hanoi

Need to move all rings onto another pole

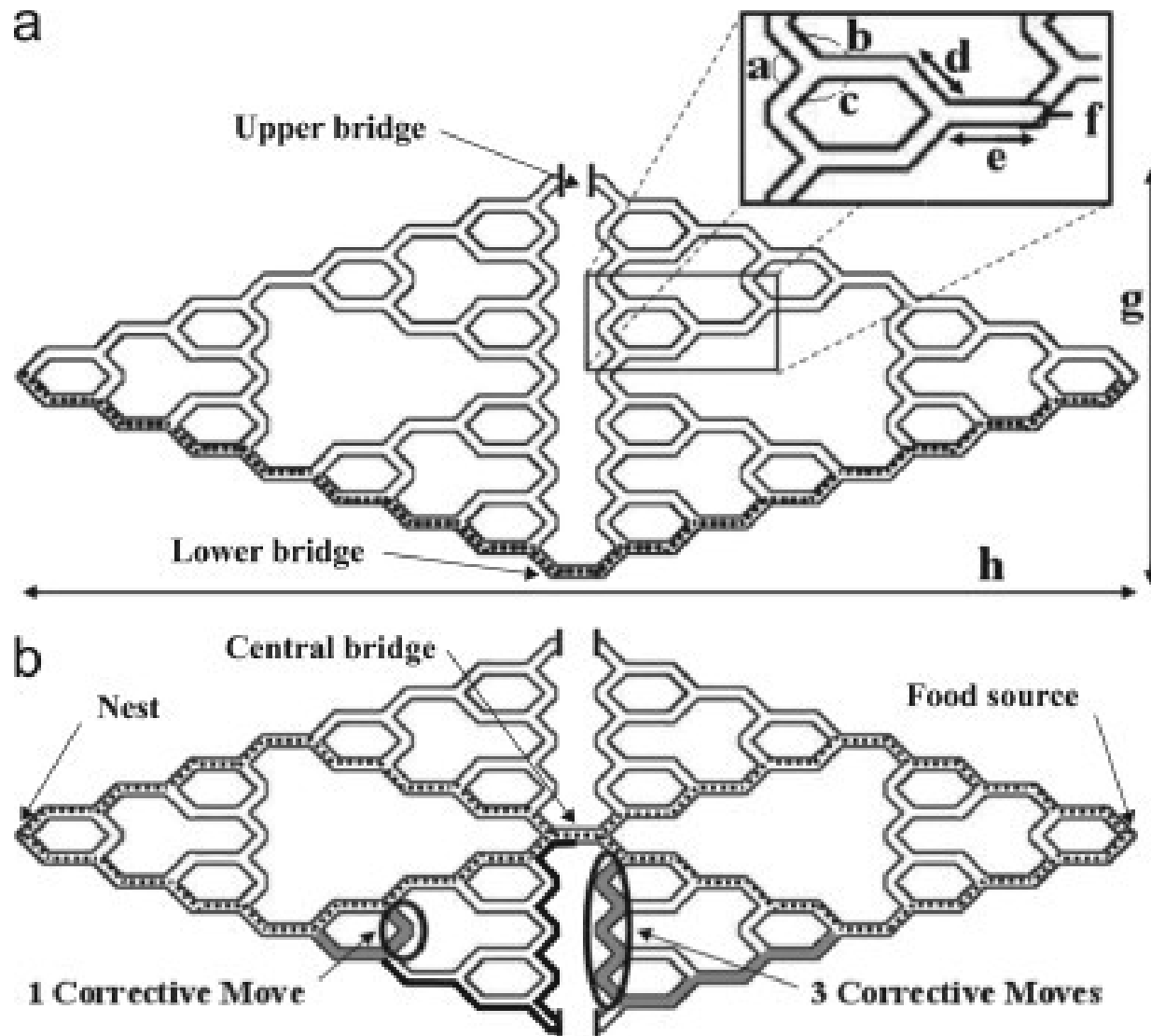
Can only move one ring at a time

Can't place a larger ring on top of a smaller one

Complexity $2^n - 1$ where n is the number of rings.



Tower of Hanoi – Ant Solution

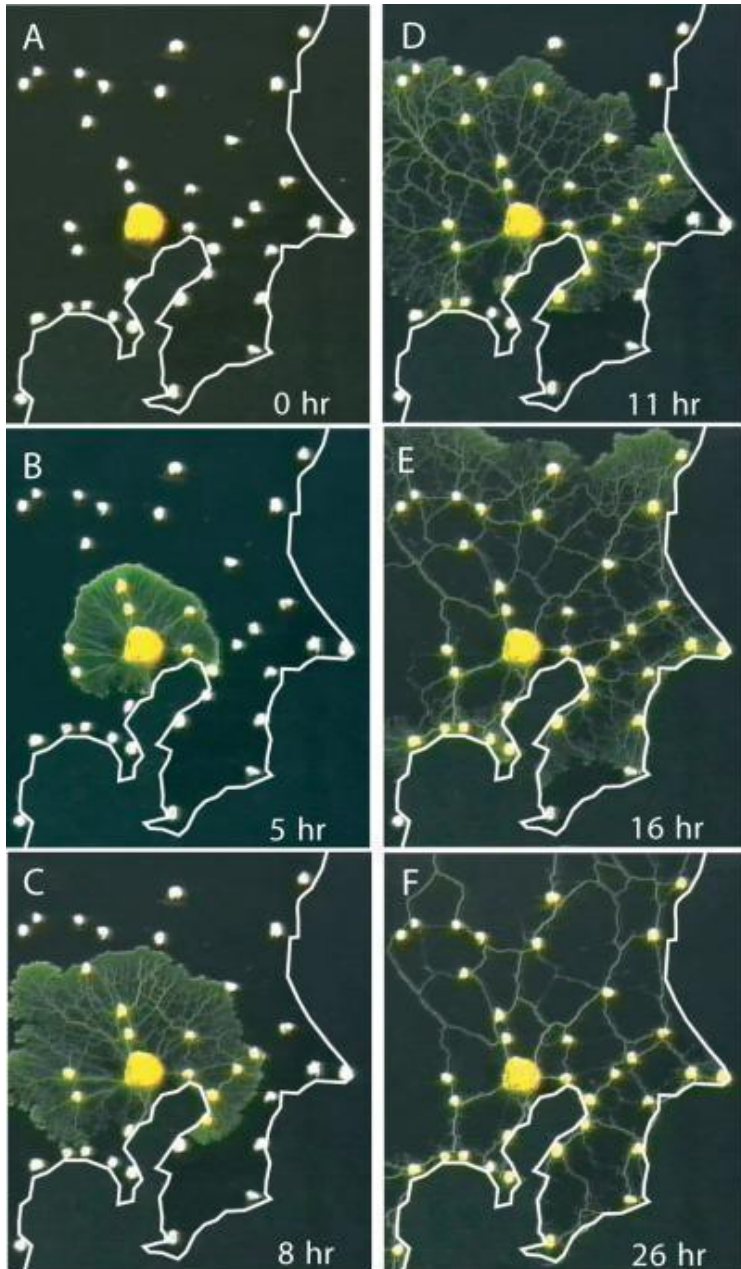


Represent the problem as a maze

Ants lay pheromones as they explore and find food

Ants quickly adapt to changes in the maze

Slime



Physarum polycephalum

A form of slime mould

Can also solve the Hanoi maze

Seen here replicating the Tokyo train network with protoplasmic veins

Reid and Beekman
Journal of Experimental Biology, Vol -, 2013

Tero et al.
Science, 2010

Thanks for listening,
any questions?

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UCAS students open day 22/3/2013 & 5/4/2013