Allometry

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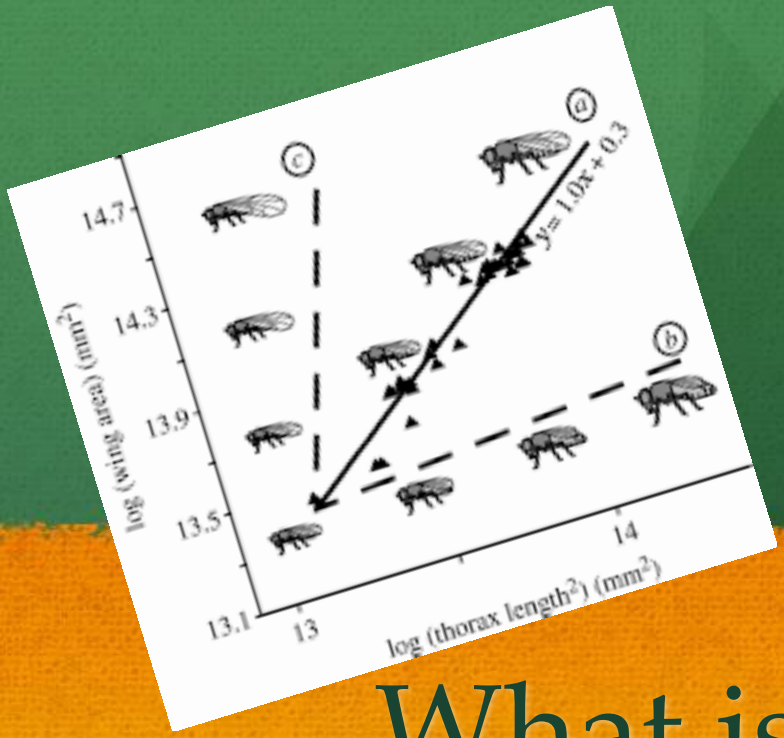
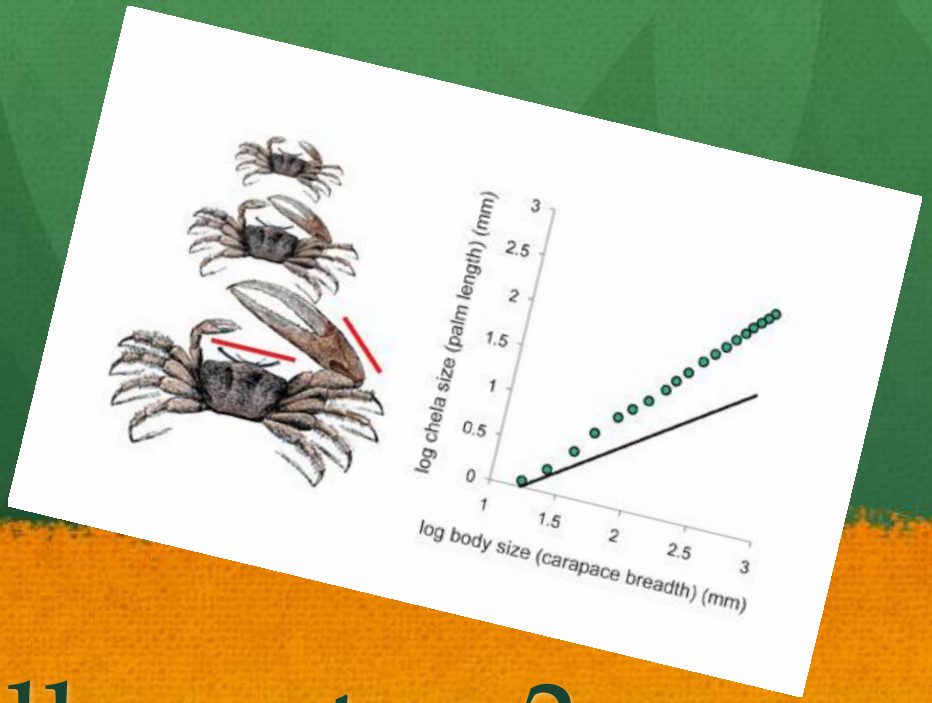
5th IYNT 2017
Nanjing, China

Problem

How do length and thickness of bones scale with overall size of animal ?

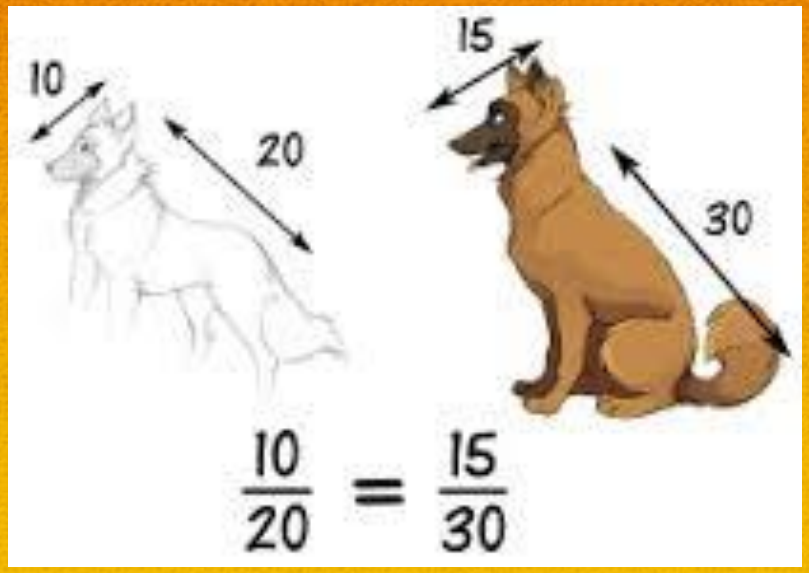


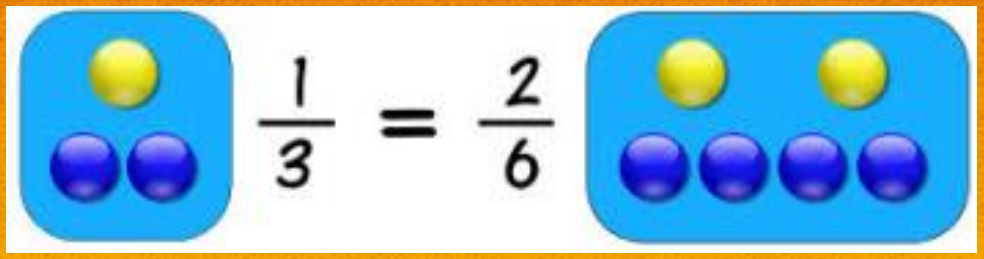


What is Allometry ?

A study about the growth of body parts at different rates, resulting in a change of body proportions.

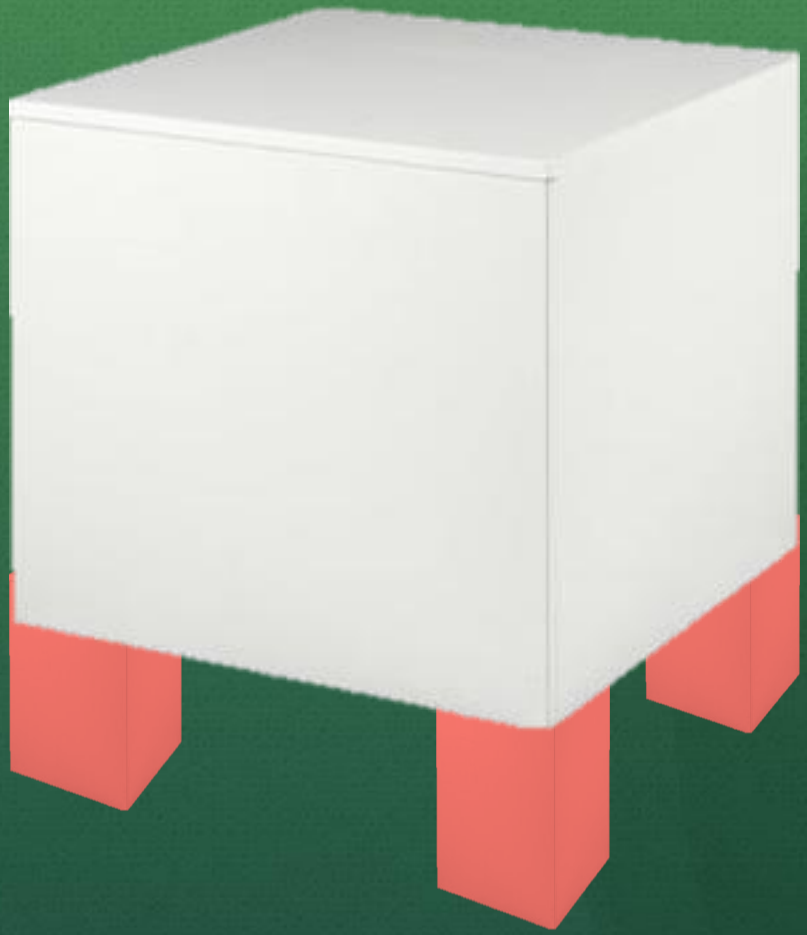
Proportions



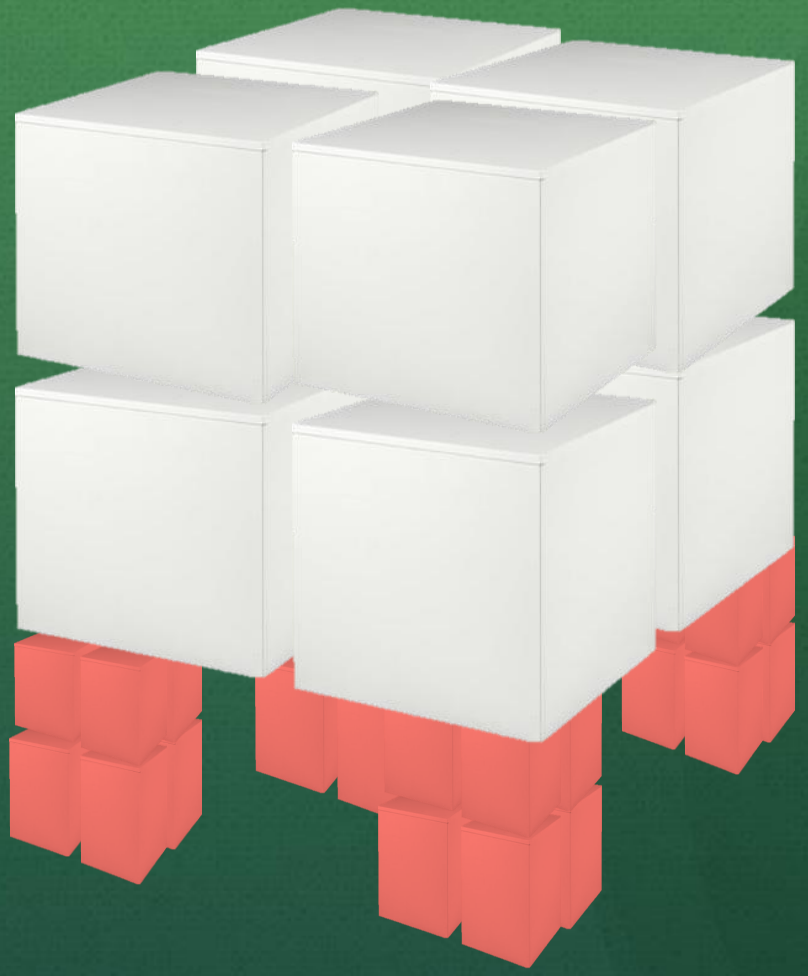


$$\frac{2}{3} = \frac{4}{6} \qquad \frac{5}{15} = \frac{1}{3}$$

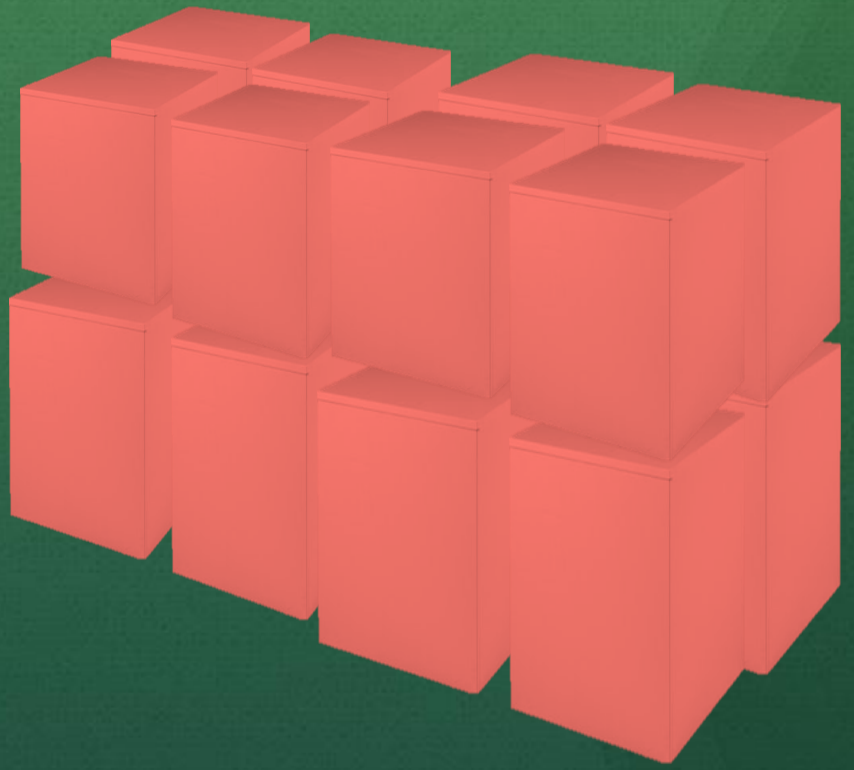
Proportions



Proportions

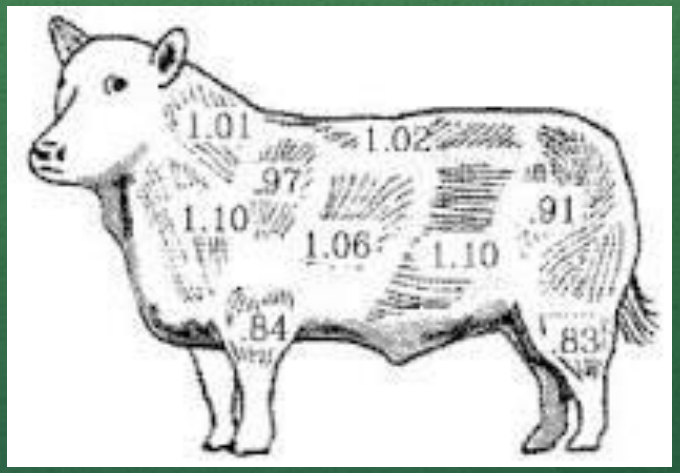


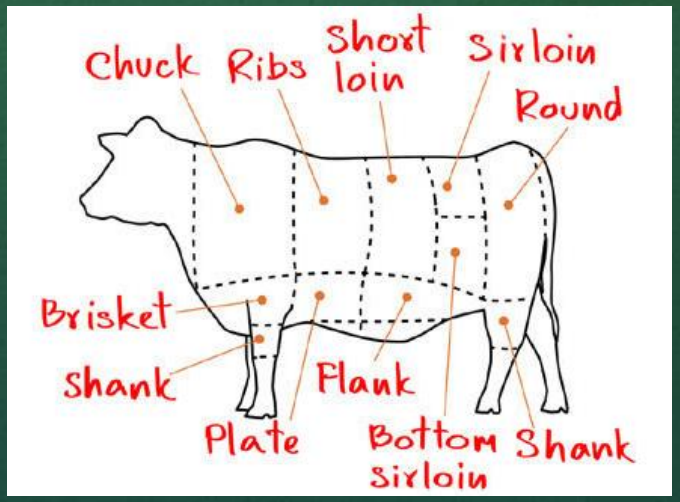
Proportions



What Is Allometric Growth ?

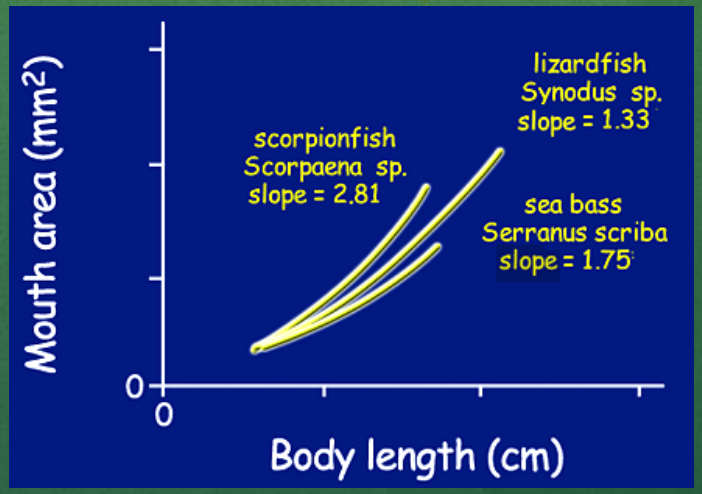
- Pattern of growth
- Y=bx^a
- Y = mass of an organ
- X = mass of the organism
- a = slope
- b = a constant

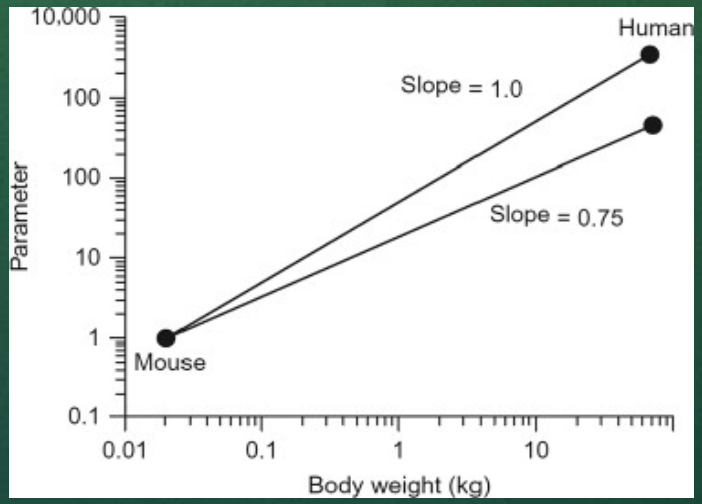




What Is Allometric Scaling ?

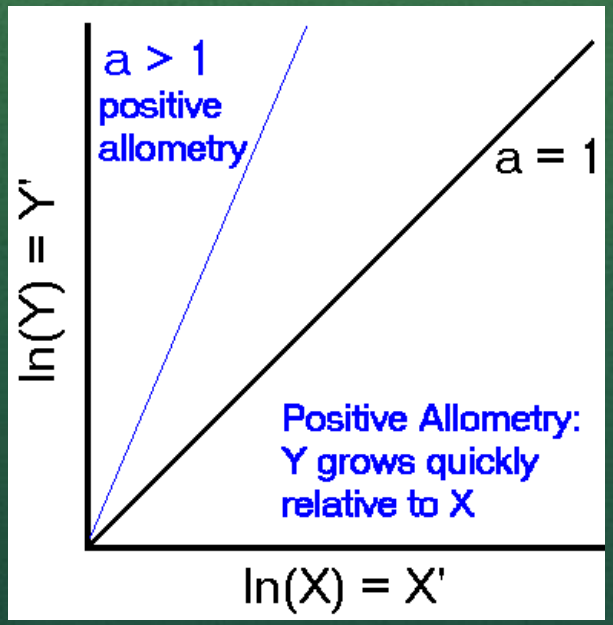
- Y=aM^b
- log y=log a + b*log m
- Y = biological variable
- M = measure of a body size
- b = scaling exponent
- Presented in logarithmic



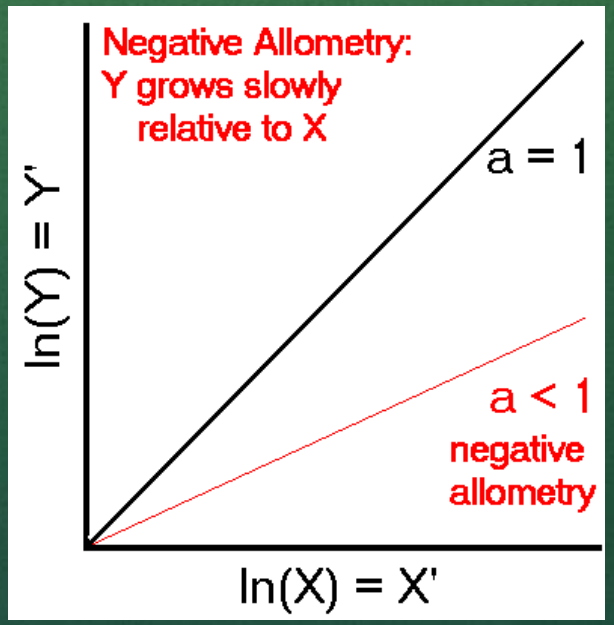


Kinds of Allometry (1)

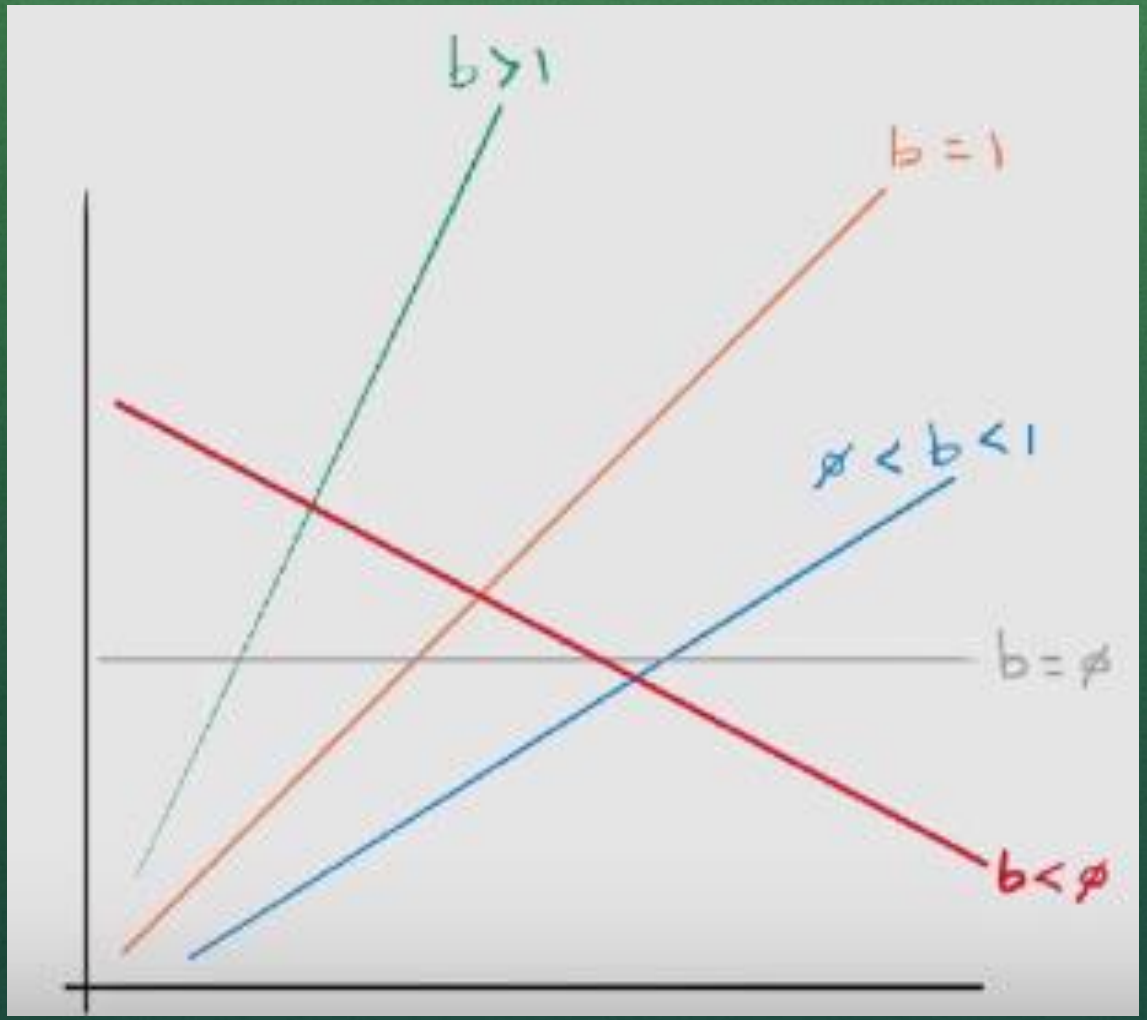
Positive Allometry



Negative Allometry



Kinds of Allometry (2)

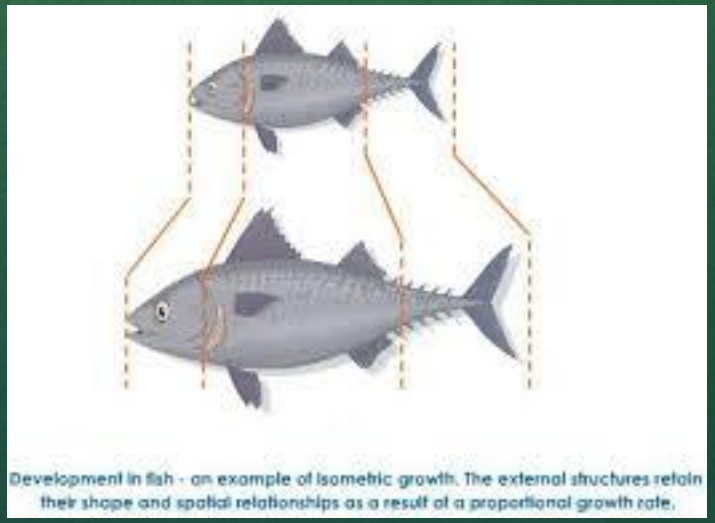


Independence

Inverse Allometry

Isometric Growth

- Opposite of Allometric growth
- Animal's body parts grow at the same rate
- Unchange proportions


Development in fish - an example of isometric growth. The external structures retain their shape and spatial relationships as a result of a proportional growth rate.

Relationship Between Thickness of an ANIMAL Bone to the Overall Mass

Elephant

Mouse

MY Experiment

- To test the relationship between height and weight of human to the overall surface area
- Variable tested :

1. Height (Independent)
2. Weight (Independent)
3. Surface area (Dependent)

Relationship Between Height and Weight of Human to the Overall Surface Area

No.	Height (cm)	Weight (kg)	Surface Area (m2)
1	158	34	1.51
2	155	42	1.81
3	146	45	1.81
4	154	39	1.67
5	156	61	2.66
6	168	59	2.75
7	177	51	2.51
8	162	68	3.06
9	158	53	2.34

No.	Height (cm)	Weight (kg)	Surface Area
10	147	42	1.72
11	160	43	1.93
12	162	44	1.98
13	157	40	1.74
14	162	44	1.97
15	142	28	1.11
16	159	56	2.47
17	162	49	2.21
18	162	43	1.93
19	156	47	2.04
20	149	36	2.96
21	142	42	1.64
22	160	59	2.62
23	155	38	1.65
24	173	63	3.03

Average

Height (cm)	Weight (kg)	Surface Area (m2)
157.56	46.93	2.13

Variables

No.	Variables	Height (cm)	Weight (kg)	Surface Area (m2)
1.	The Tallest	177	51	2.51
2.	The Shortest	1. 142 2. 142	28 42	1.11 1.64
3.	The Heaviest	162	68	3.06
4.	The Lightest	142	28	1.11
5.	The Widest (Body Surface)	162	68	3.06
6.	The Smallest (Body Surface)	142	28	1.11

Conclusion (1)

- Allometry = change body proportions
- Allometric >< Isometric
- Proportions : 2 equal fractions
- Size ⬆ bone proportions ⬆
- Positive allometry >< Negative Allometry
- Isometry = Neutral = (b=1)
- Negative Allometry, Independence, And Inverse Allometry (b<0)
- Positive Allometry (b>1)

Conclusion (2)

- Height ↑ + Weight ↑ = Surface Area ↑
- Height ↓ + Weight ↓ = Surface Area ↓
- Height ↑ + Weight ↓ = Height ↓ + Weight ↑
- Allometric scaling equation :

1. Exponensial : Y=aM^b
2. Logarithmic : log y = log a + b*log m

- Allometric growth equation :

1. Y=bx^a

Sources

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