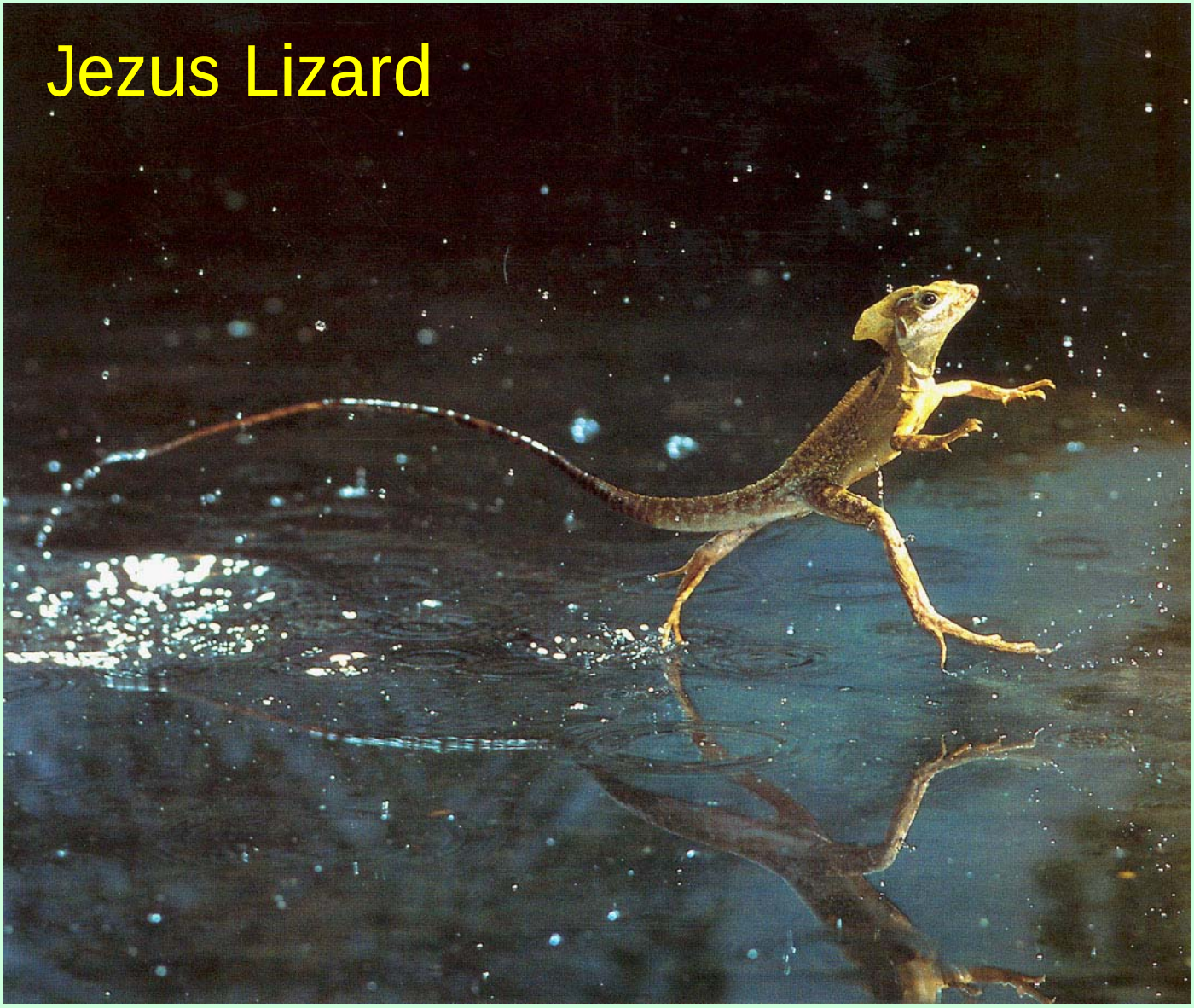
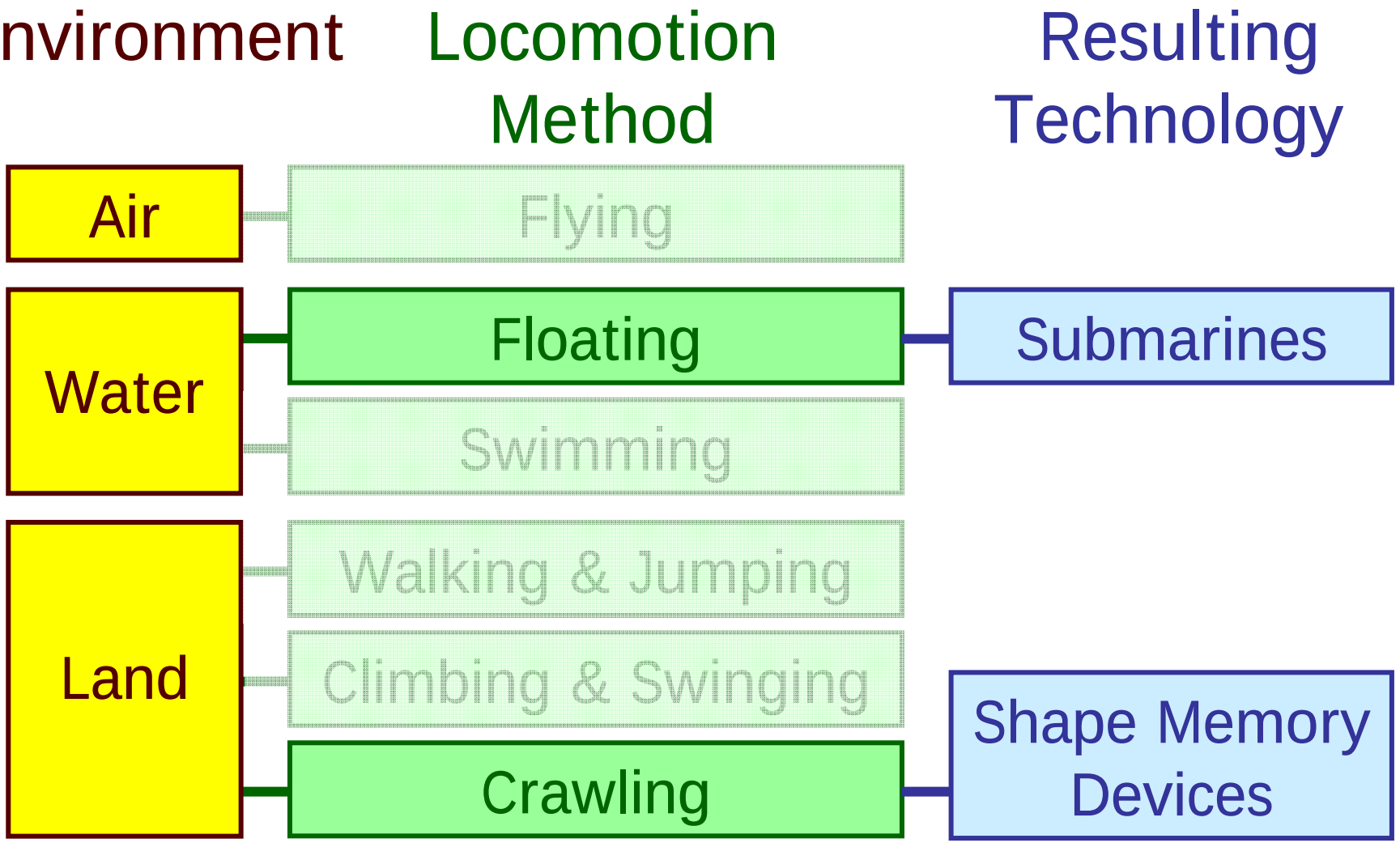
Jezus Lizard

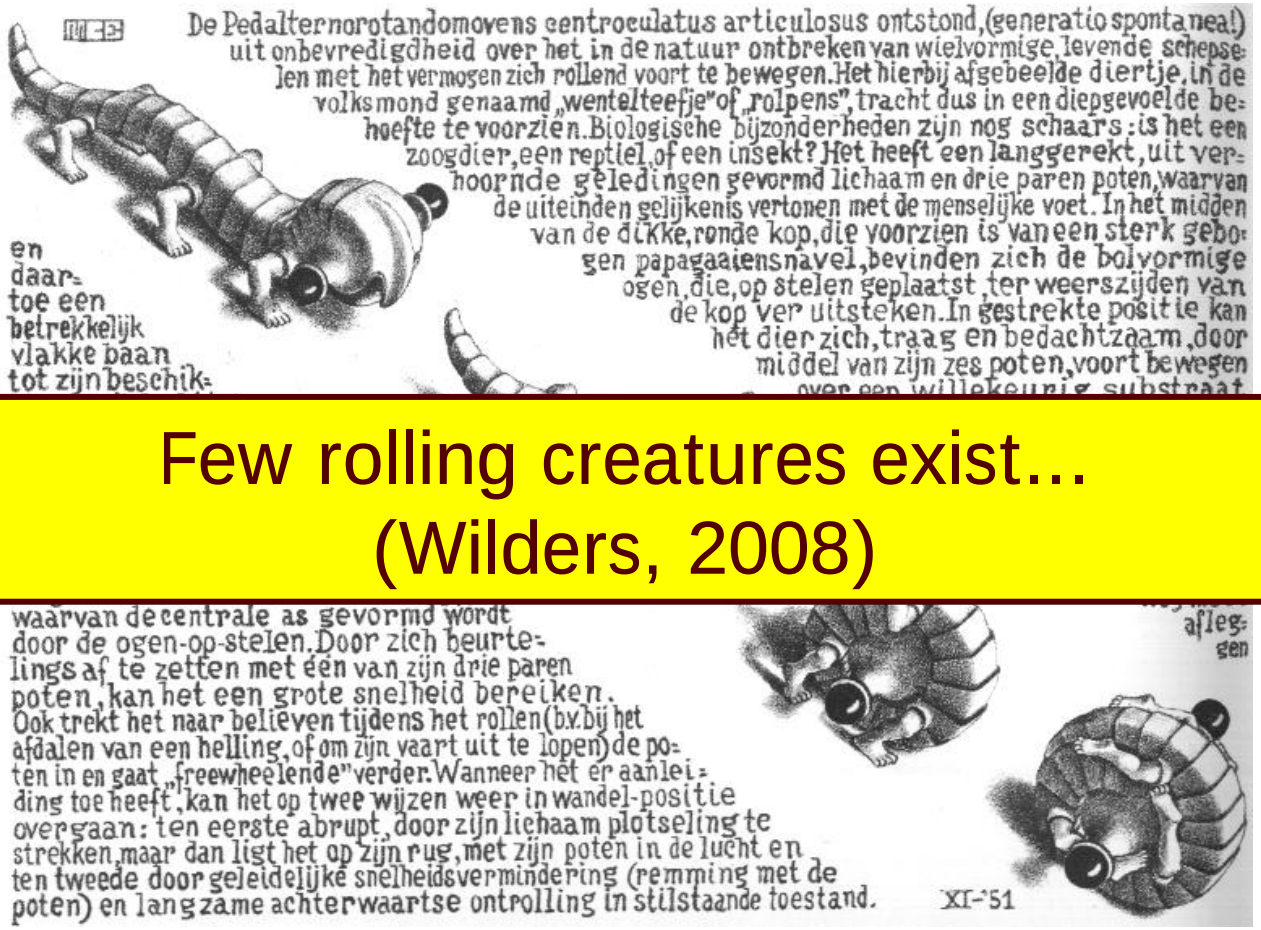


Overview


Environment
Locomotion Method
Resulting Technology
Air
Flying
Water
Floating
Swimming
Submarines
Land
Walking & Jumping
Climbing & Swinging
Crawling
Shape Memory Devices

Floating

Crawling



Few rolling creatures exist…
(Wilders, 2008)

Rolling? (“Wentelteefje”, M. C. Esher)

Floating

Crawling

Passive rolling (wind)

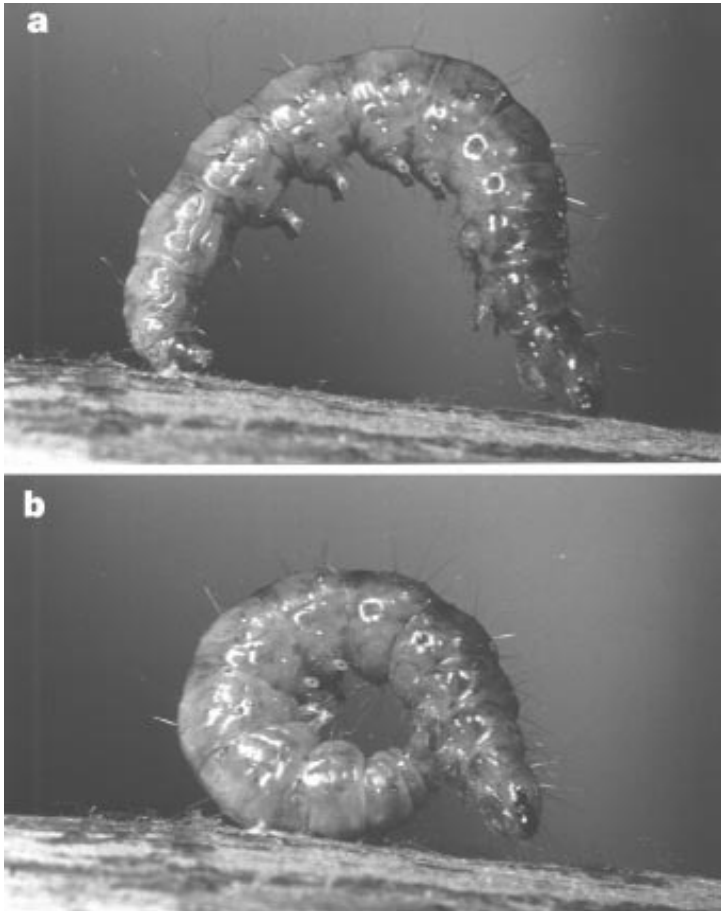
Floating	Crawling

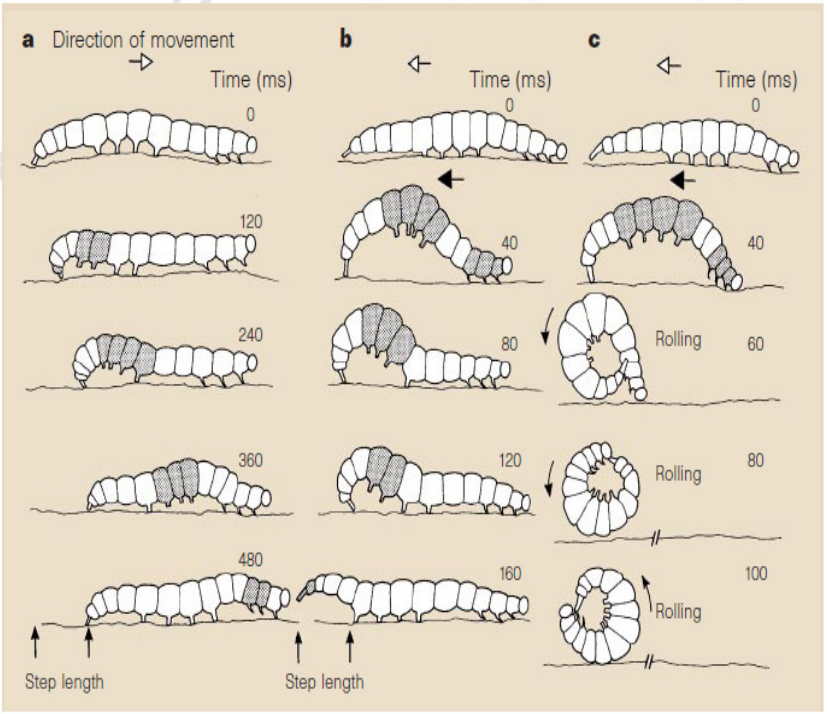
Namib Wheeling Spider
(Golden Wheel Spider)

Partially active rolling (take off, hill)

Floating

Crawling

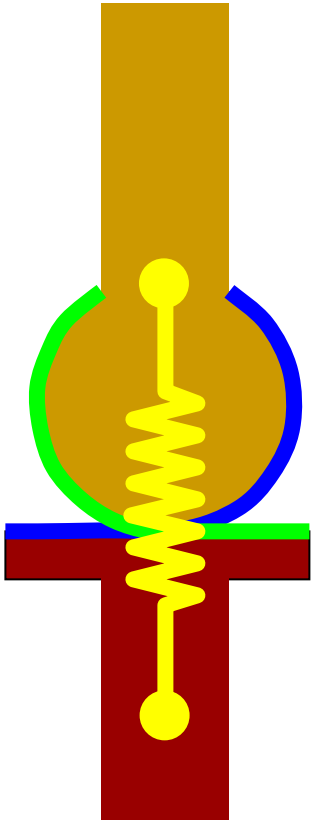




Mother-Of-Pearl Moth

Active rolling (take off, horizontal)

Floating	Crawling

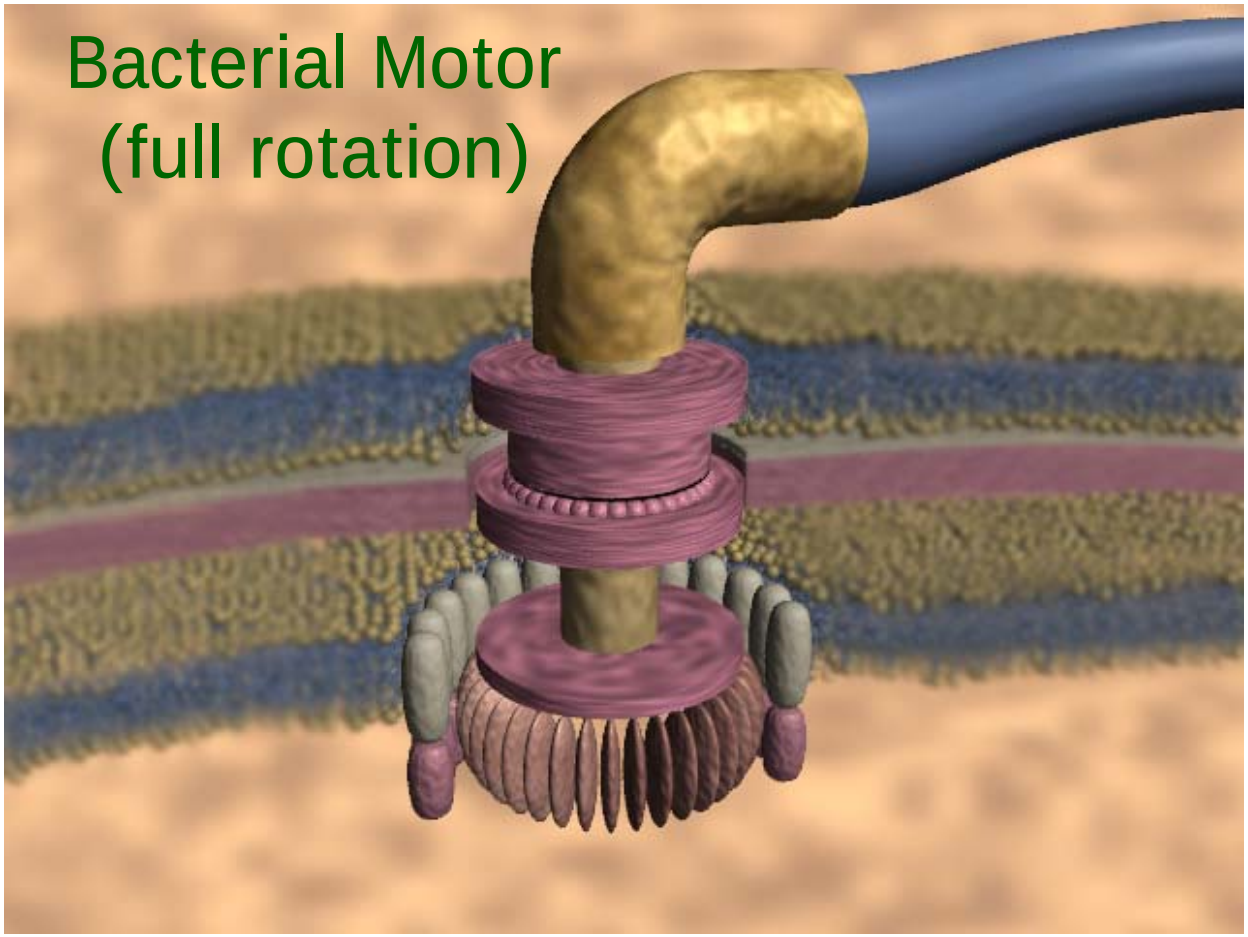


- No backlash
- No friction
- No lubrication

Rolling anatomic elements (partial rotation)

Floating

Crawling



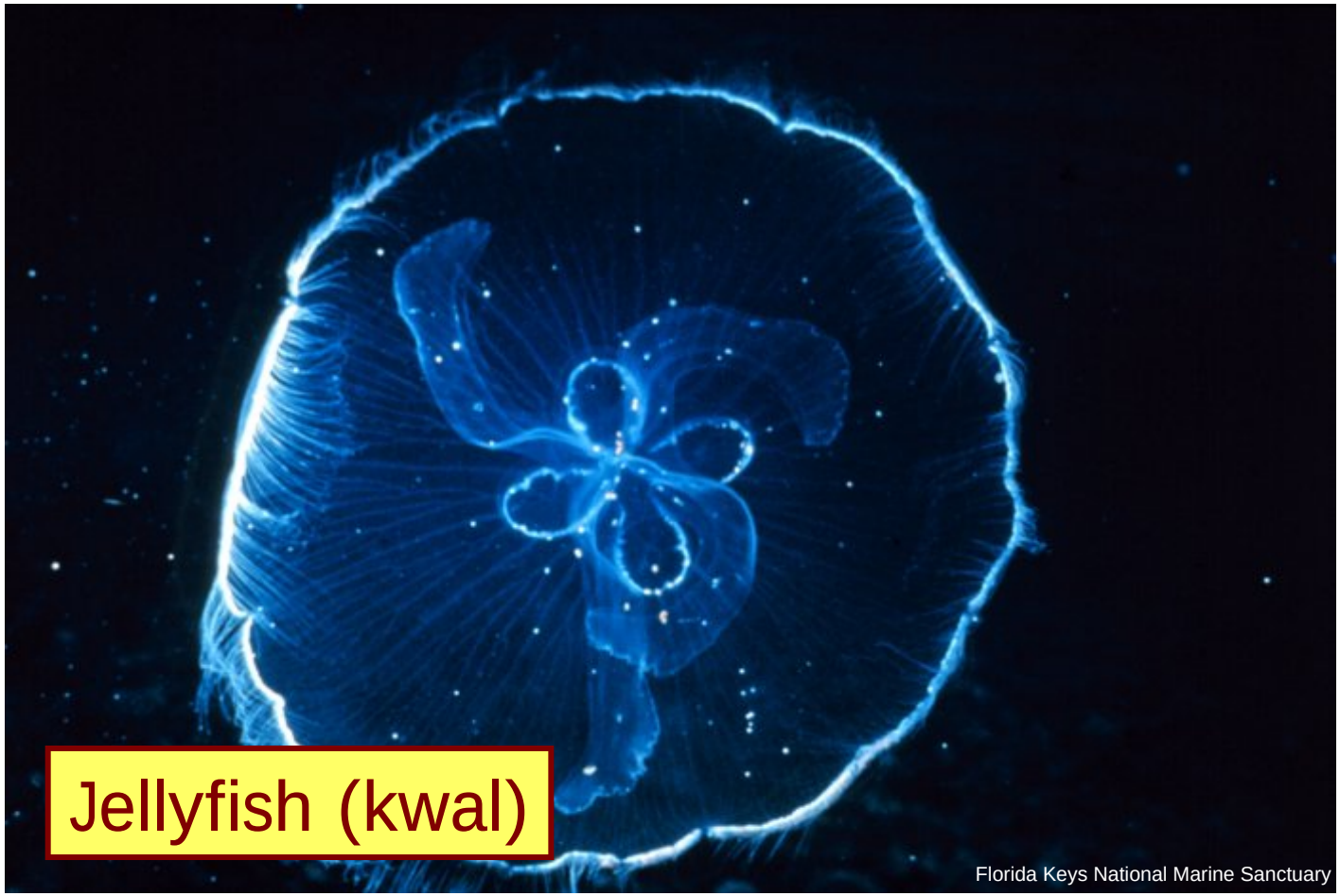
Rolling anatomic elements (full rotation)

Floating

Crawling

Floating

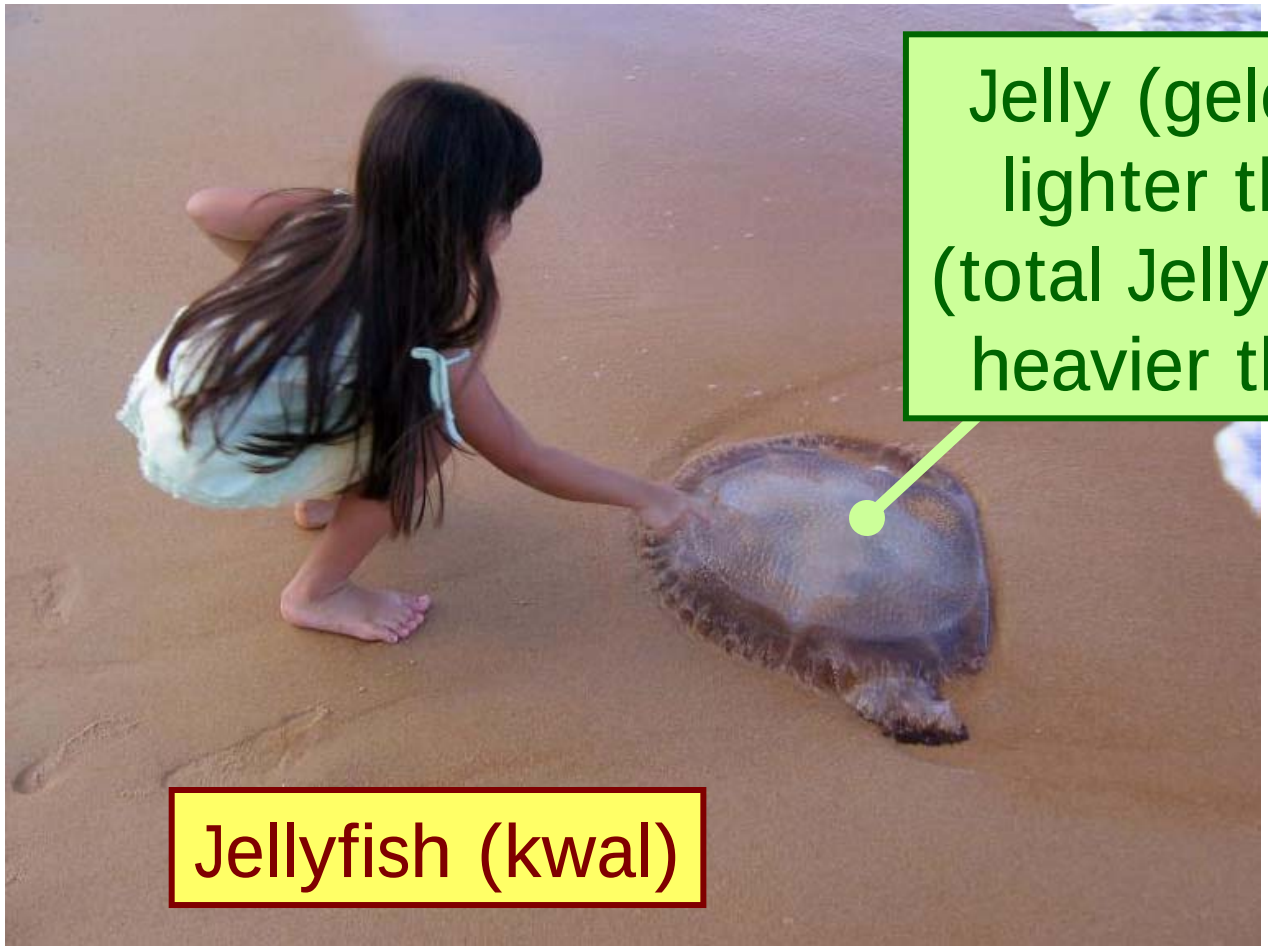
Crawling



Swimming or sinking

Floating

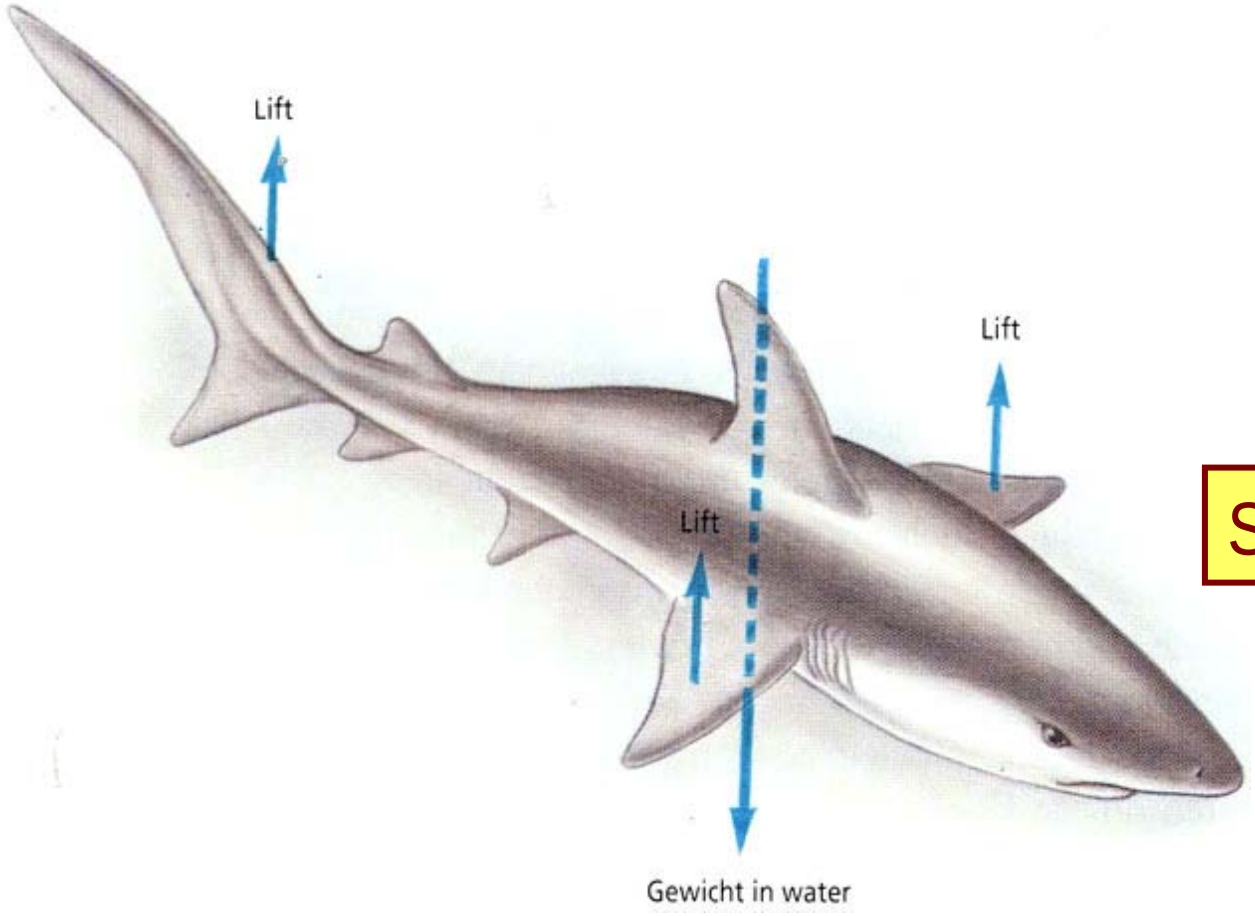
Crawling



Swimming or sinking

Floating

Crawling



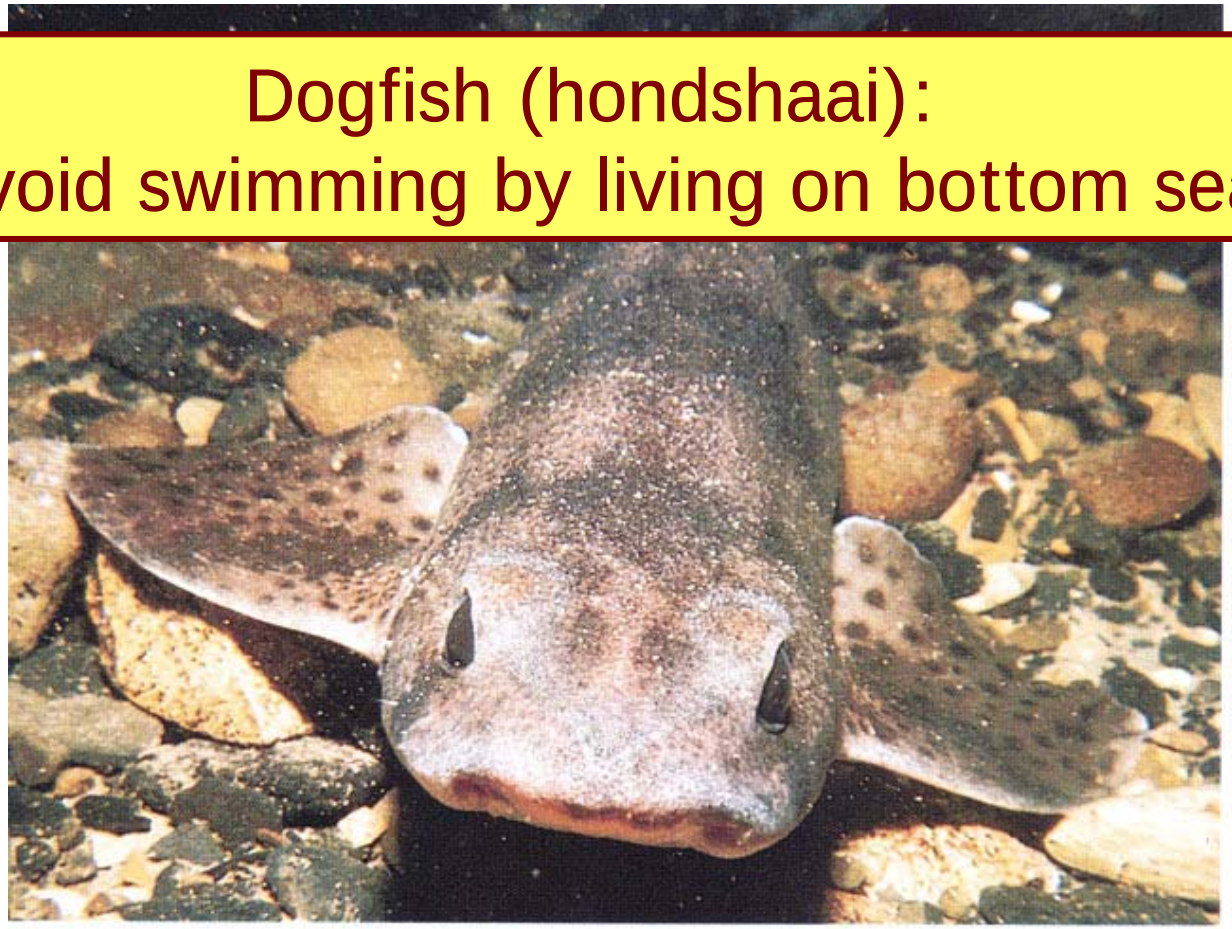
Shark

Swimming or sinking

Floating

Crawling

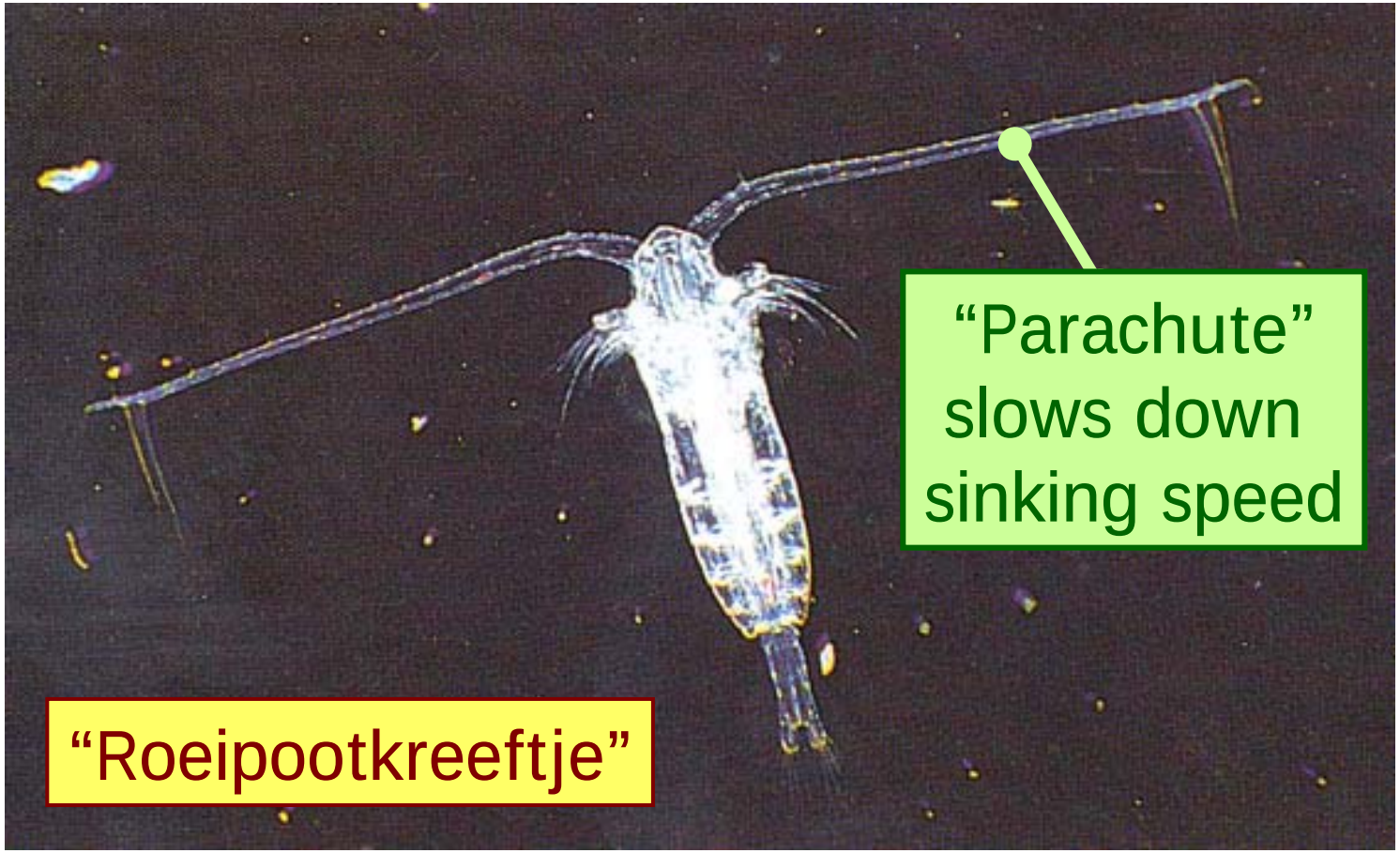
Dogfish (hondshaai):
avoid swimming by living on bottom sea



Swimming or sinking

Floating

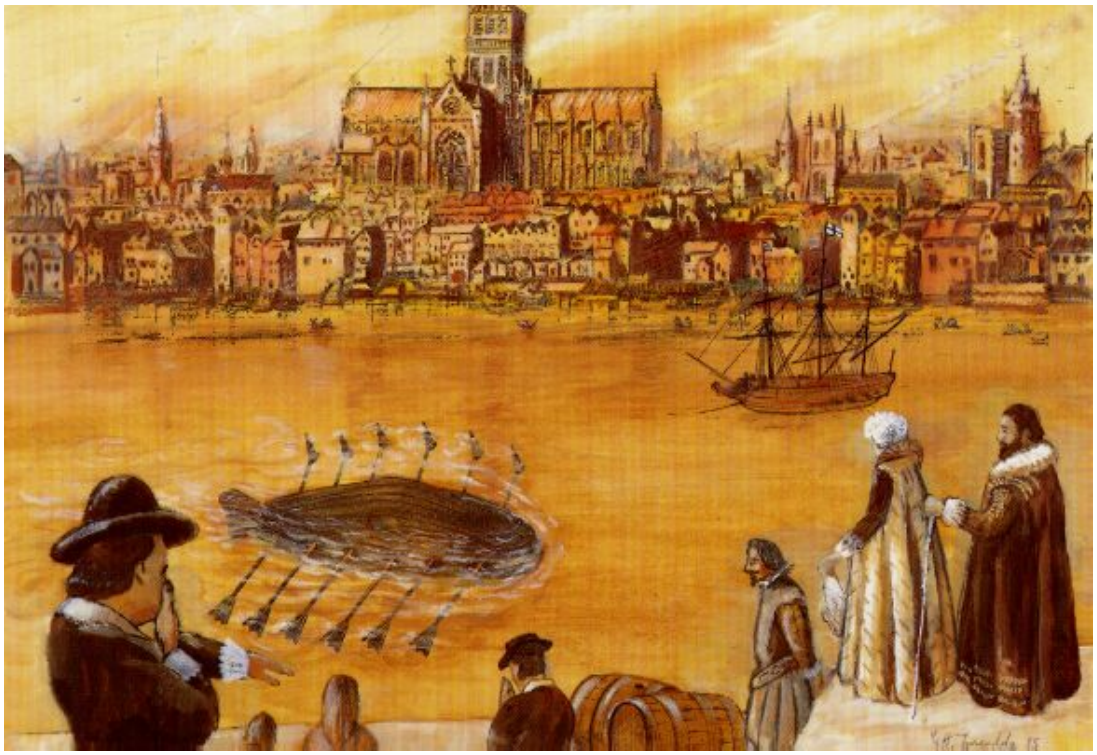
Crawling



Swimming or sinking

Floating

Crawling



Cornelis Drebbel, 1620: first submarine

Swimming or sinking

Floating

Crawling

Swimming or sinking

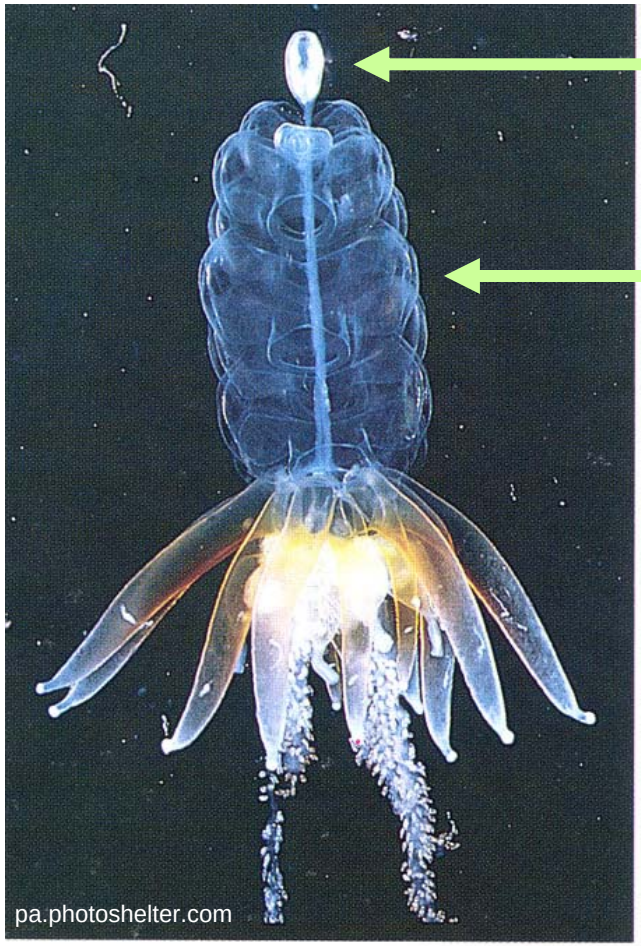
Floating

Crawling

http://www.expedition-engineering.com/main.php

TU Delft

Floating | Crawling



Gas Chamber

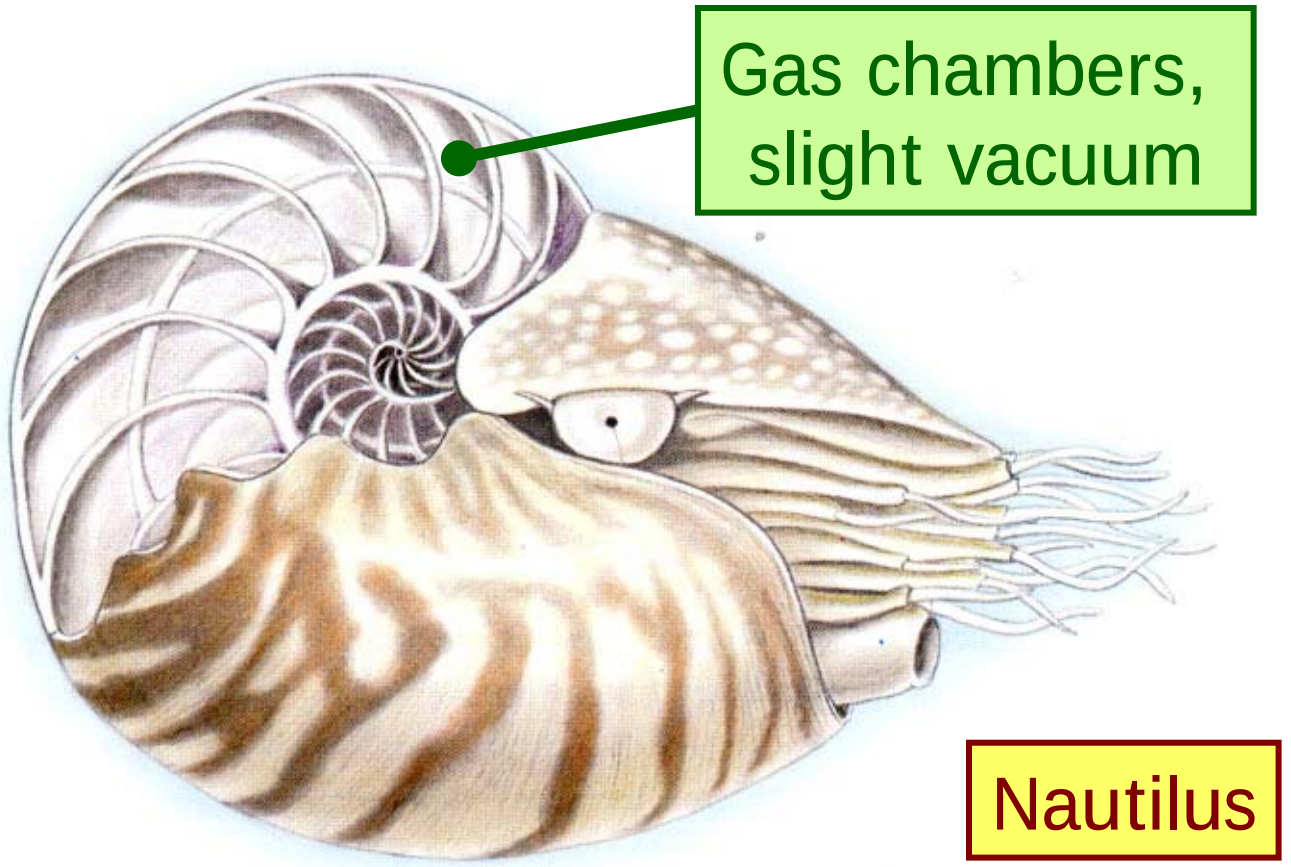
Jet Propulsion

“Staatkwal”

Using gas chambers to compensate weight

Floating

Crawling



Using gas chambers to compensate weight

Floating

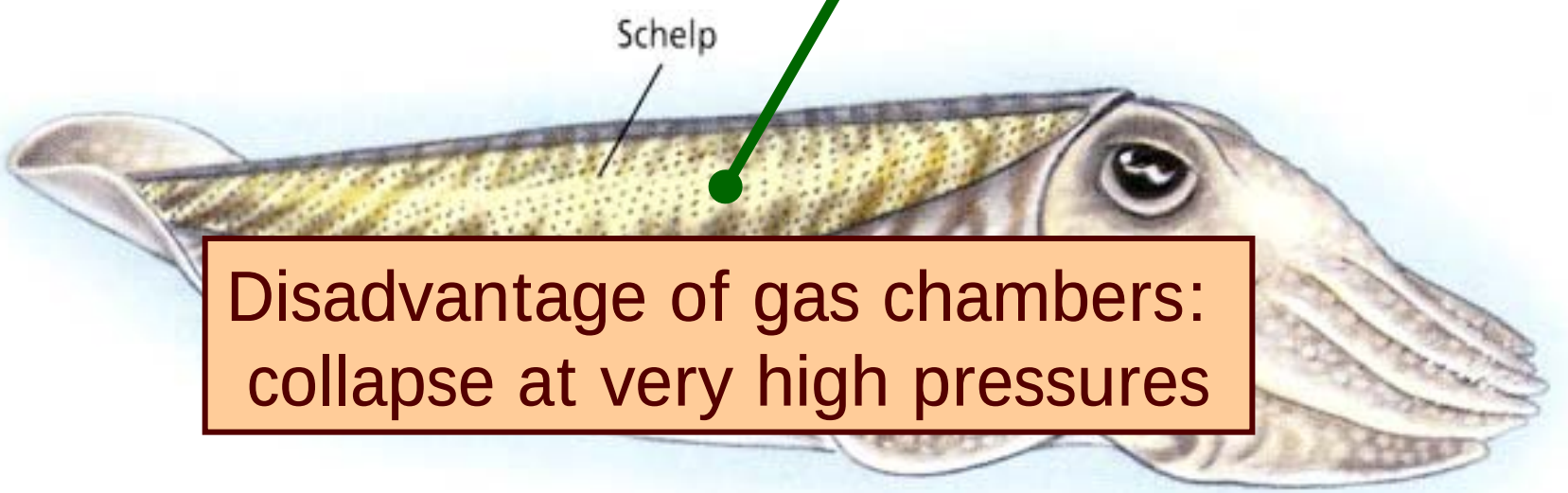
Crawling

Using gas chambers to compensate weight

Floating

Crawling

Foam: large amount of very small air chambers



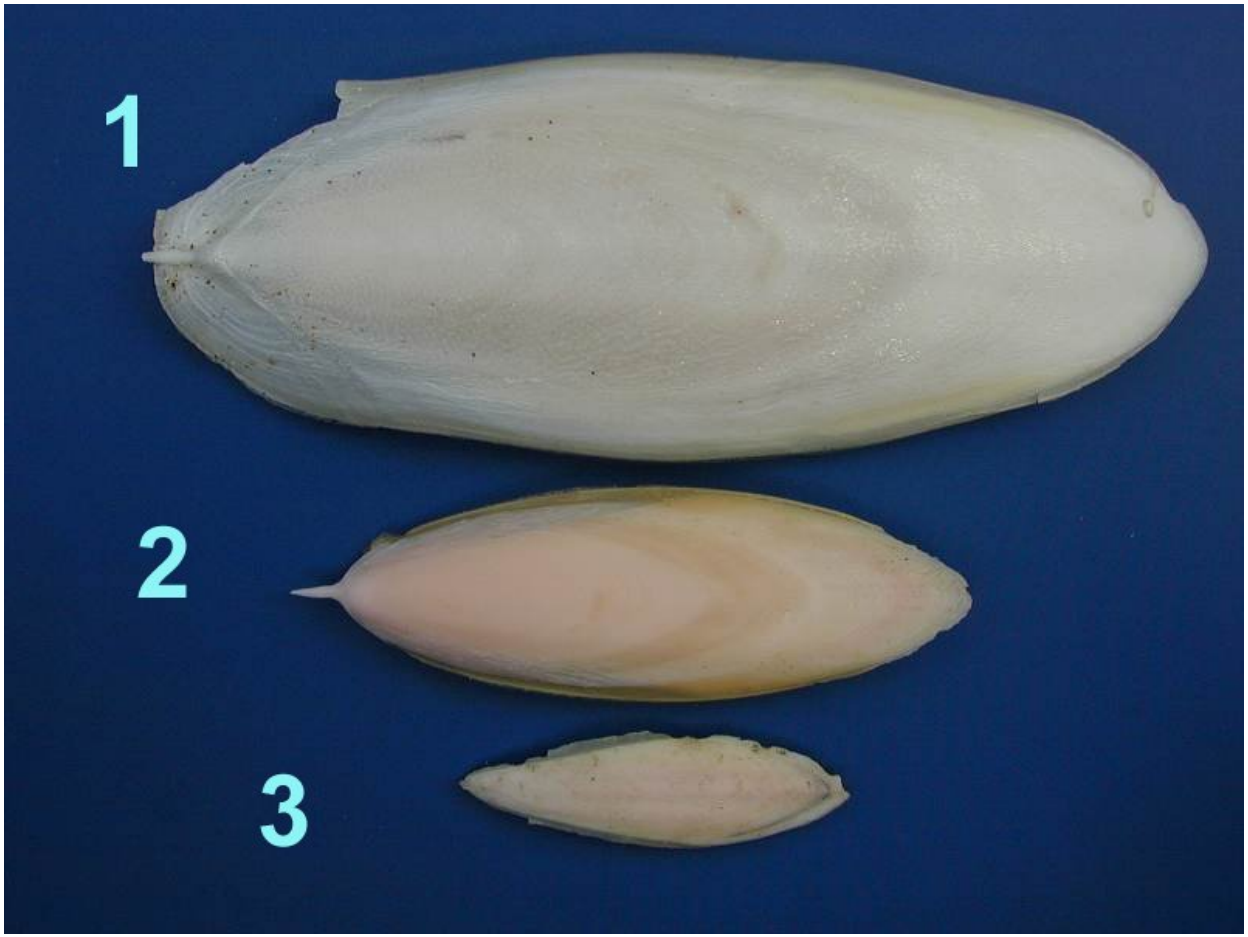
Disadvantage of gas chambers: collapse at very high pressures

Sepia (zeekat)

Using gas chambers to compensate weight

Floating

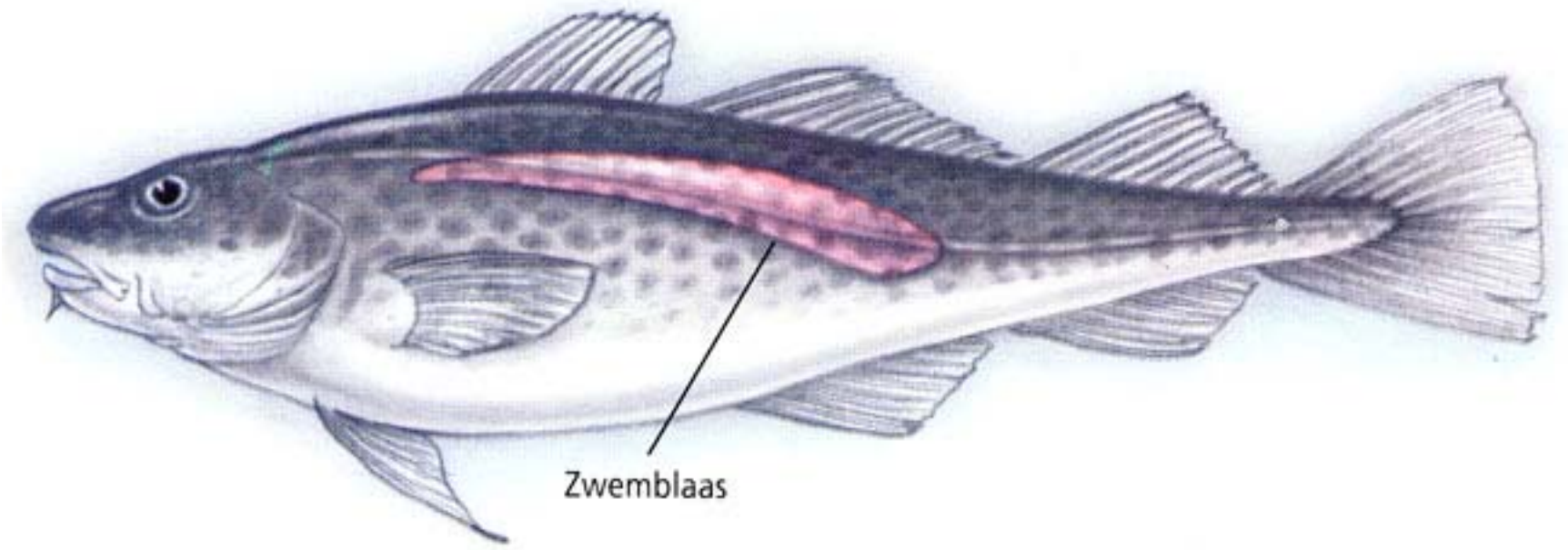
Crawling



Using gas chambers to compensate weight

Floating

Crawling



Using swimming bladder to compensate weight

Floating | Crawling

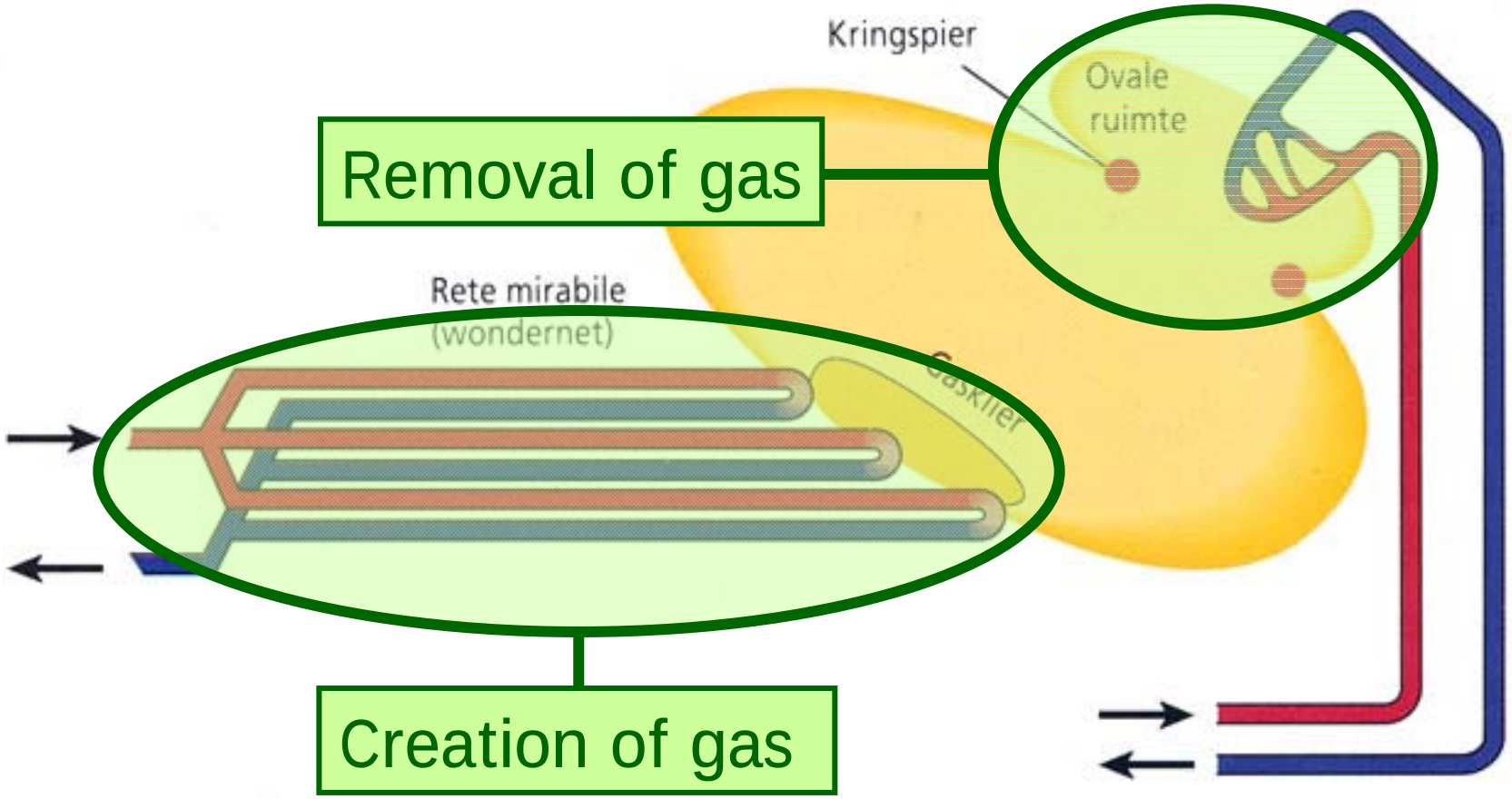
Swimming bladder is compressible:
Pre: No collapse at very high pressures
Con: Amount of gas needs to be controlled

No gas control gives unstable system:
> water pressure → bladder smaller → fish sinks more
< water pressure → bladder larger → fish rises more

Using swimming bladder to compensate weight

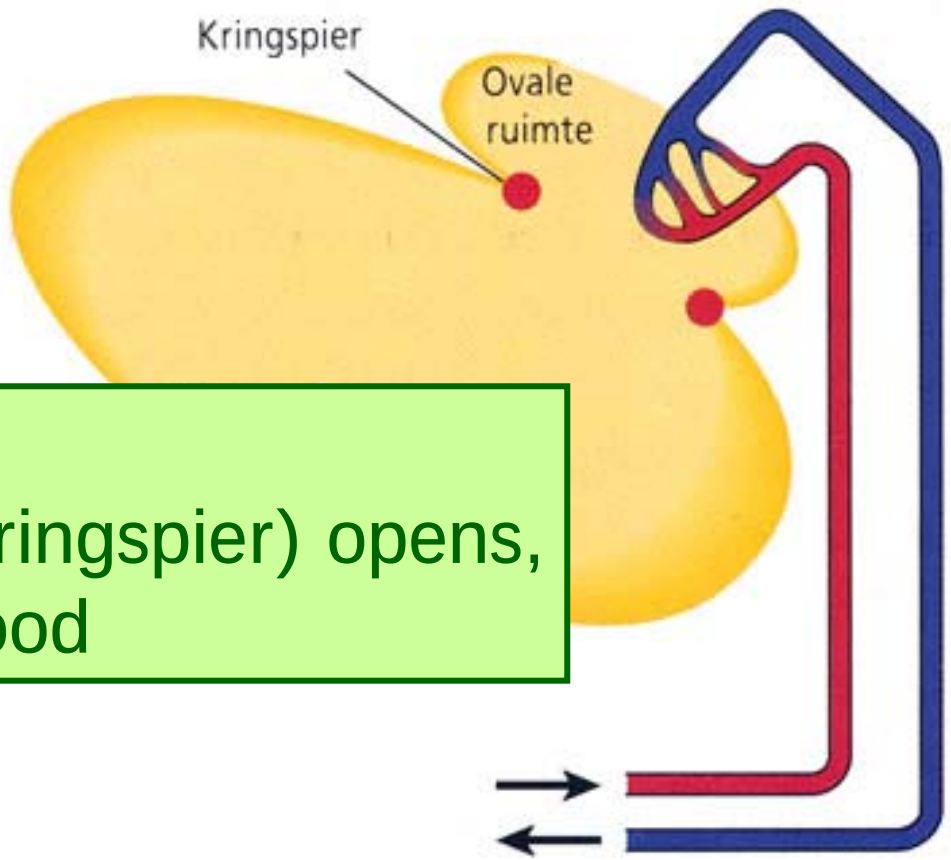
Floating

Crawling



Using swimming bladder to compensate weight

Floating | Crawling



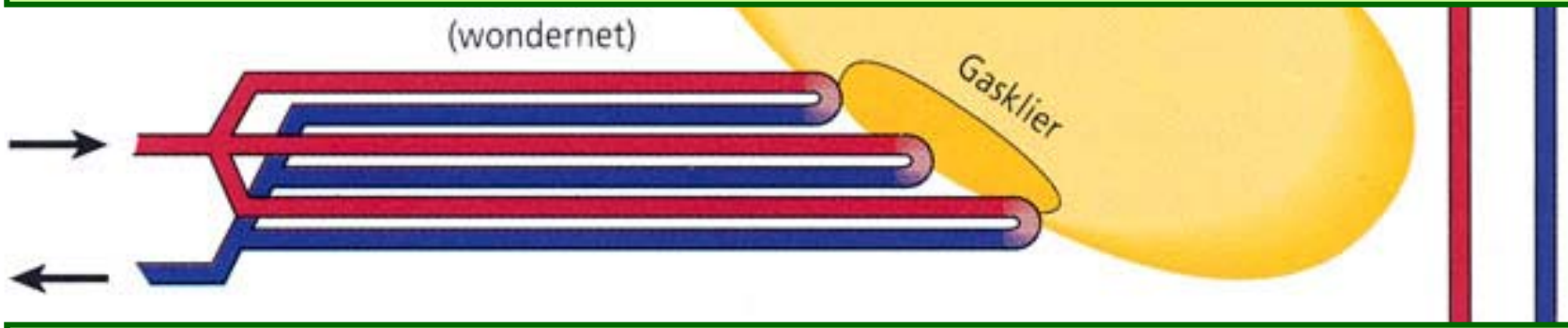
Removal of gas:
- Sphincter muscle (kringspier) opens,
- Gas diffuses into blood

Using swimming bladder to compensate weight

Floating | Crawling

Creation of gas:

- Gas gland (gasklier) creates gas in blood
- Gas accumulates via diffusion in Rete Mirabile (wondernet) till pressure > water pressure

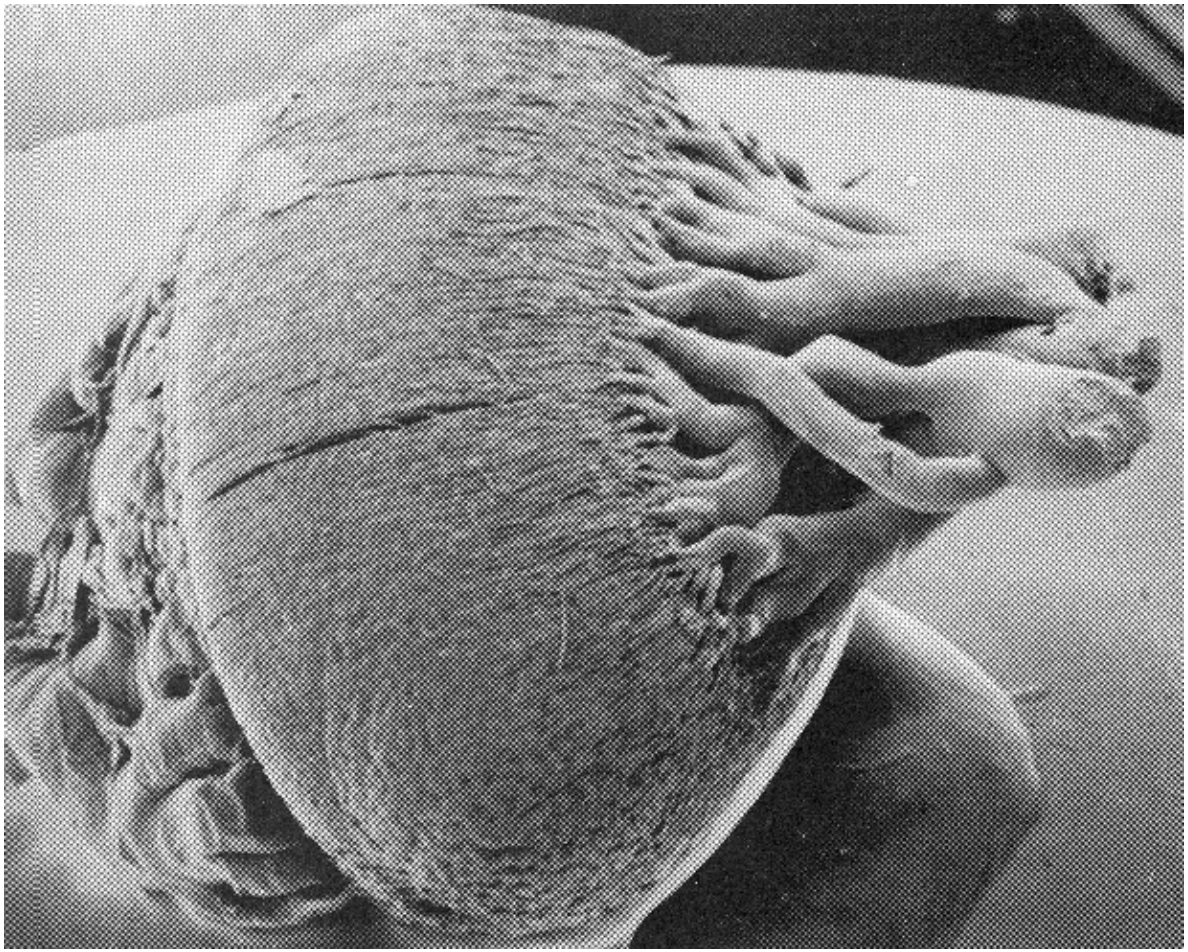


Rete Mirabile (wondernet): parallel arterial & venal hair vessels for maximum diffusion

Using swimming bladder to compensate weight

Floating

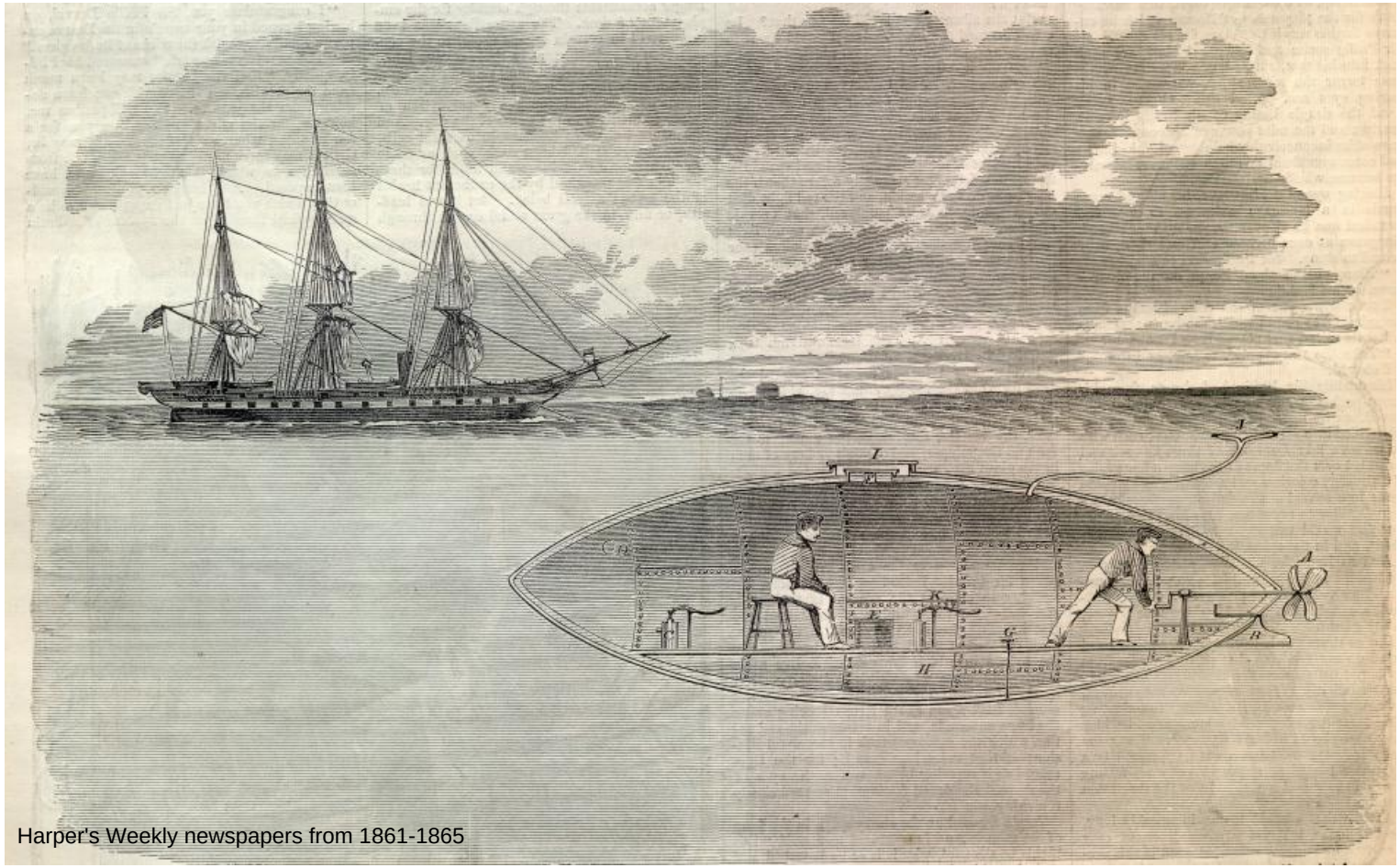
Crawling



Using swimming bladder to compensate weight

Floating

Crawling



Harper's Weekly newspapers from 1861-1865

Submarine

Floating

Crawling

Astute submarine - Royal US Navy

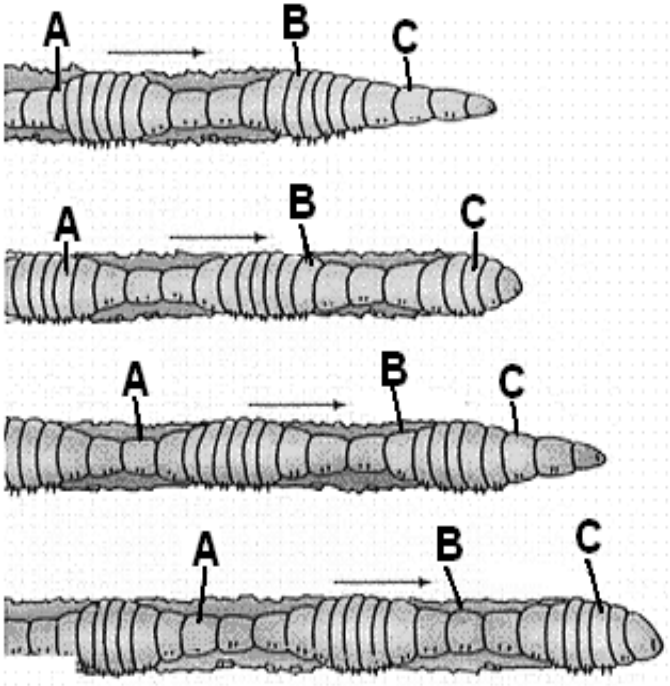
Submarine

Floating

Crawling

Floating

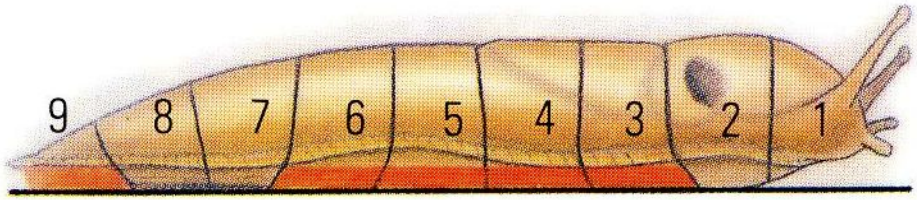
Crawling

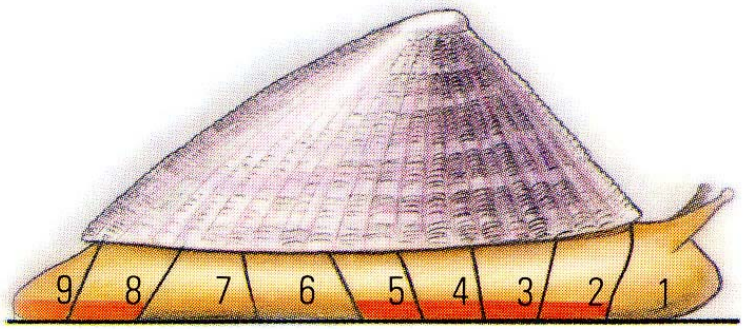


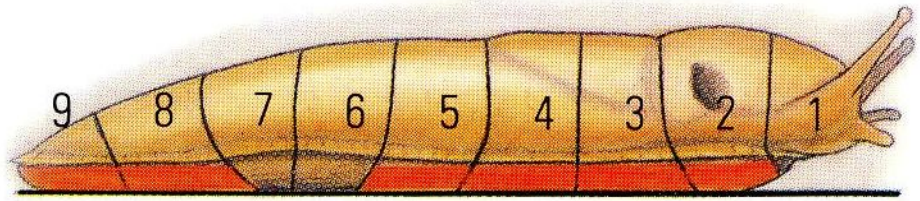
Longitudinal Wave (Earthworm, body)

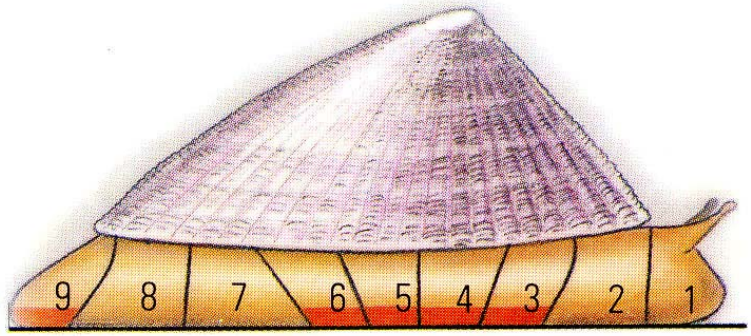
Floating

Crawling









Longitudinal Wave (Snail, body)

Floating

Crawling

Longitudinal Wave (Milipede, legs)

Floating

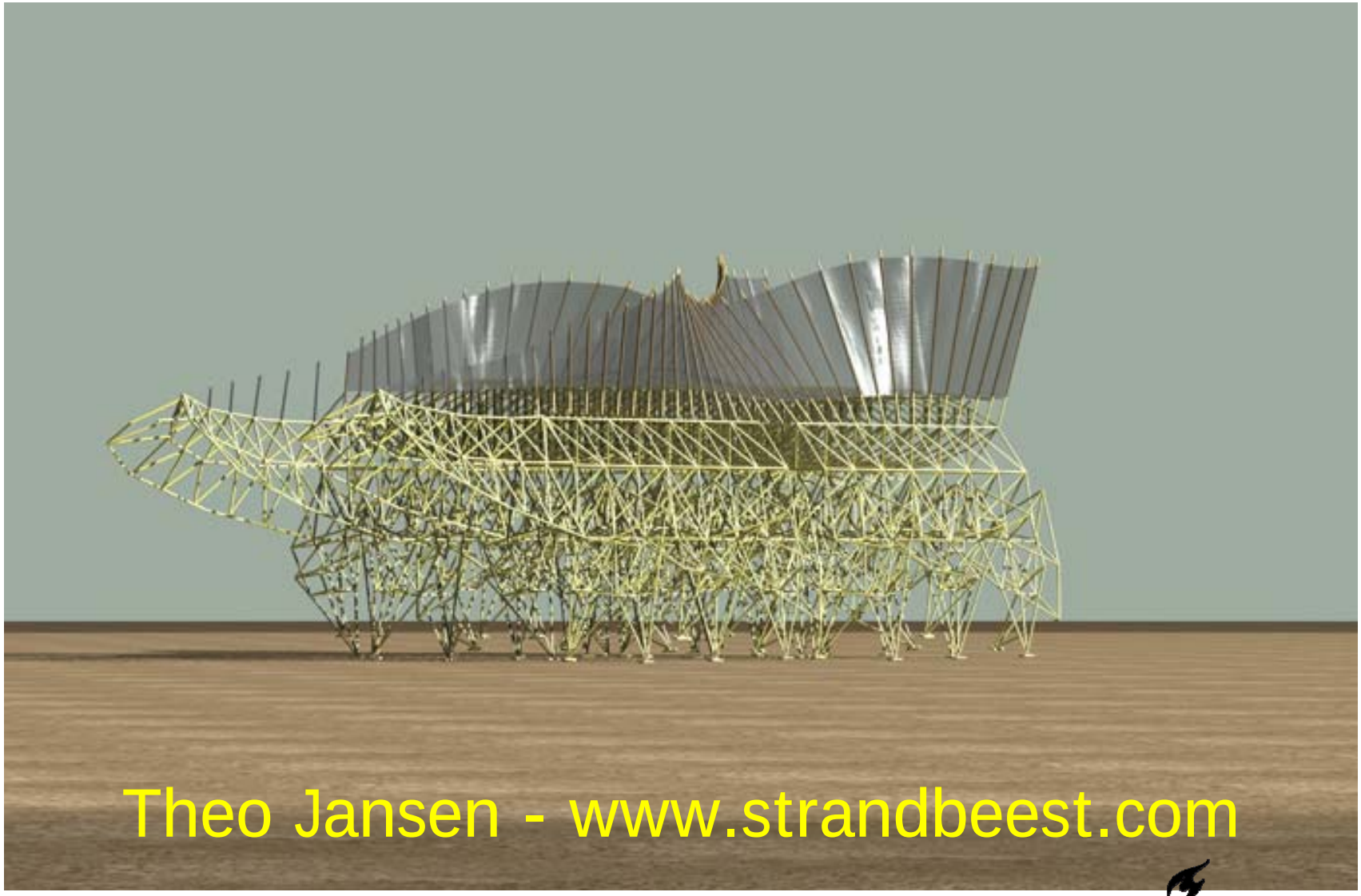
Crawling

Toyota Engineering Society (TES) Festival 2004

Milipede Device

Floating

Crawling



Floating

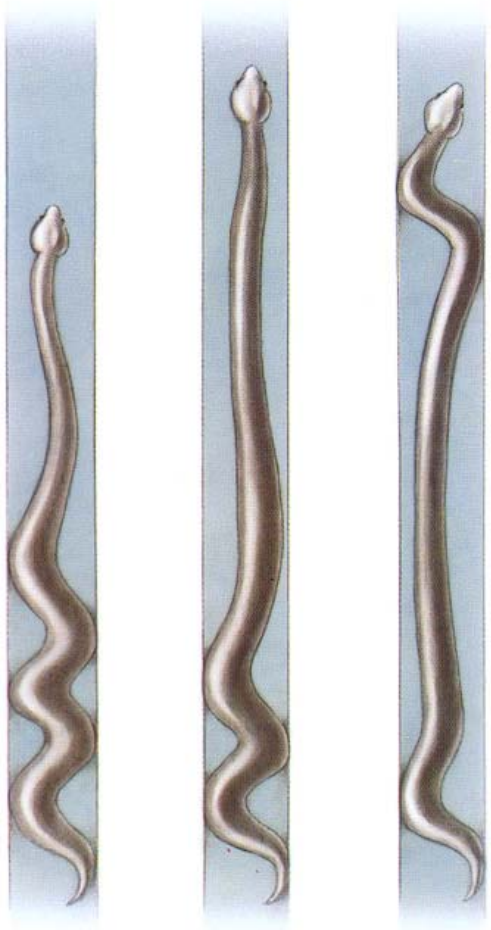
Crawling

A snake has 3 methods of locomotion..

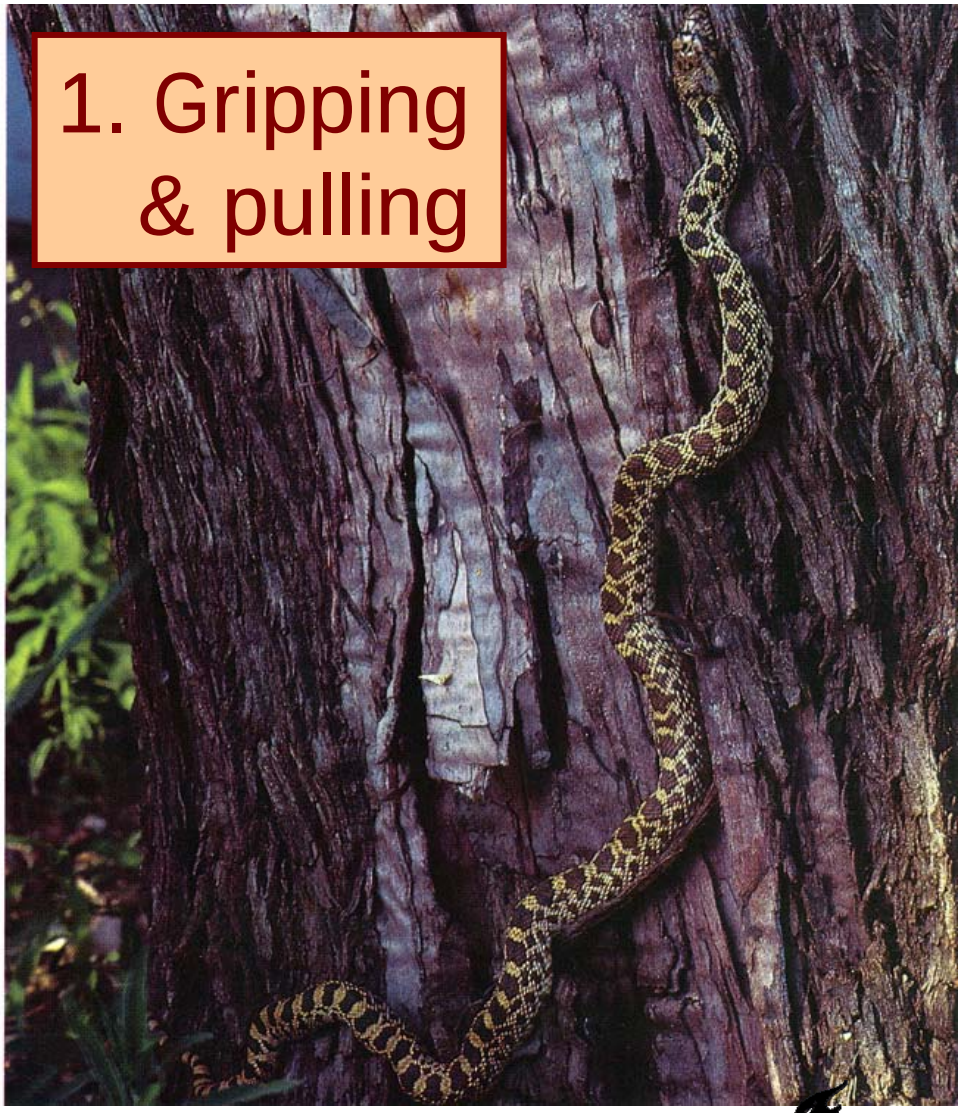
Transversal Wave (Snake, body)

Floating

Crawling



1. Gripping & pulling



Floating

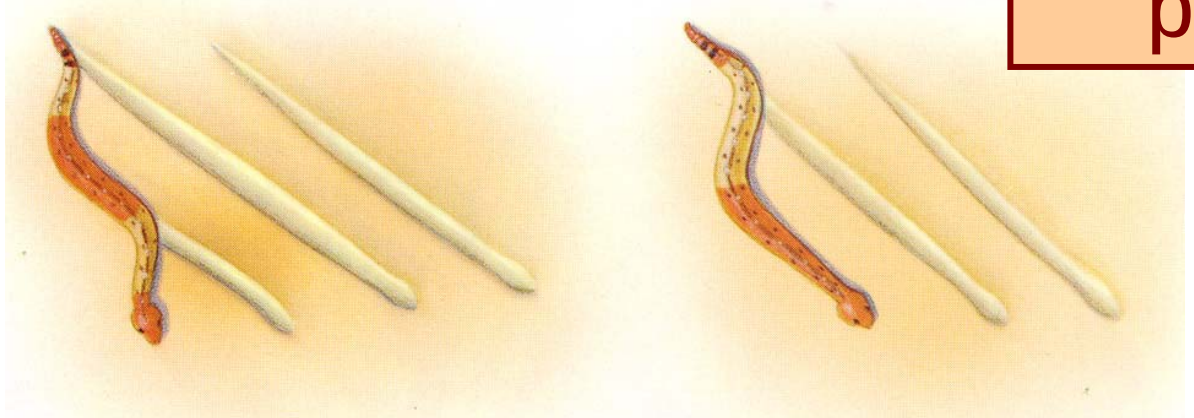
Crawling

2. Memorizing & shifting shape backward

Floating

Crawling

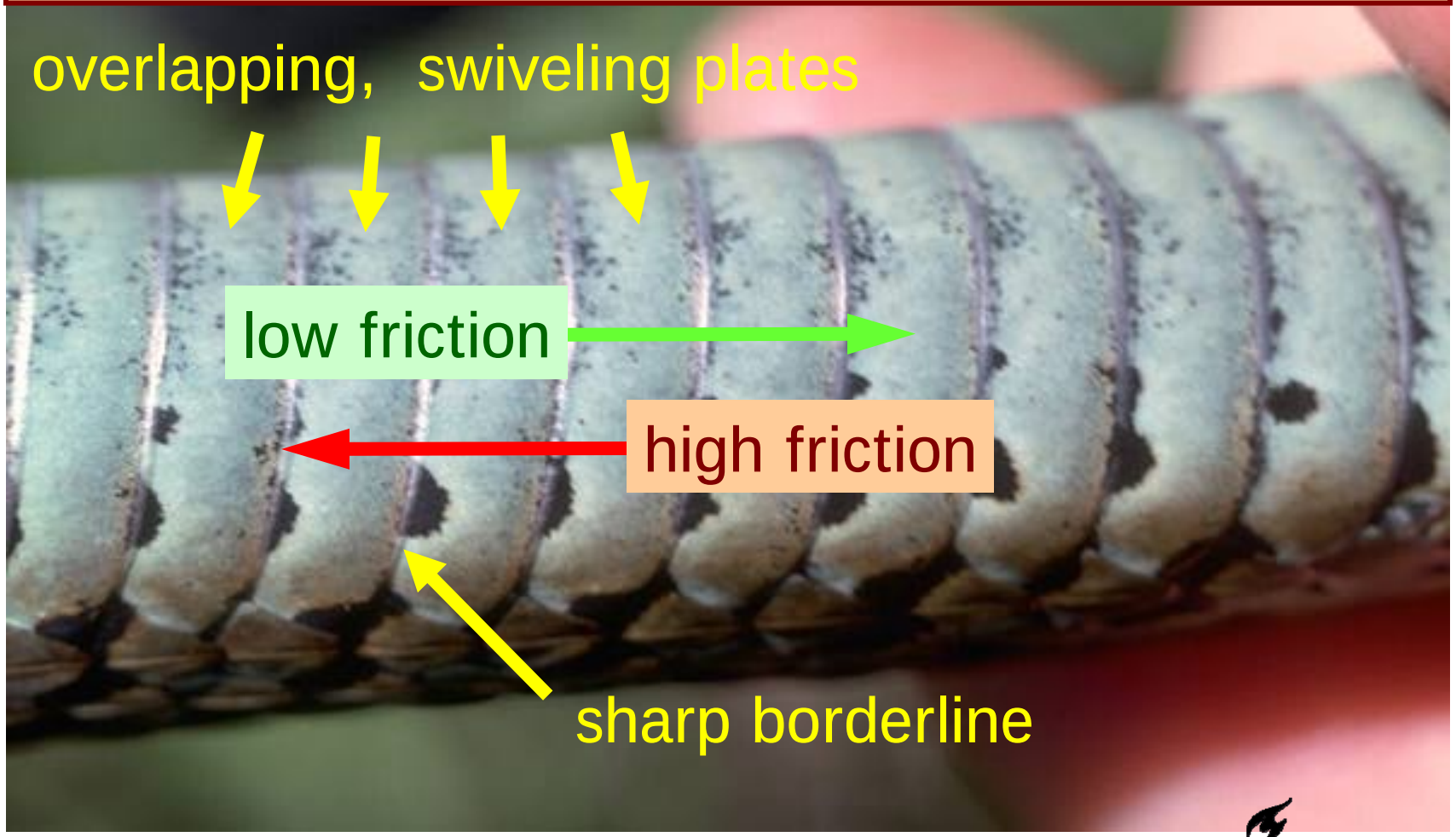
3. Idem + lifting parts of body



TU Delft

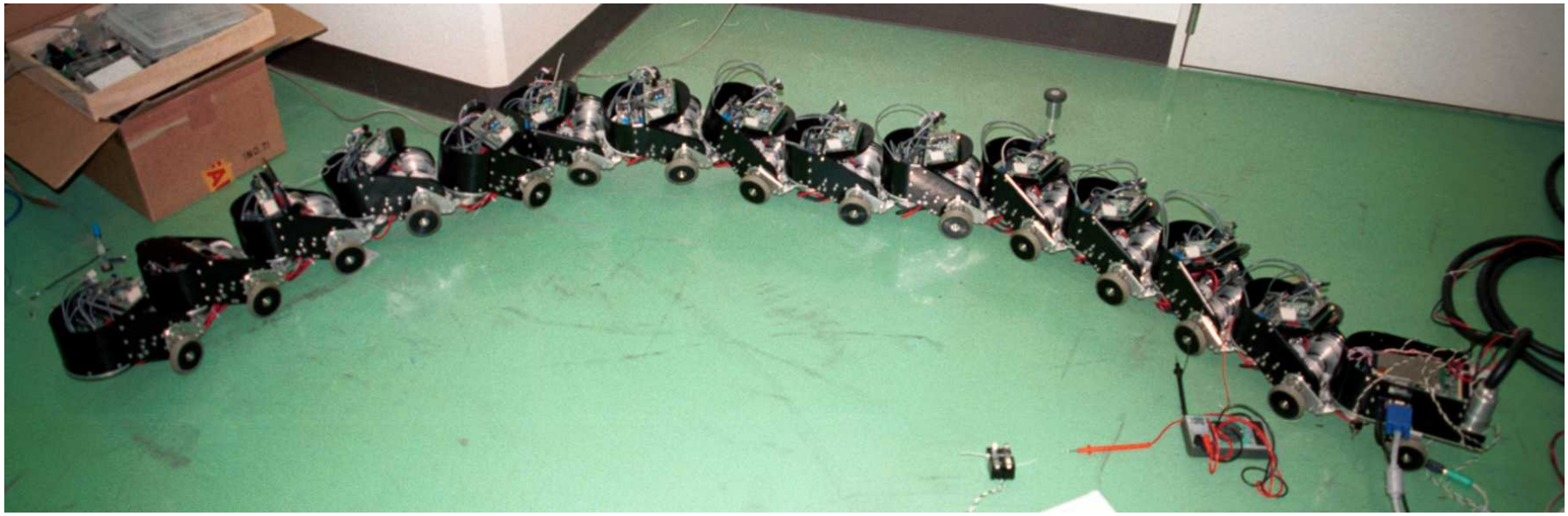
Floating | Crawling

Snake bottom: direction-dependent friction



Floating

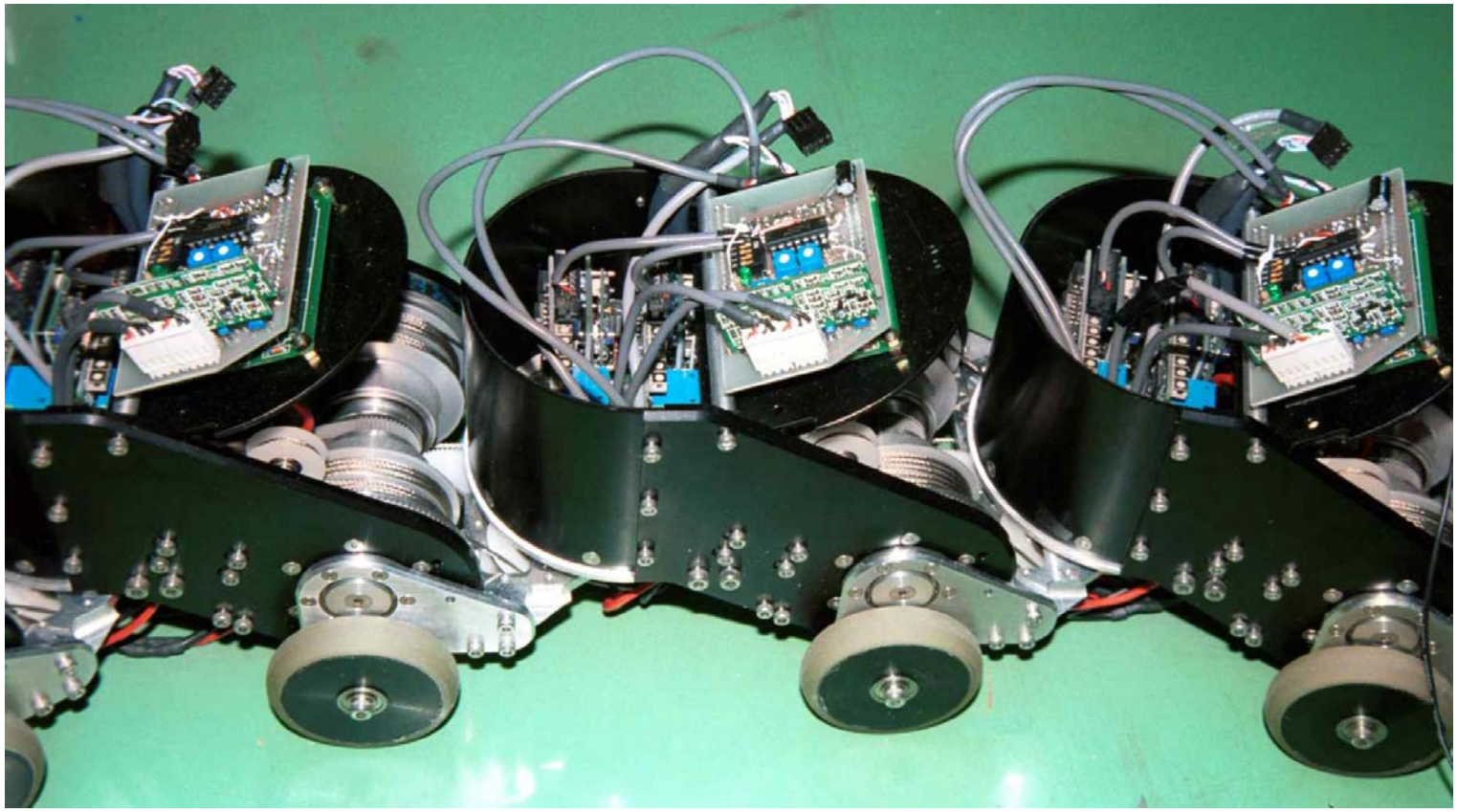
Crawling



Locomotion method 2 (in 2D) applied in snake robot (Hirose, Japan)

Floating

Crawling



Wheels are passive, angles between segments are actuated and fed back to previous segments

Floating

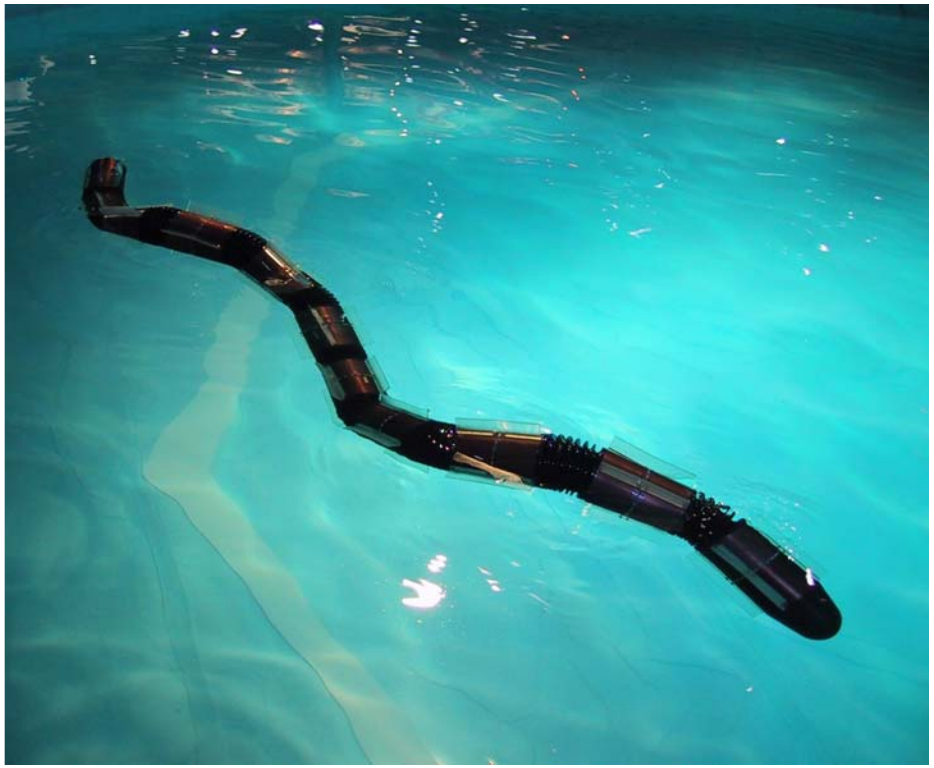
Crawling

Floating

Crawling

Floating

Crawling



Locomotion method 2 (in 3D) applied in swimming snake robot (Hirose, Japan)

Floating

Crawling

Floating

Crawling

Locomotion method 3 applied in snake robot (Hirose, Japan)

Floating

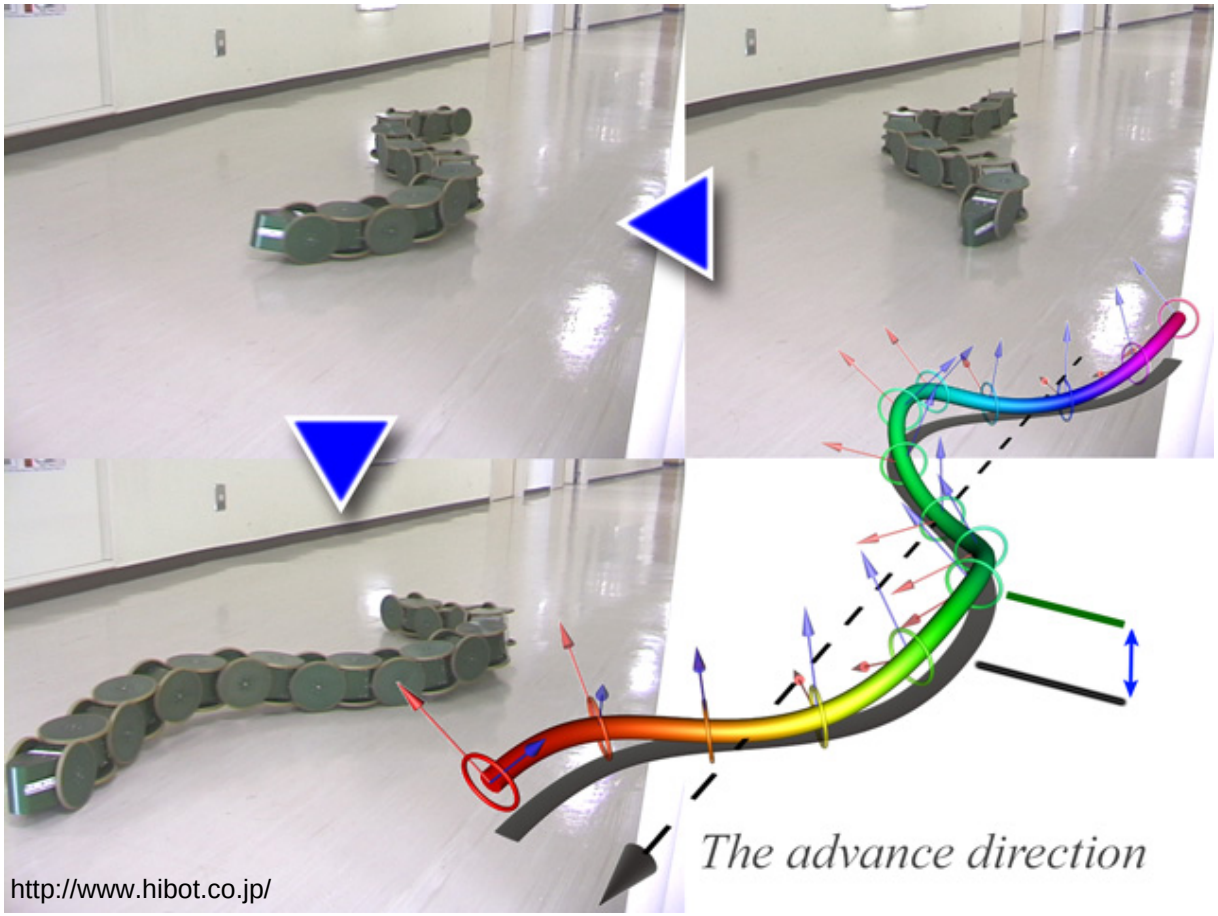
Crawling

Locomotion method 3 applied in snake robot (Hirose, Japan)

Passive wheels
Actuated angles

Floating

Crawling



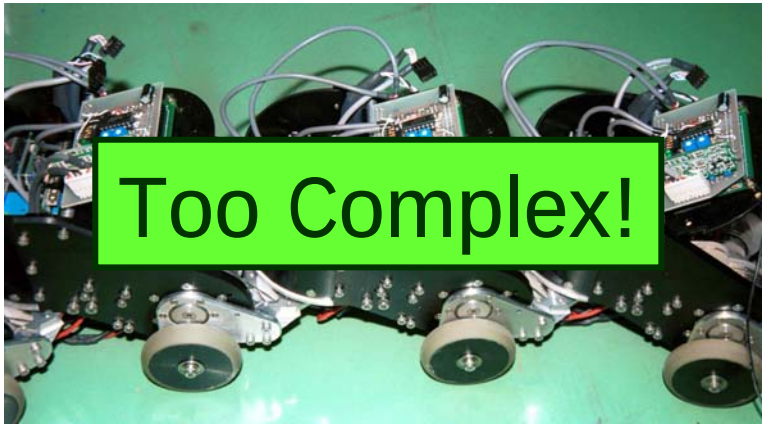
Locomotion (like snake in desert)

Floating

Crawling

http://visualsunlimited.photoshelter.com/image/I0000pWOFIcXzjDA

Strong reduction of forces on intestinal wall when pushing colonoscope forward

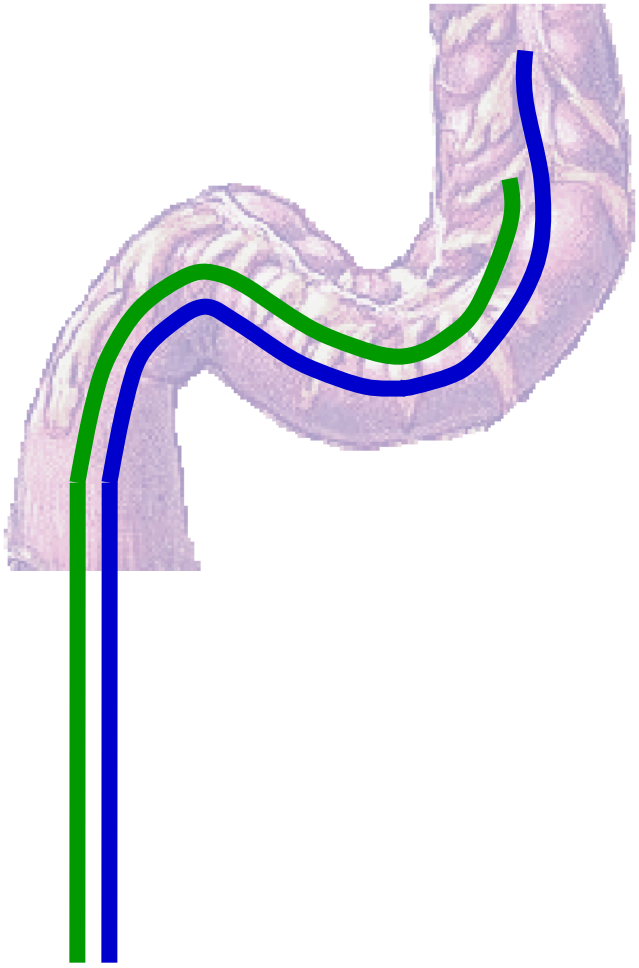


Locomotion method 2 (in 3D) applied in Shape Memory Colonoscope

Floating

Crawling

http://visualsunlimited.photoshelter.com/image/I0000pWOFIcXzjDA



Twin-Spine Shape Memory System

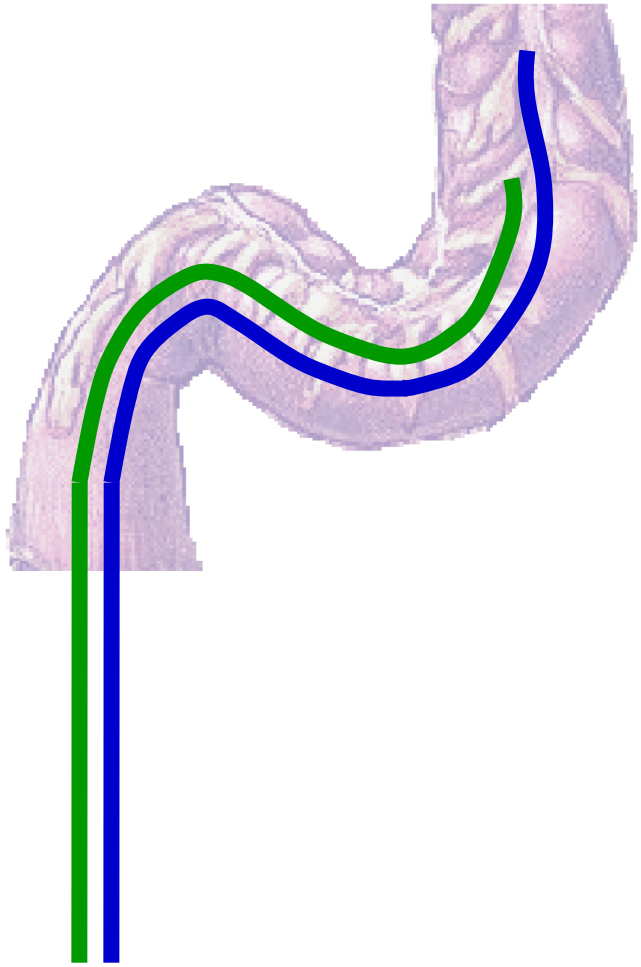
Floating

Crawling

Two spines that can be made rigid or flexible

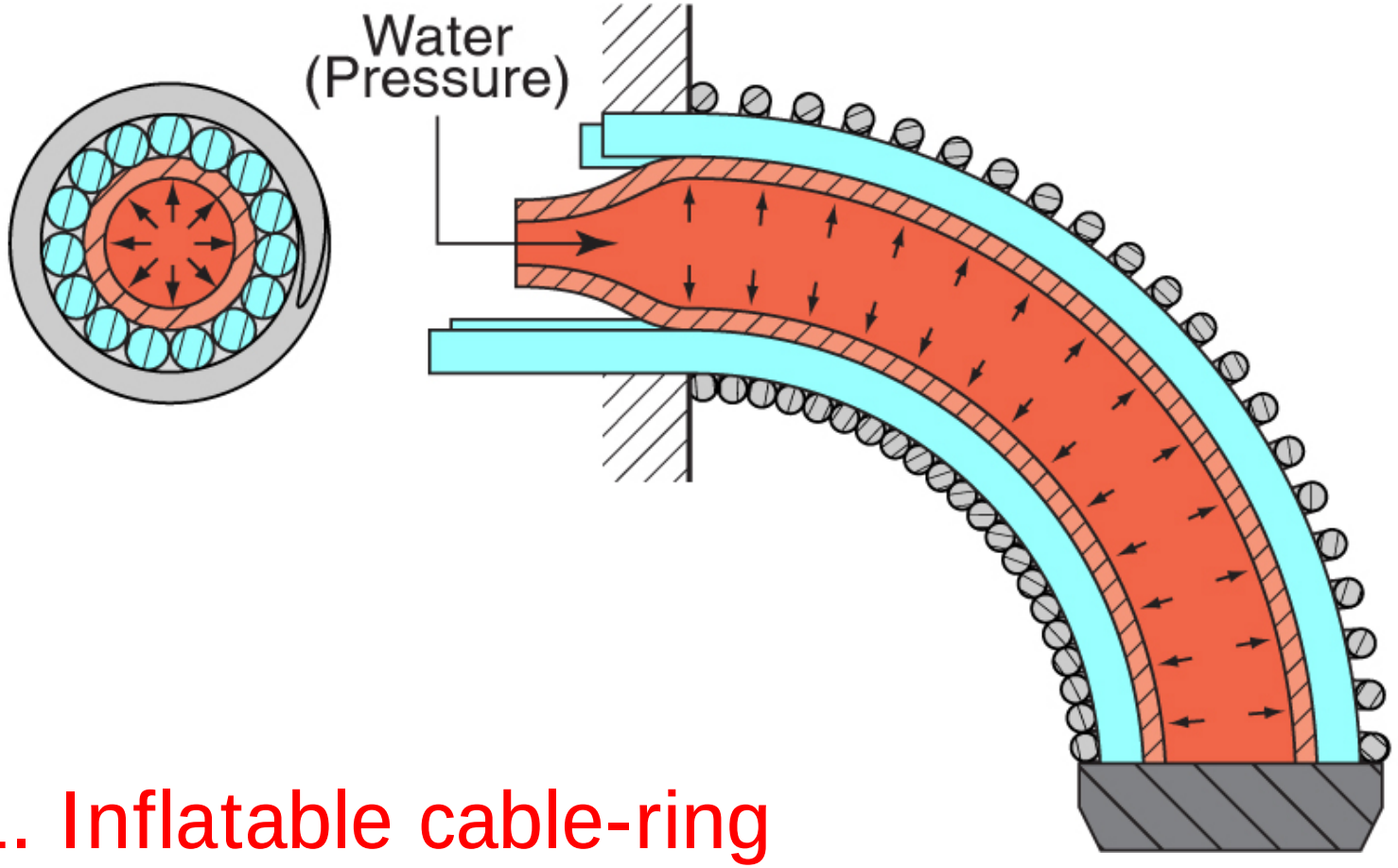
Rigid spine is shape memory for flexible spine

How to make a flexible/rigid spine?



Floating

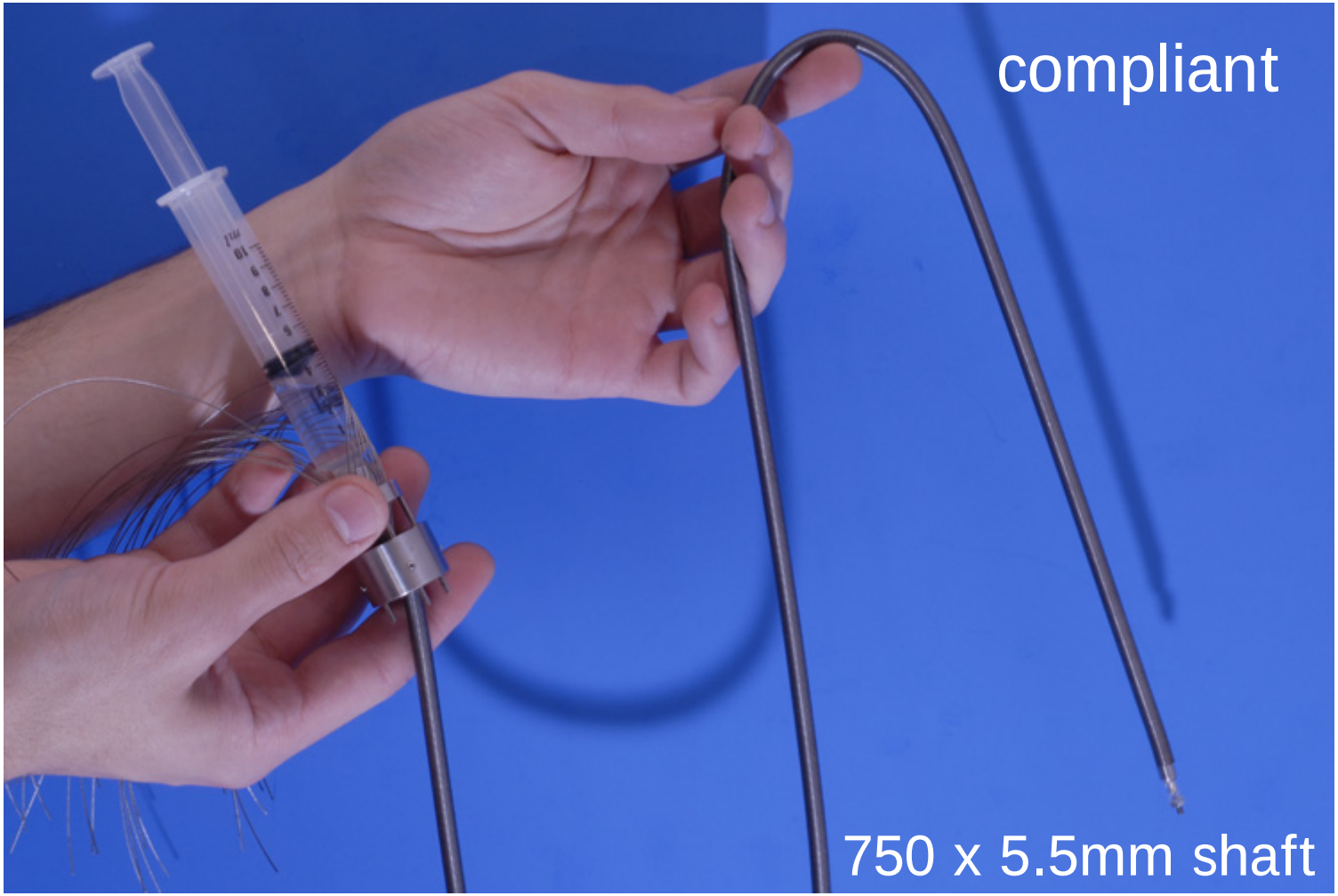
Crawling



1. Inflatable cable-ring (Arjo Loeve)

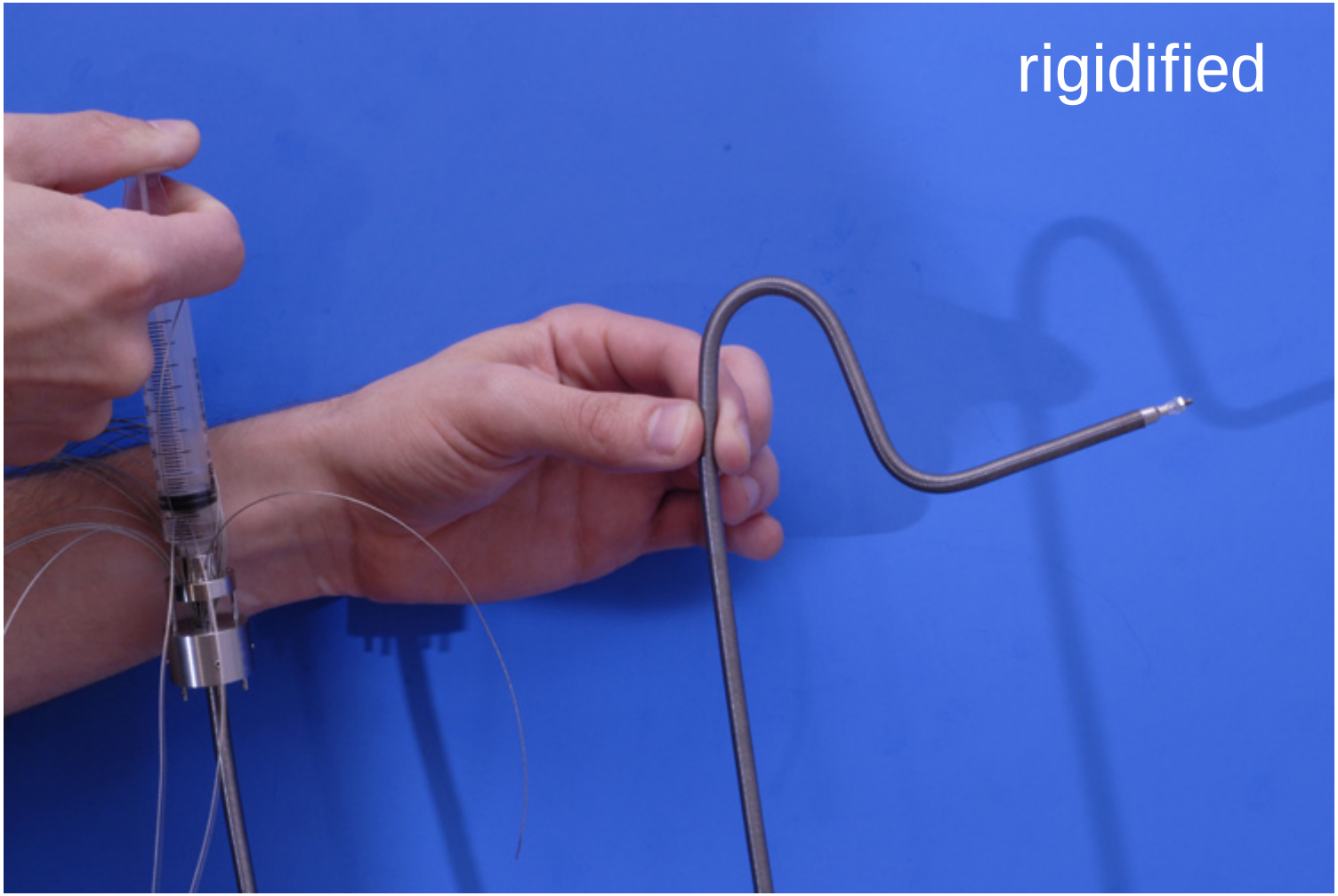
Floating

Crawling

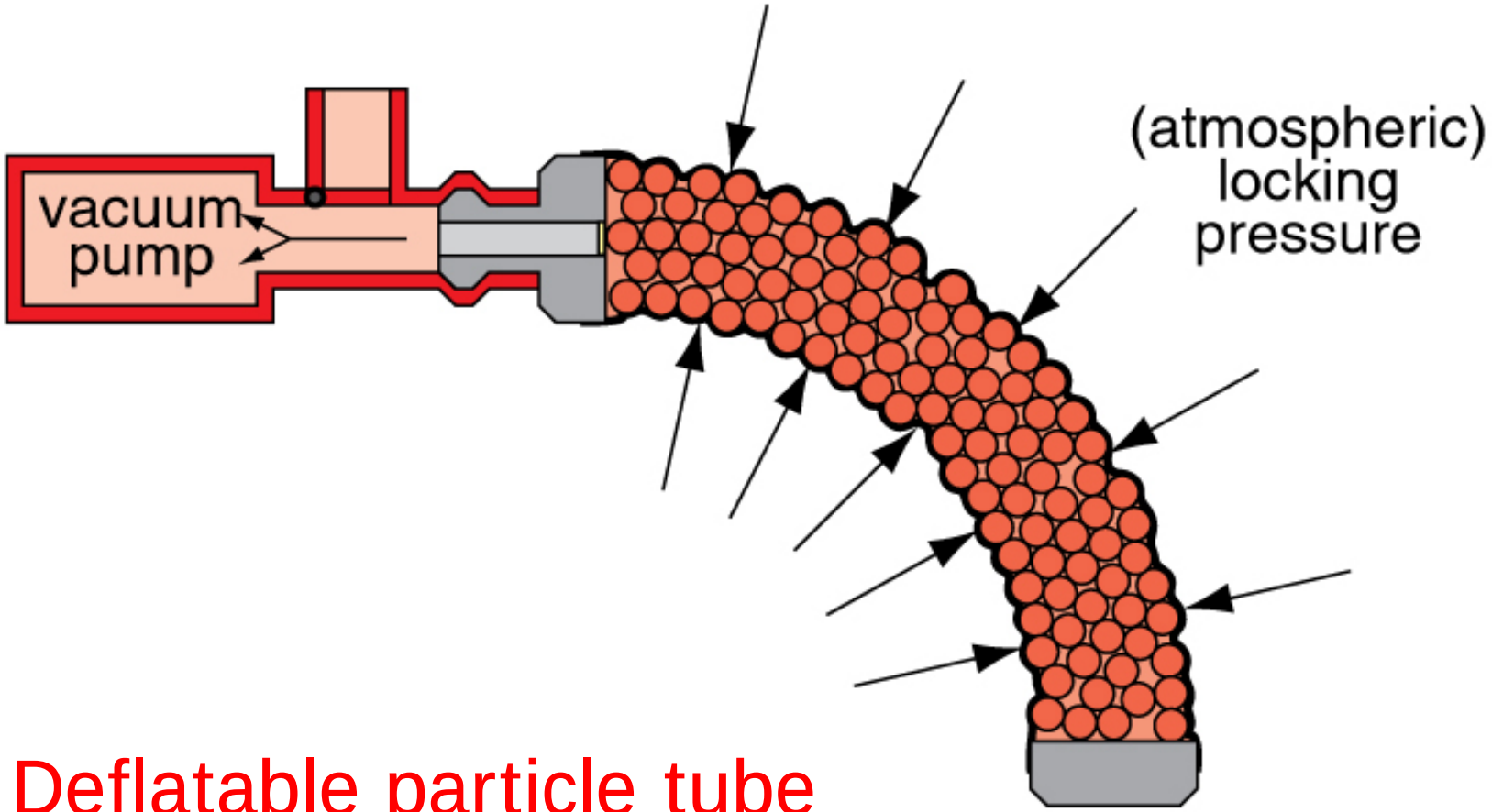


Floating

Crawling



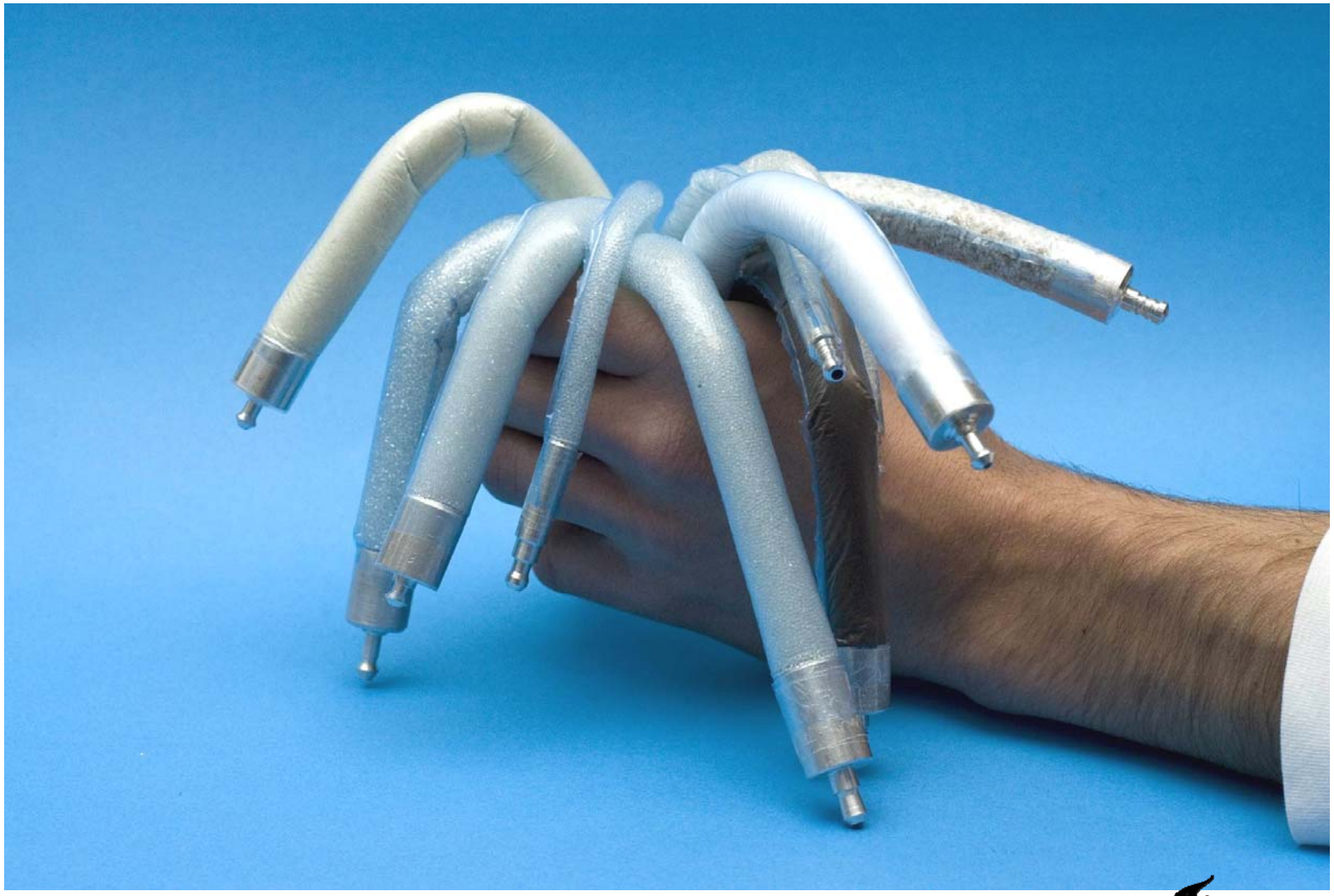
Floating | Crawling



2. Deflatable particle tube (Arjo Loeve)

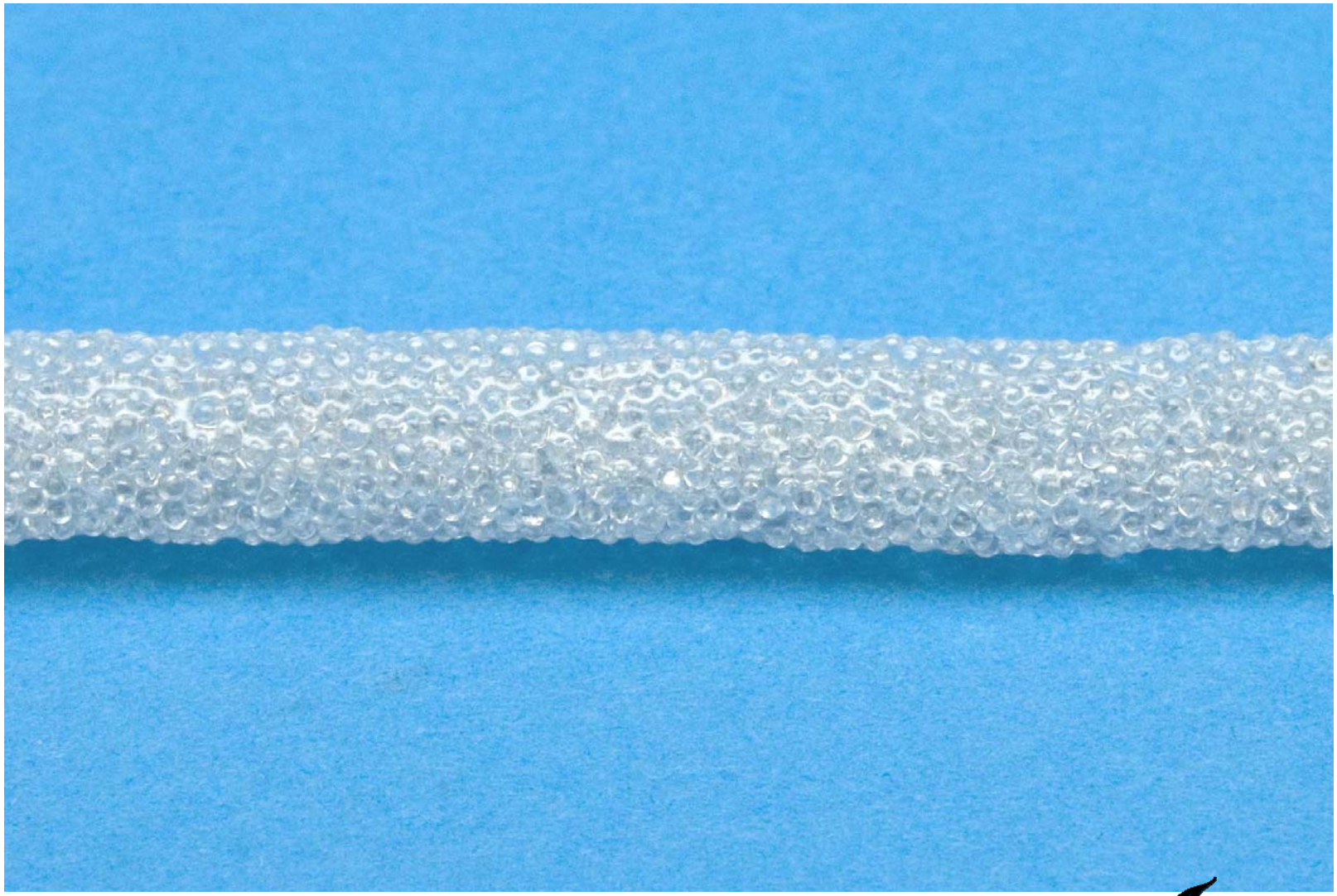
Floating

Crawling



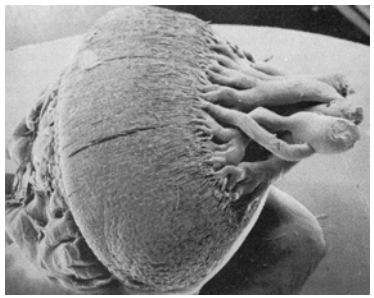
Floating

Crawling



Floating

By swiming
By using gas chambers
By using a swimming bladder



Crawling

Longitudinal wave
Transversal wave
Snake motion:
1. Gripping & Pulling
2. Memorizing & shifting shape backward (Twin Spine System)
3. Idem + lifting parts of body

Direction dependent friction