

Physiological ecology: Temperature and water



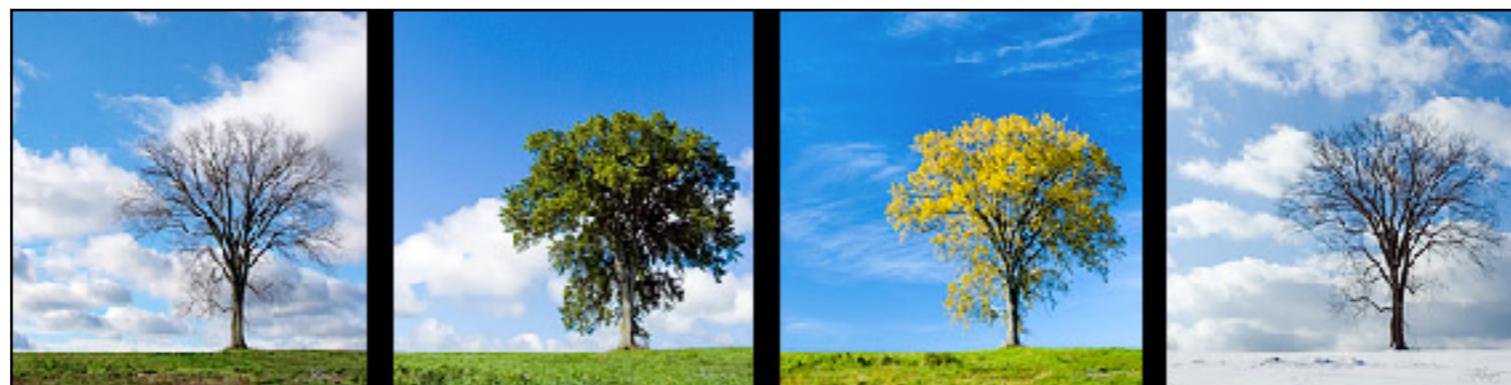
Lecture 2, BI271: Introduction to Ecology
Fall 2017

Environmental heterogeneity

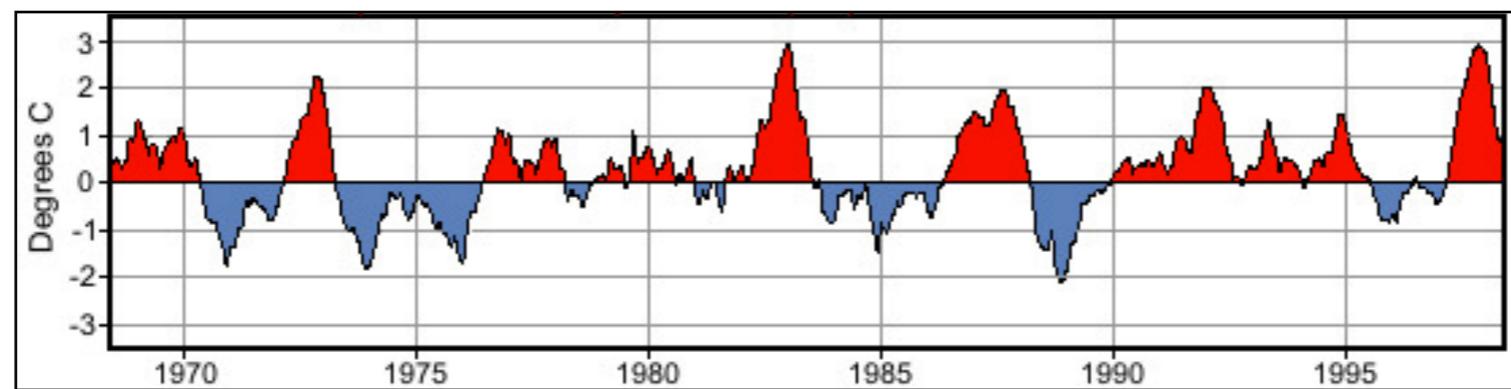
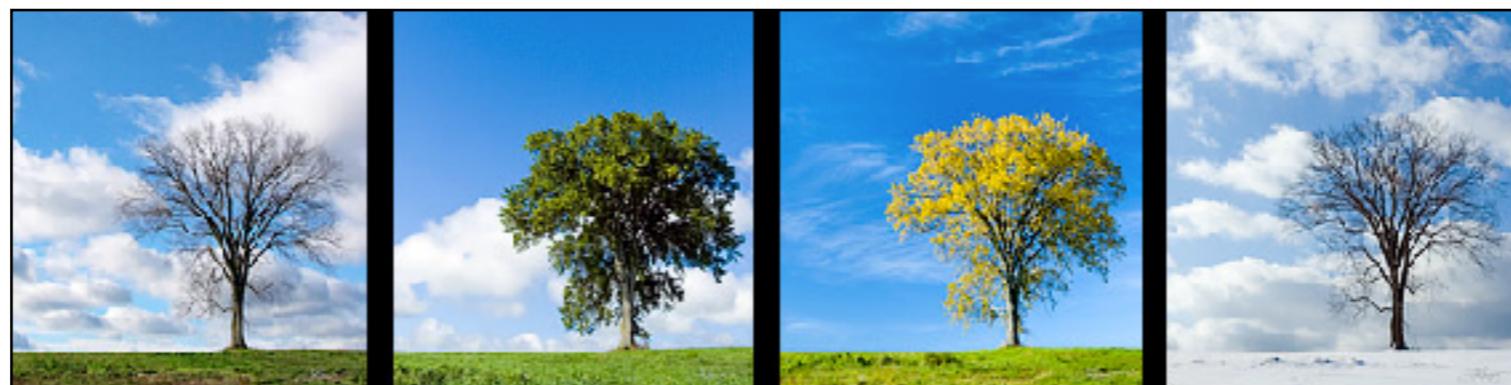
Environmental heterogeneity



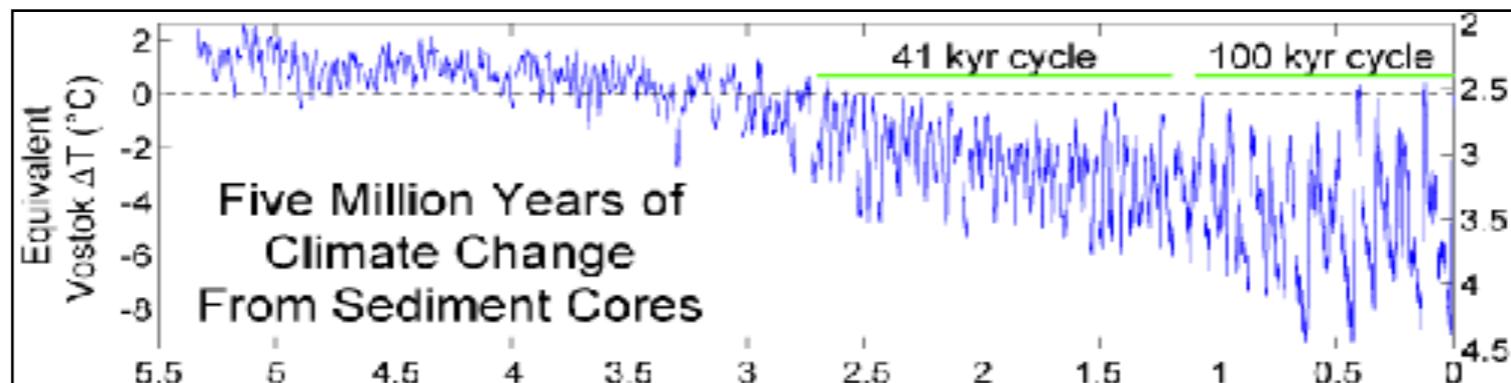
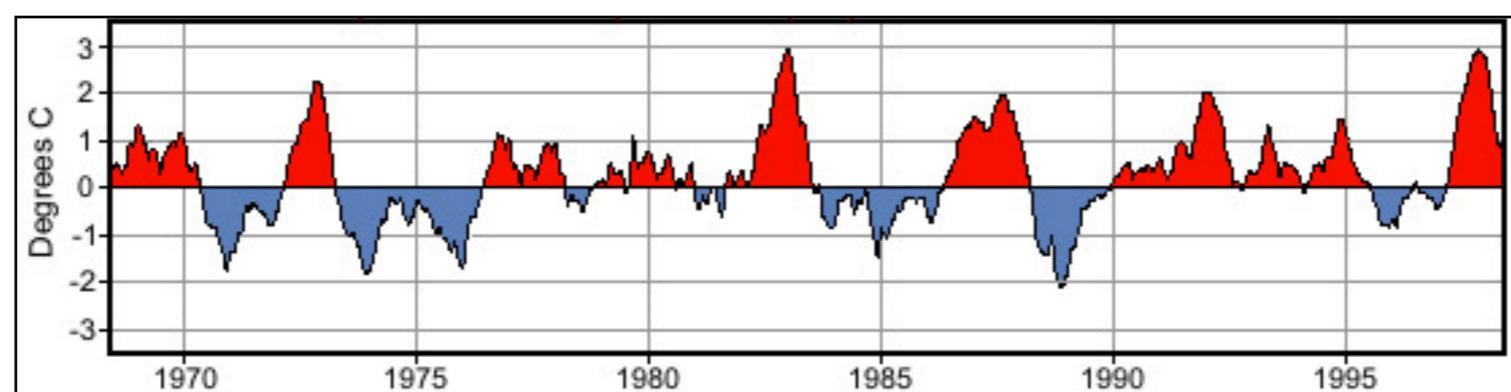
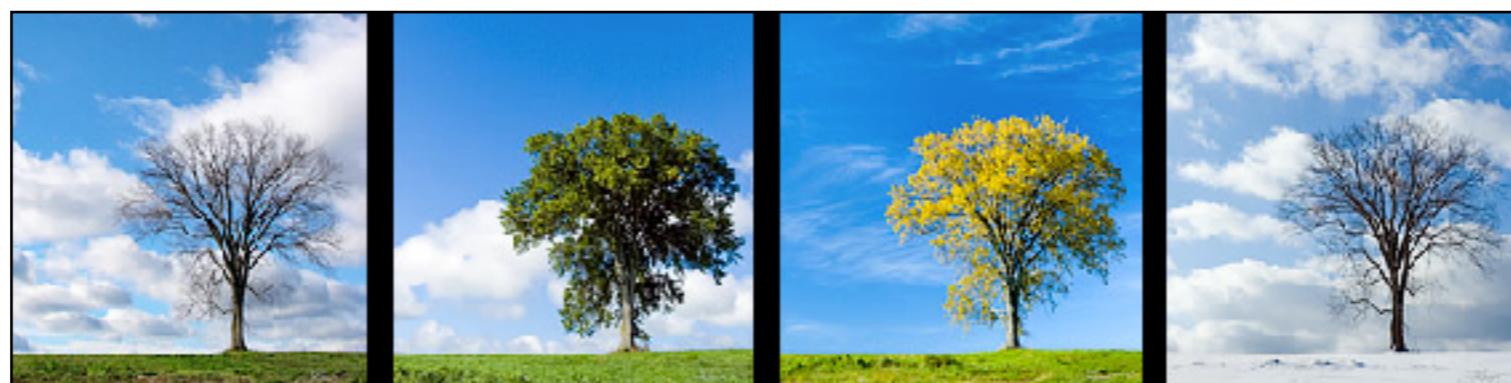
Environmental heterogeneity



Environmental heterogeneity



Environmental heterogeneity

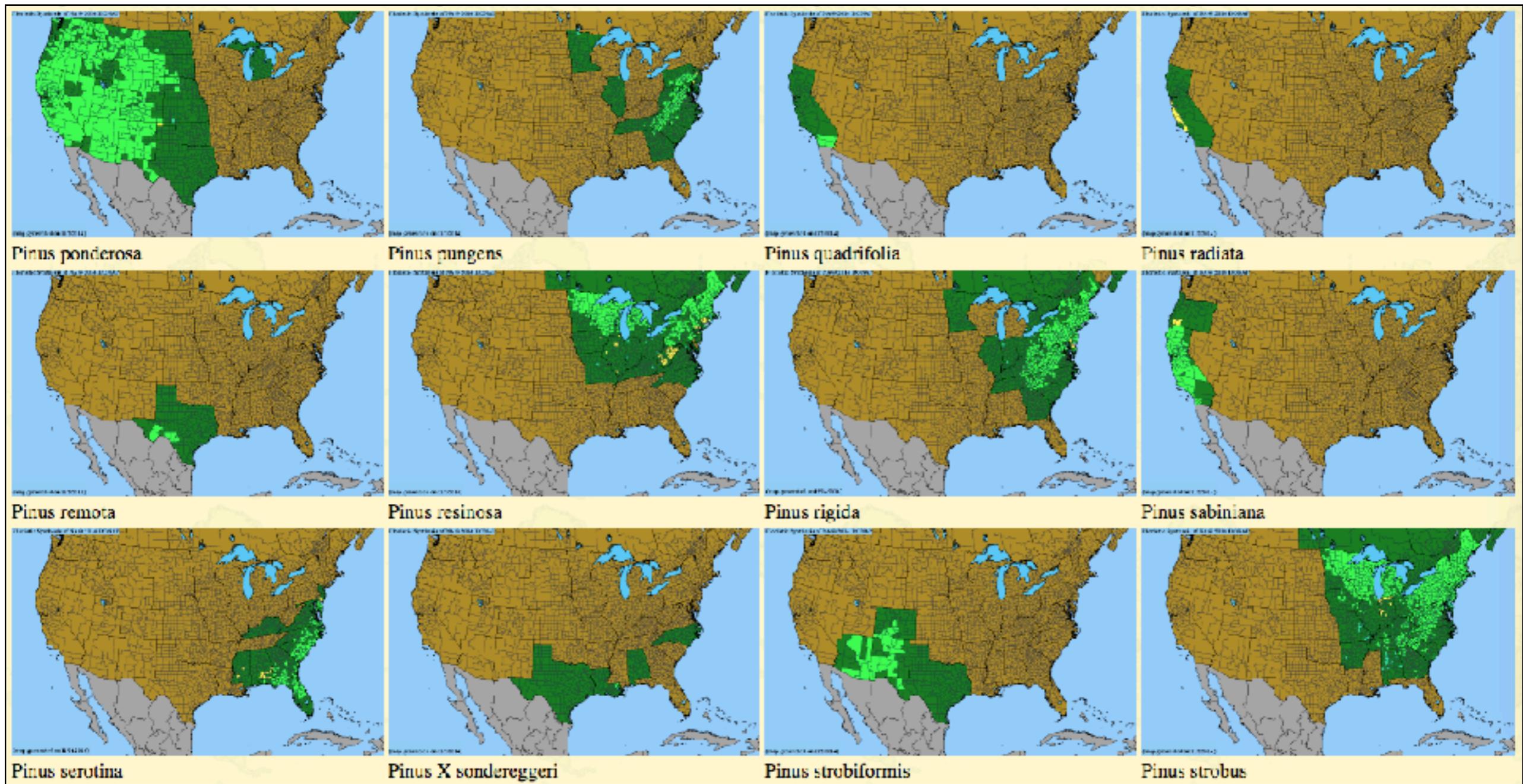


Limits to physiological responses

Physiology: study the normal functions of living organisms and their parts

Limits to physiological responses

Physiology: study the normal functions of living organisms and their parts



Temperature

Temperature

Transfer of energy

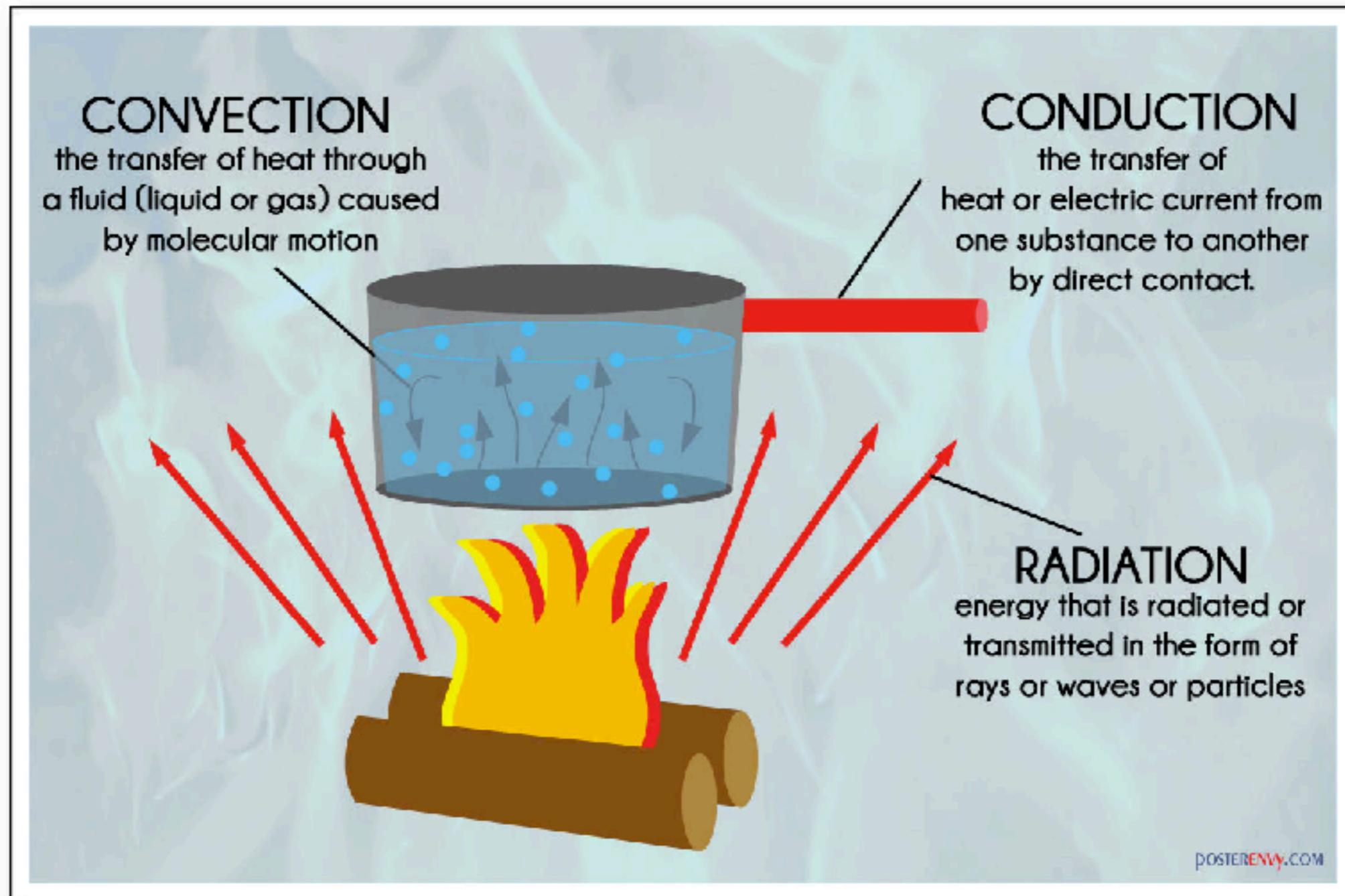


Image sourced from the 1990s

Temperature

Plants

ΔH_{plant}

ΔH_{plant} heat energy

Temperature

Plants

$$\Delta H_{plant} = SR$$

ΔH_{plant} heat energy

SR solar radiation

Temperature

Plants

$$\Delta H_{plant} = SR + IR_{in}$$

ΔH_{plant} heat energy

SR solar radiation

IR_{in} infrared, in

Temperature

Plants

$$\Delta H_{plant} = SR + IR_{in} - IR_{out}$$

ΔH_{plant} heat energy

SR solar radiation

IR_{in} infrared, in

IR_{out} infrared, out

Temperature

Plants

$$\Delta H_{plant} = SR + IR_{in} - IR_{out} - H_{convection}$$

ΔH_{plant} heat energy

SR solar radiation

IR_{in} infrared, in

IR_{out} infrared, out

$H_{convection}$ convective heat

Temperature

Plants

$$\Delta H_{plant} = SR + IR_{in} - IR_{out} - H_{convection} + H_{conduction}$$

ΔH_{plant} heat energy

SR solar radiation

IR_{in} infrared, in

IR_{out} infrared, out

$H_{convection}$ convective heat

$H_{conduction}$ conductive heat

Temperature

Plants

$$\Delta H_{plant} = SR + IR_{in} - IR_{out} - H_{convection} + H_{conduction} - H_{et}$$

ΔH_{plant} heat energy

SR solar radiation

IR_{in} infrared, in

IR_{out} infrared, out

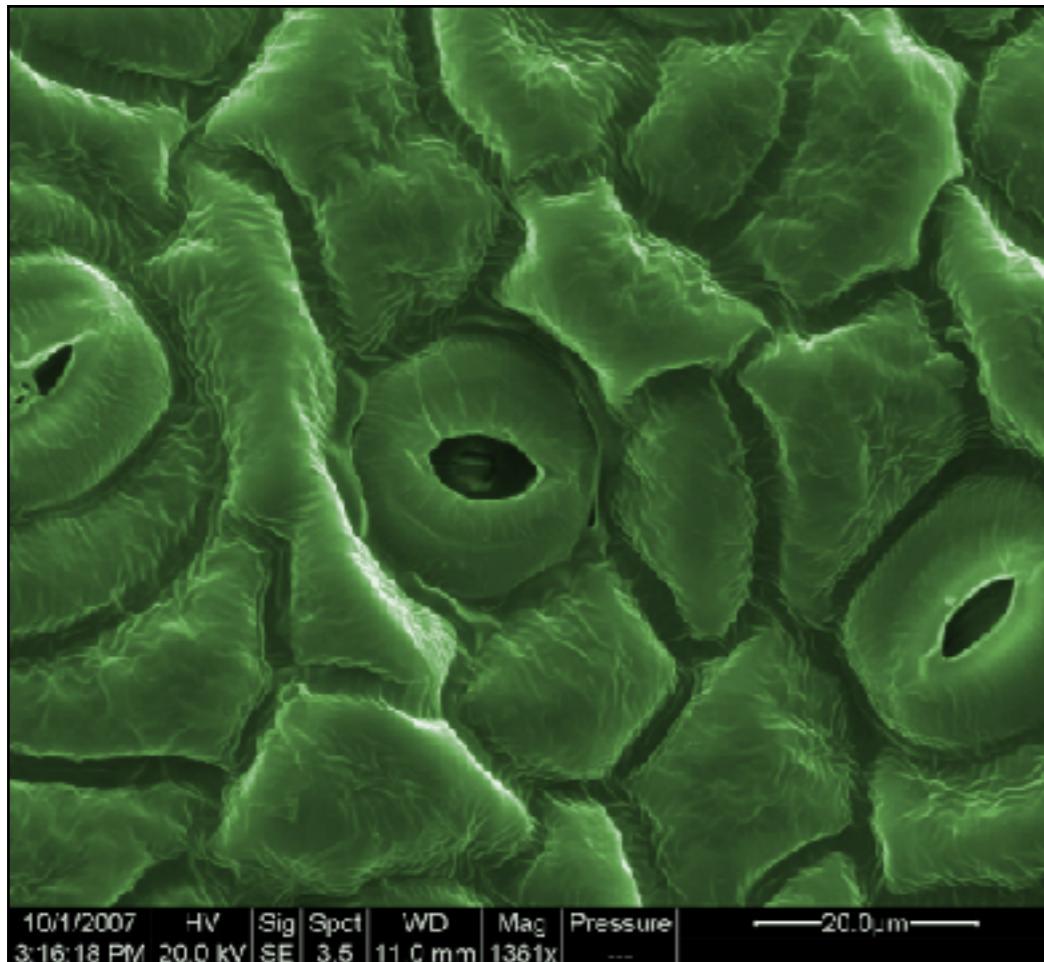
$H_{convection}$ convective heat

$H_{conduction}$ conductive heat

H_{et} evapotranspiration

Temperature

Plants



[http://orig11.deviantart.net/6e23/f/2009/004/a/e/
stomata_under_sem_by_onychophoran.jpg](http://orig11.deviantart.net/6e23/f/2009/004/a/e/stomata_under_sem_by_onychophoran.jpg)



Wikipedia

Temperature

Animals

ΔH_{animal}

ΔH_{animal} Change in heat energy

Temperature

Animals

$$\Delta H_{animal} = SR$$

ΔH_{animal} Change in heat energy

SR Solar radiation

Temperature

Animals

$$\Delta H_{animal} = SR + IR_{in}$$

ΔH_{animal} Change in heat energy

SR Solar radiation

IR_{in} Infrared, in

Temperature

Animals

$$\Delta H_{animal} = SR + IR_{in} - IR_{out}$$

ΔH_{animal} Change in heat energy

SR Solar radiation

IR_{in} Infrared, in

IR_{out} Infrared, out

Temperature

Animals

$$\Delta H_{animal} = SR + IR_{in} - IR_{out} - H_{convection}$$

ΔH_{animal} Change in heat energy

SR Solar radiation

IR_{in} Infrared, in

IR_{out} Infrared, out

$H_{convection}$ Convection

Temperature

Animals

$$\Delta H_{animal} = SR + IR_{in} - IR_{out} - H_{convection} + H_{conduction}$$

ΔH_{animal} Change in heat energy

SR Solar radiation

IR_{in} Infrared, in

IR_{out} Infrared, out

$H_{convection}$ Convection

$H_{conduction}$ Conduction

Temperature

Animals

$$\Delta H_{animal} = SR + IR_{in} - IR_{out} - H_{convection} + H_{conduction} - H_{evaporation}$$

ΔH_{animal} Change in heat energy

SR Solar radiation

IR_{in} Infrared, in

IR_{out} Infrared, out

$H_{convection}$ Convection

$H_{conduction}$ Conduction

$H_{evaporation}$ Evaporation

Temperature

Animals

$$\Delta H_{animal} = SR + IR_{in} - IR_{out} - H_{convection} + H_{conduction} - H_{evaporation} + H_{metabolic}$$

ΔH_{animal} Change in heat energy

SR Solar radiation

IR_{in} Infrared, in

IR_{out} Infrared, out

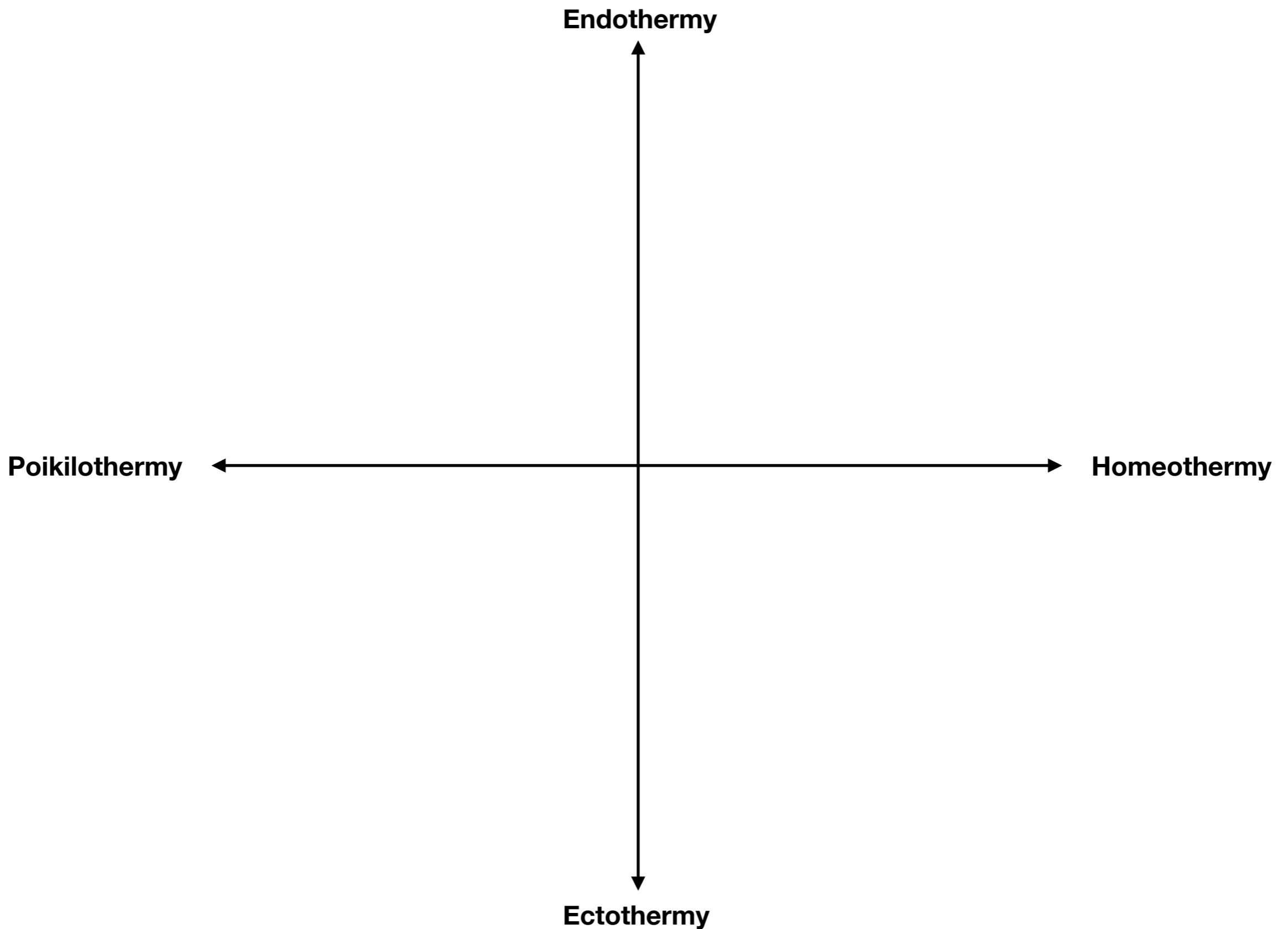
$H_{convection}$ Convection

$H_{conduction}$ Conduction

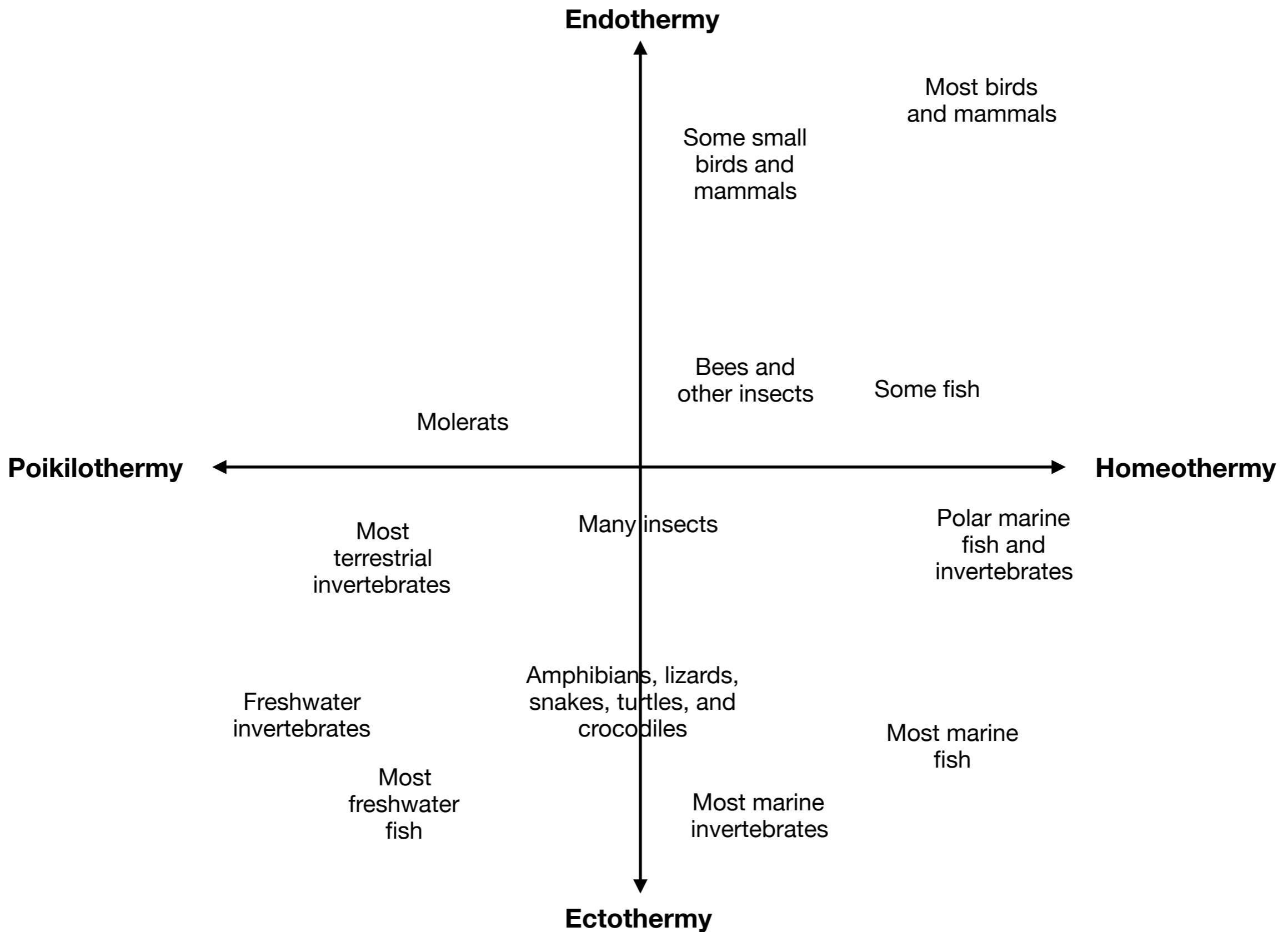
$H_{evaporation}$ Evaporation

$H_{metabolic}$ Metabolic heat

Temperature



Temperature



Water balance

Ψ

Ψ total water potential

Water balance

$$\Psi = \Psi_o$$

Ψ total water potential

Ψ_o osmotic water potential

Water balance

$$\Psi = \Psi_o + \Psi_p$$

Ψ total water potential

Ψ_o osmotic water potential

Ψ_p pressure potential

Water balance

$$\Psi = \Psi_o + \Psi_p + \Psi_m$$

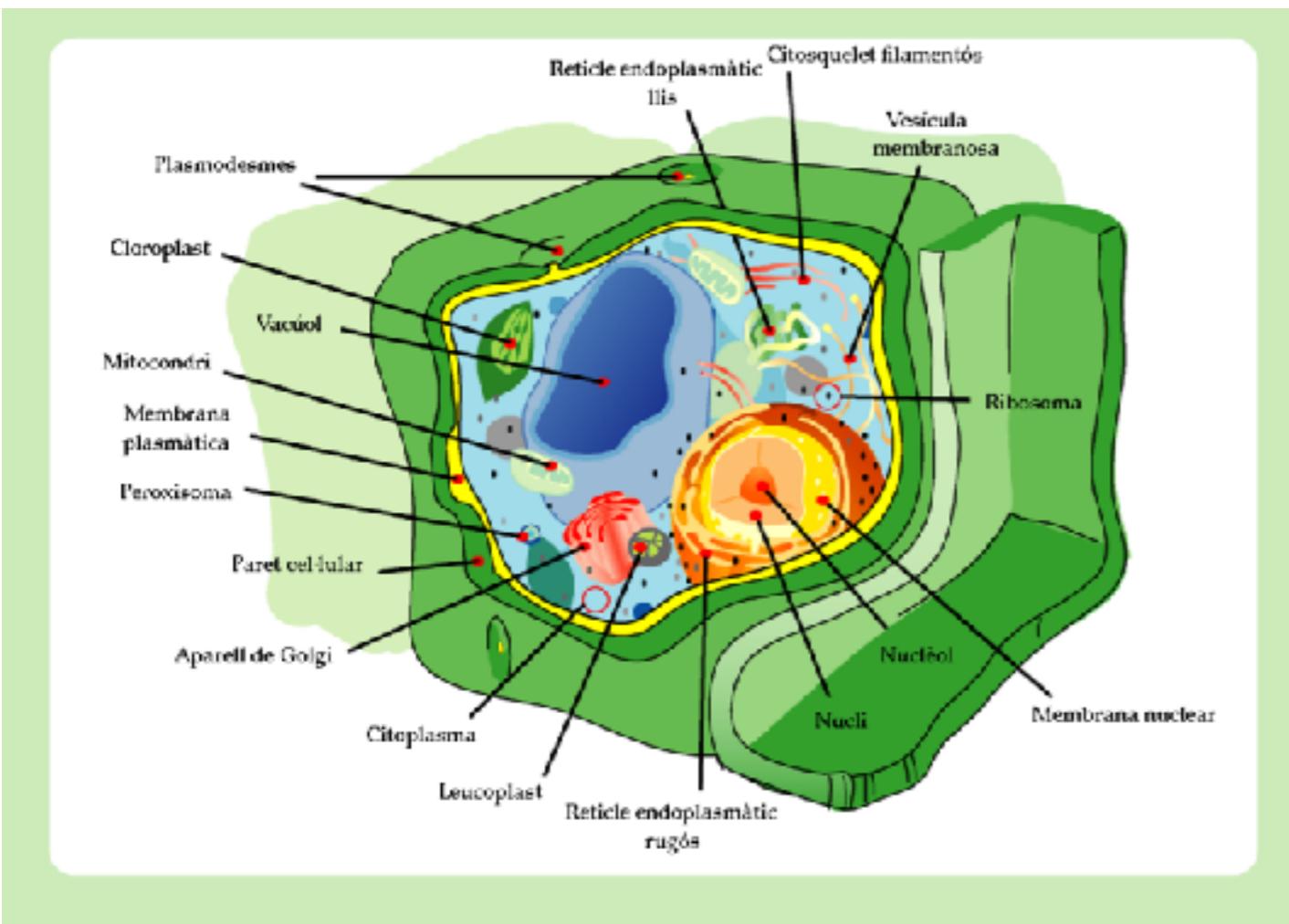
Ψ total water potential

Ψ_o osmotic water potential

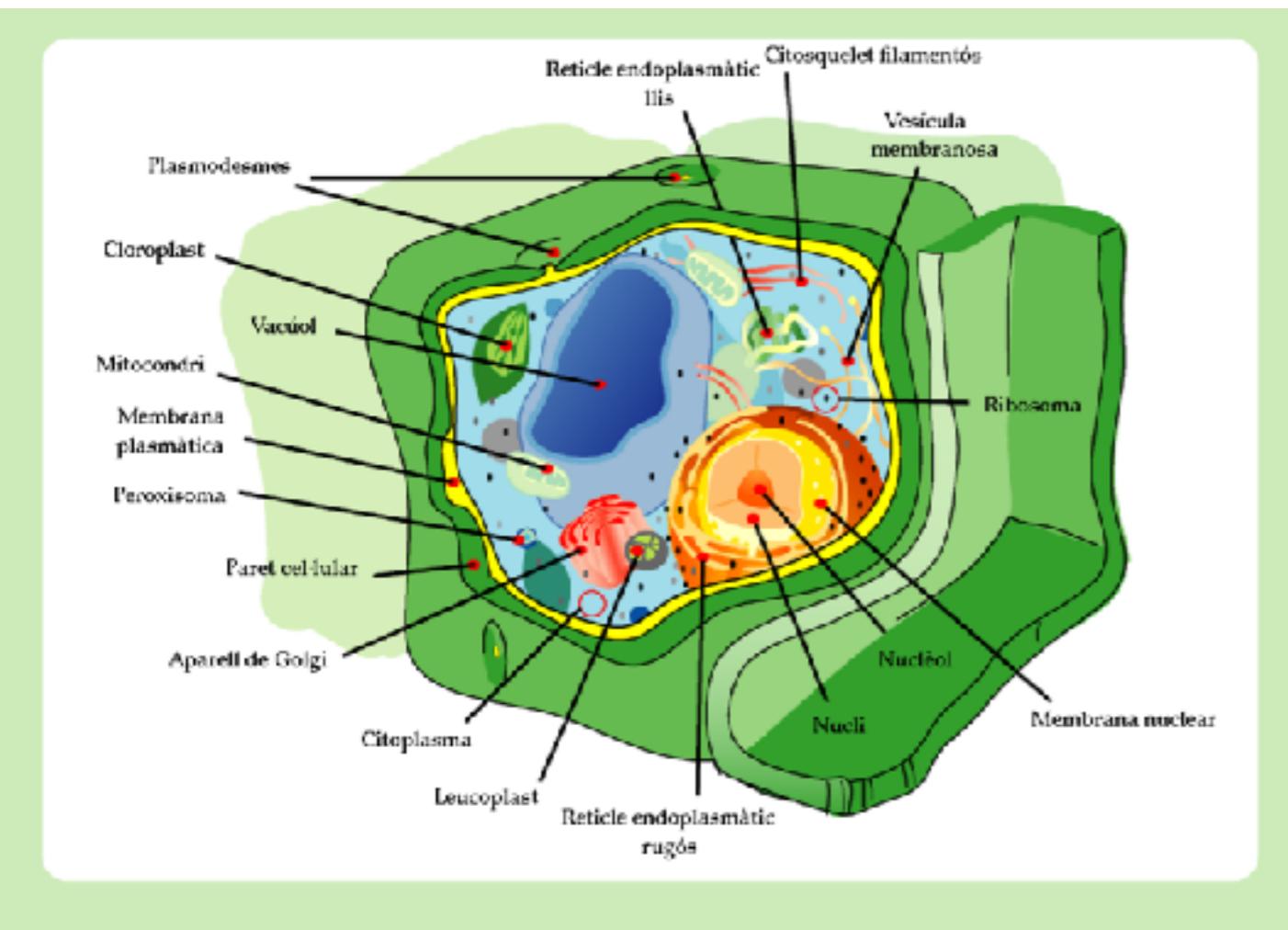
Ψ_p pressure potential

Ψ_m matrix potential

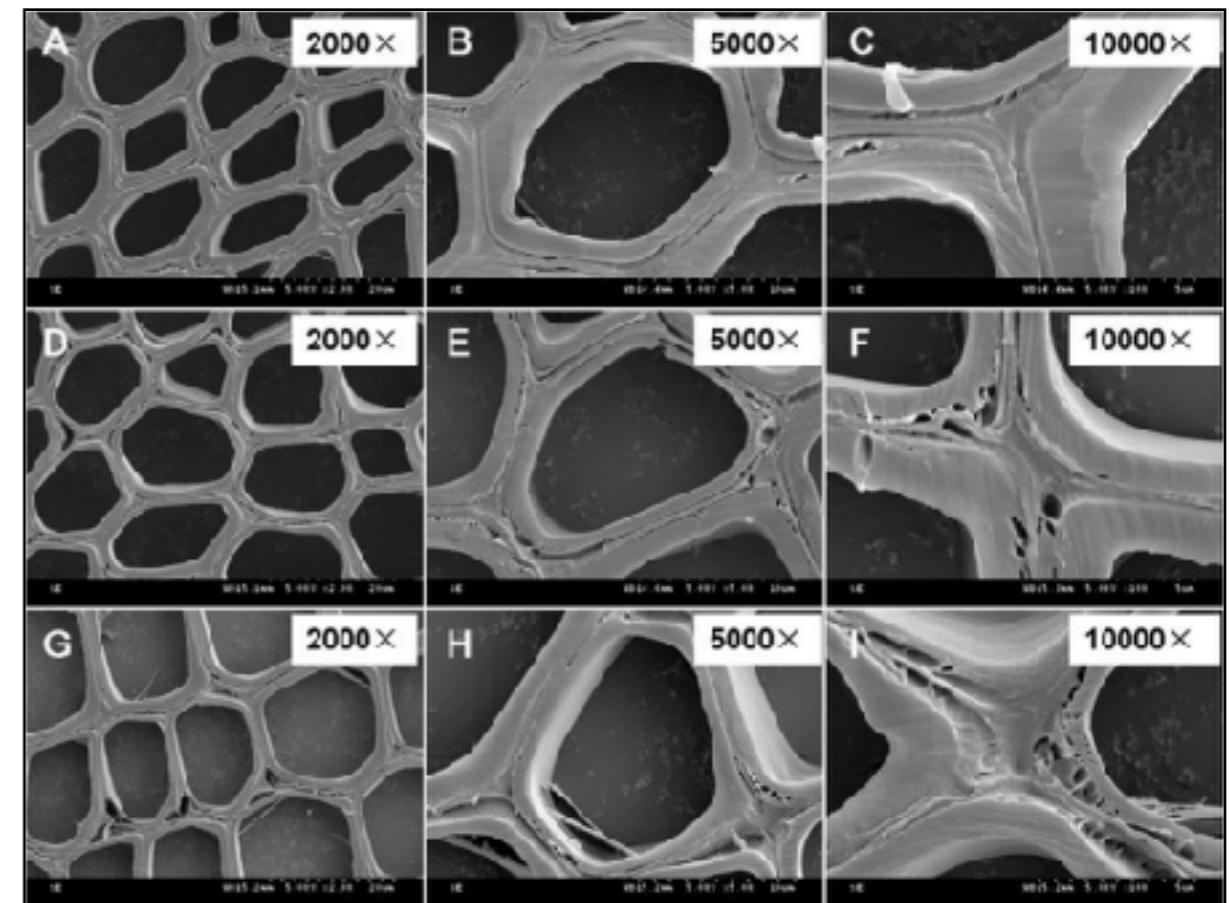
Water balance: plants



Water balance: plants

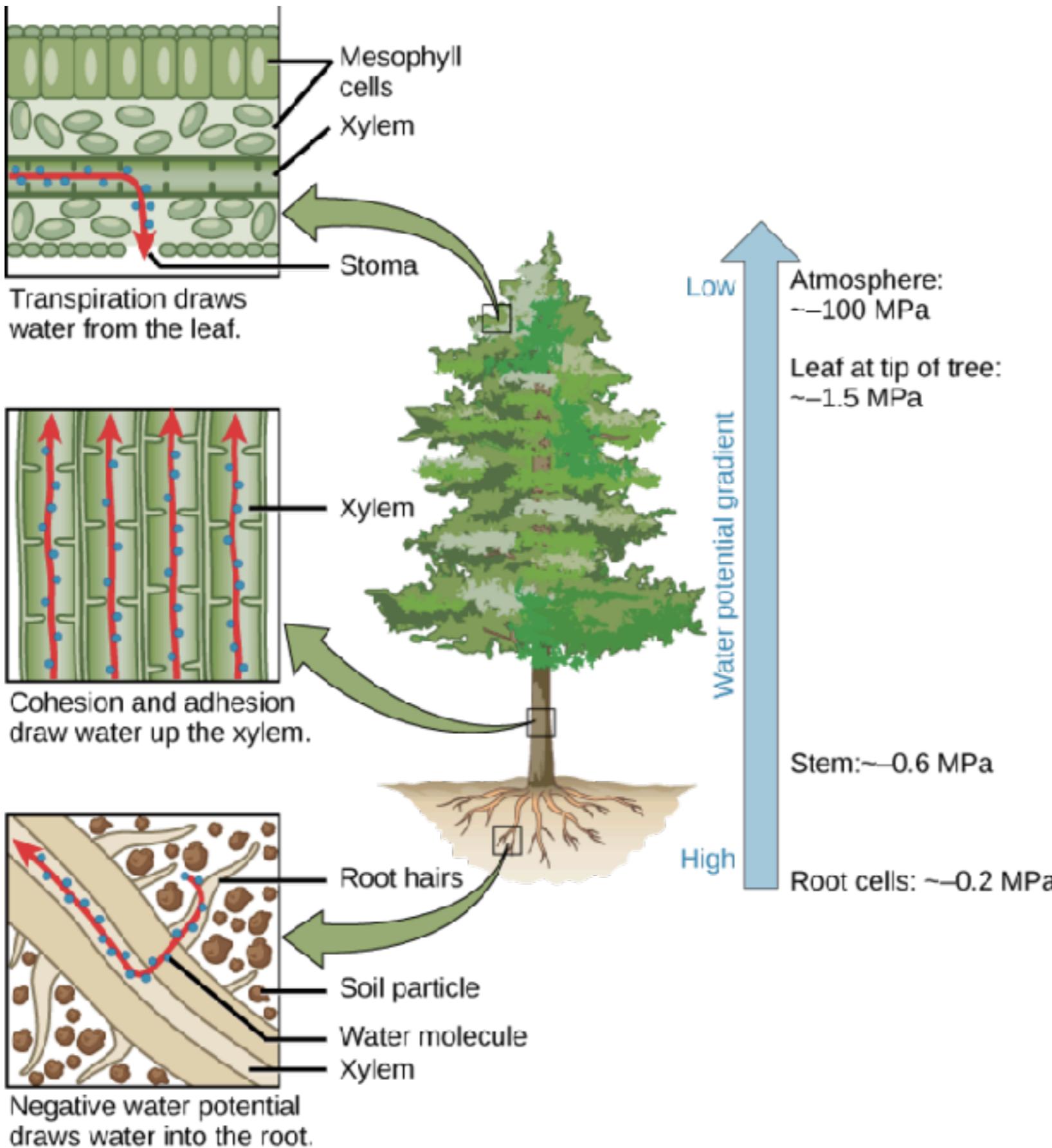


Wikimedia Commons



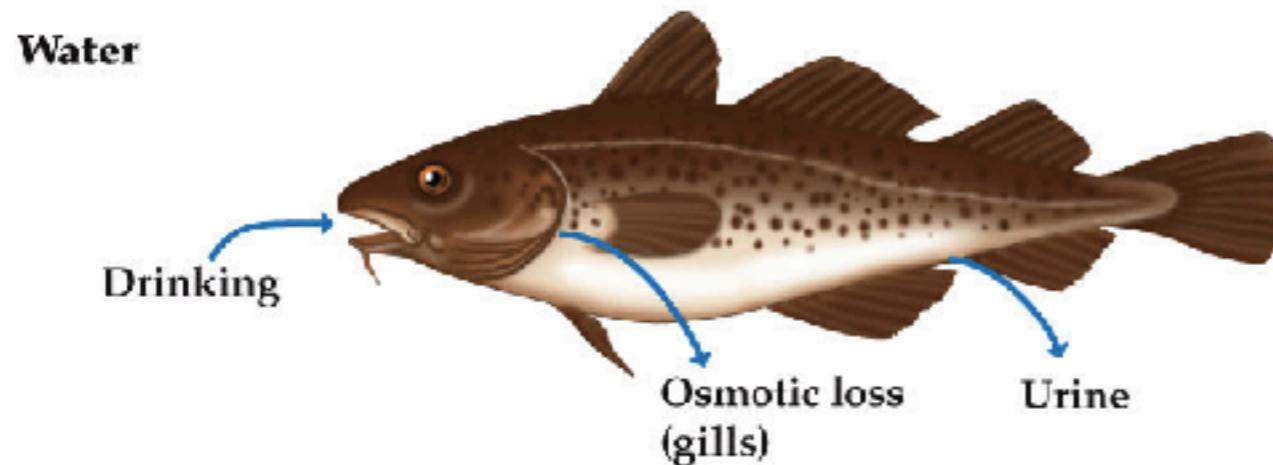
Ji, Zhe, et al. "Impact of alkali pretreatment on the chemical component distribution and ultrastructure of poplar cell walls." BioResources 9.3 (2014): 4159-4172.

Water balance: plants



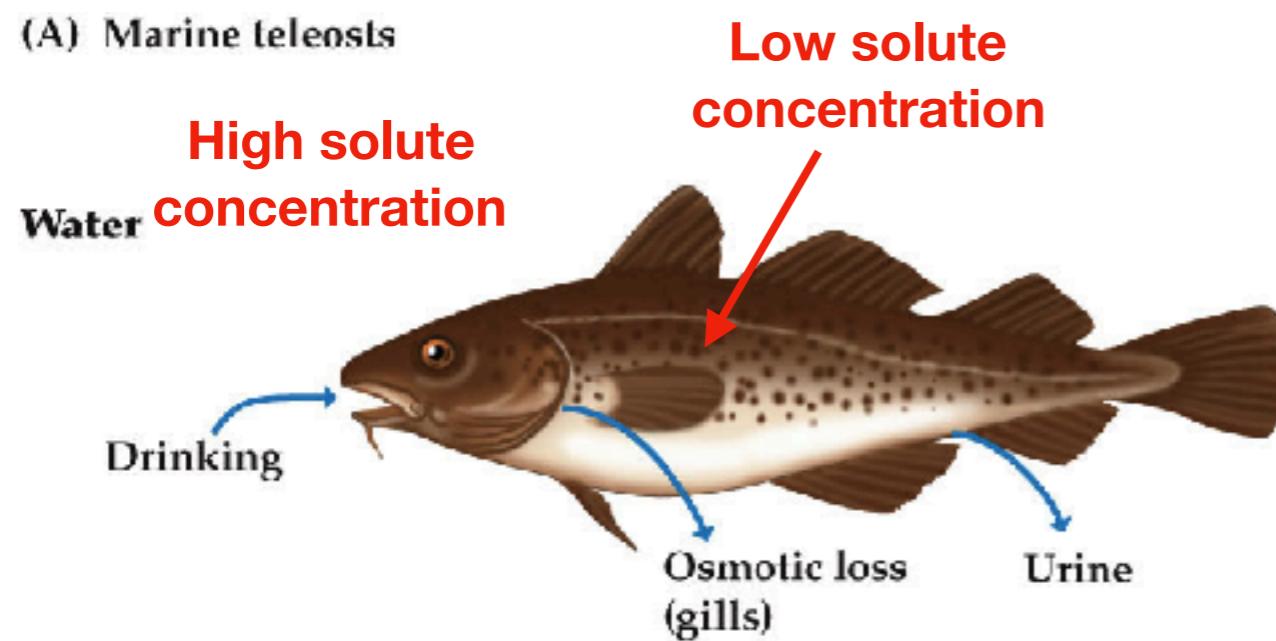
Water balance: animals

(A) Marine teleosts



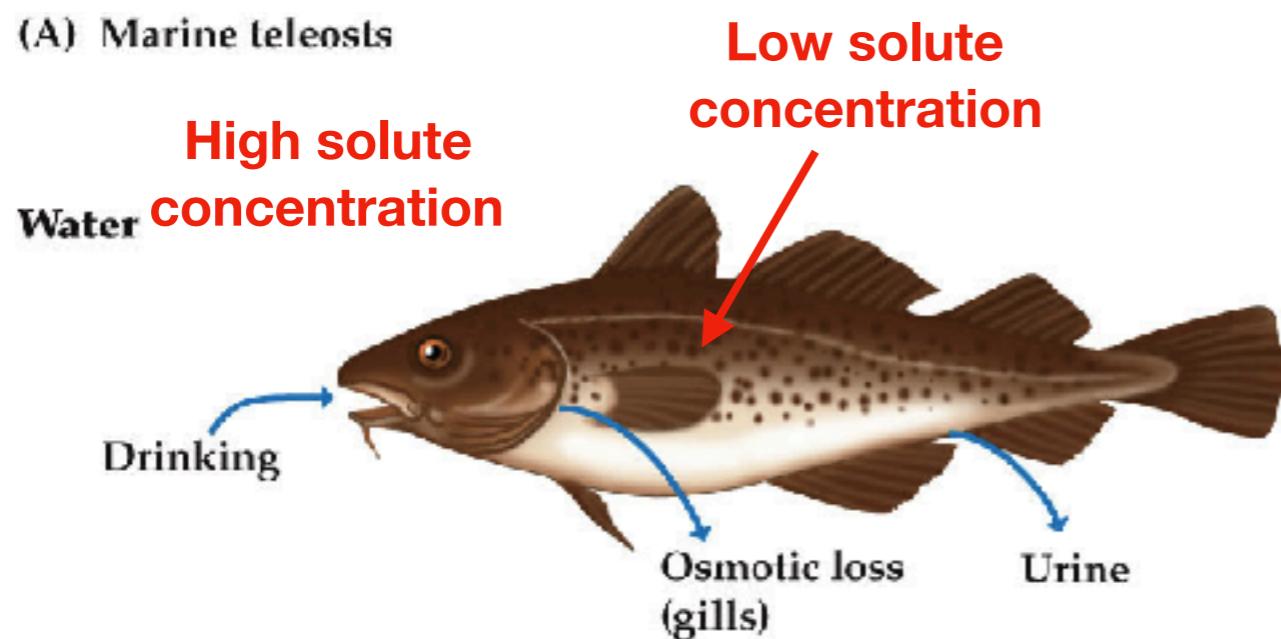
Water balance: animals

(A) Marine teleosts

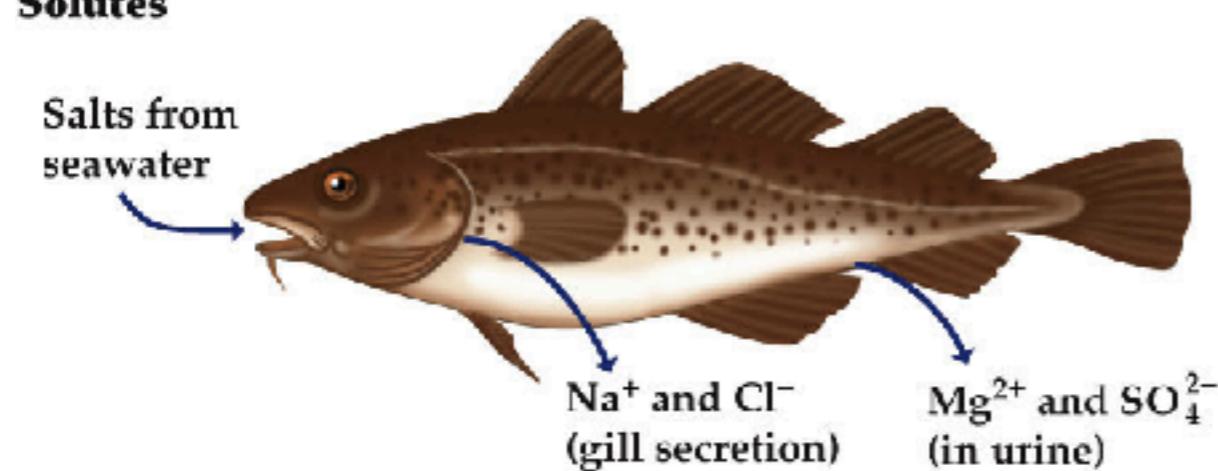


Water balance: animals

(A) Marine teleosts

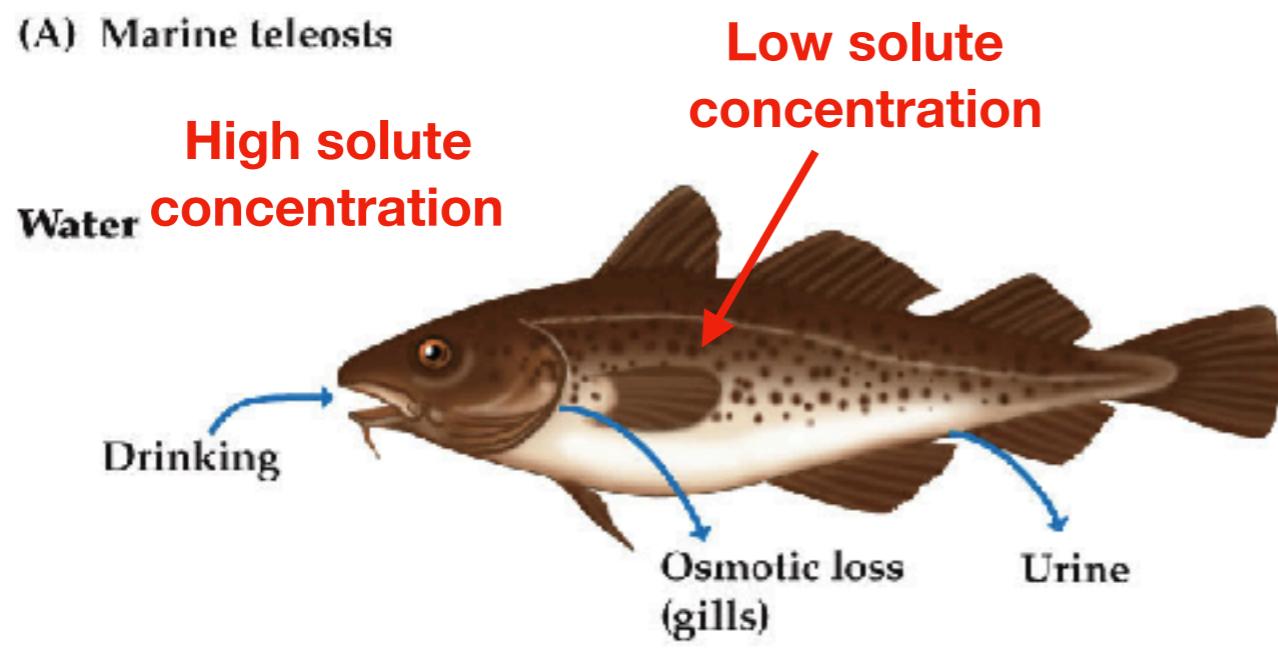


Solutes

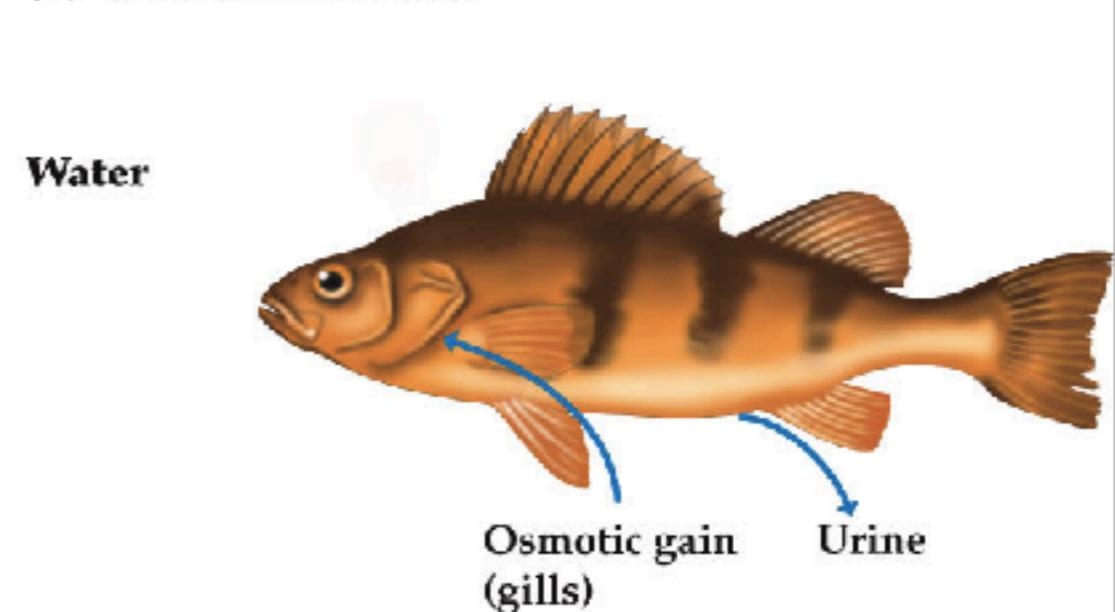


Water balance: animals

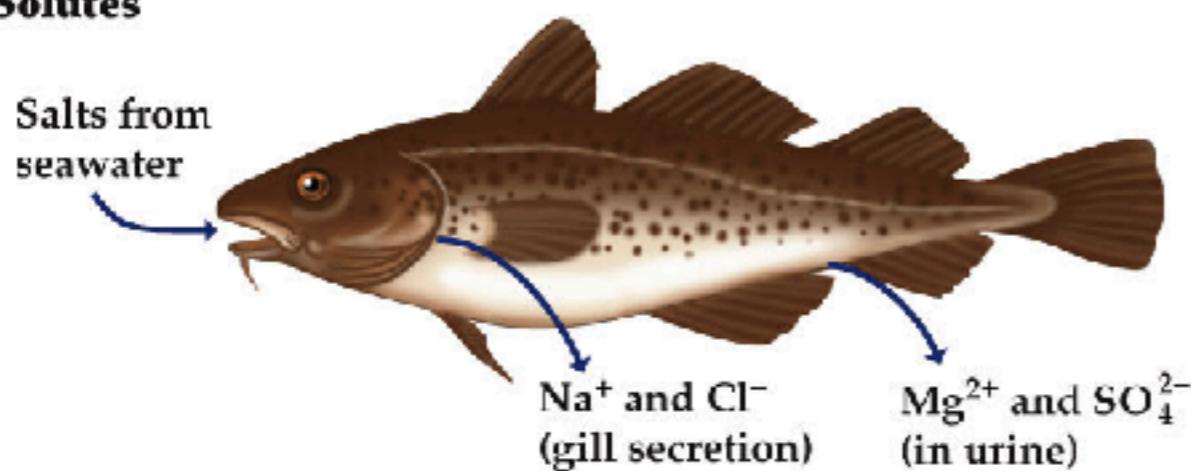
(A) Marine teleosts



(B) Freshwater teleosts

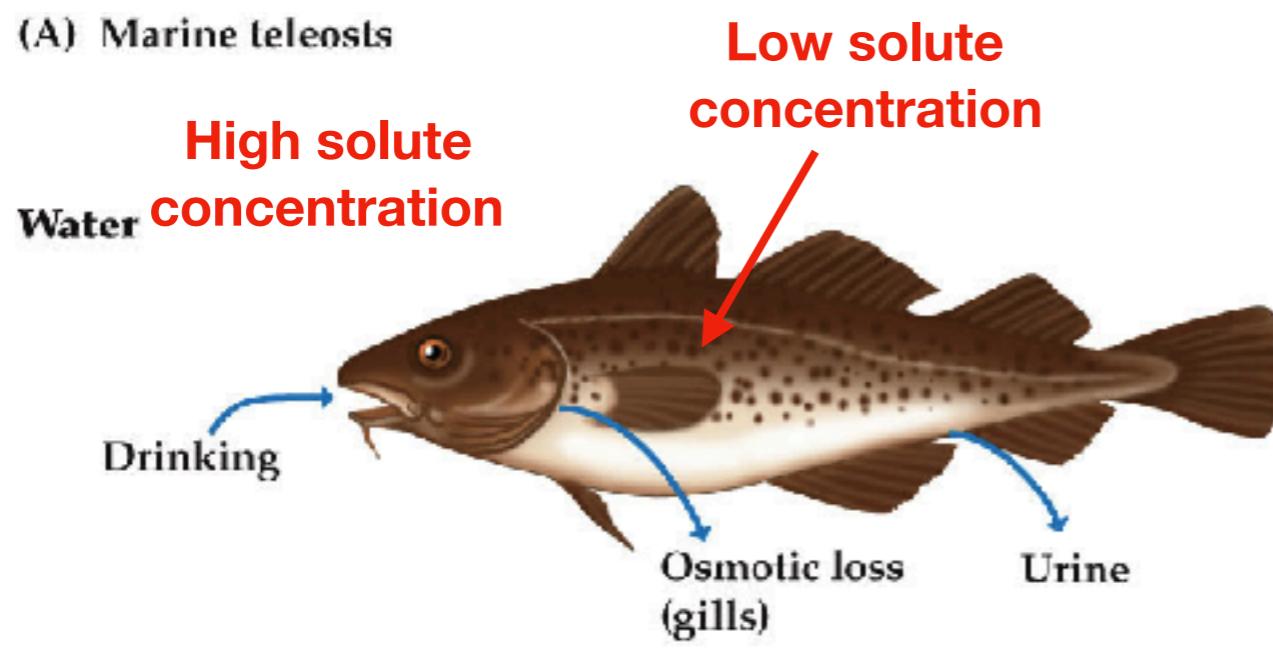


Solutes

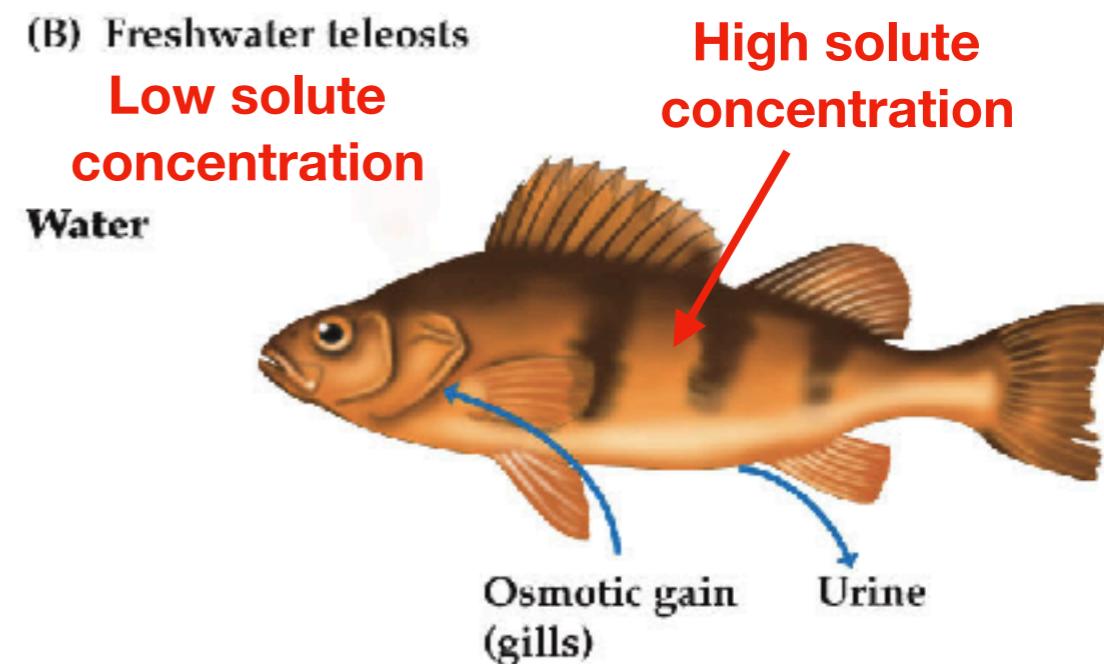


Water balance: animals

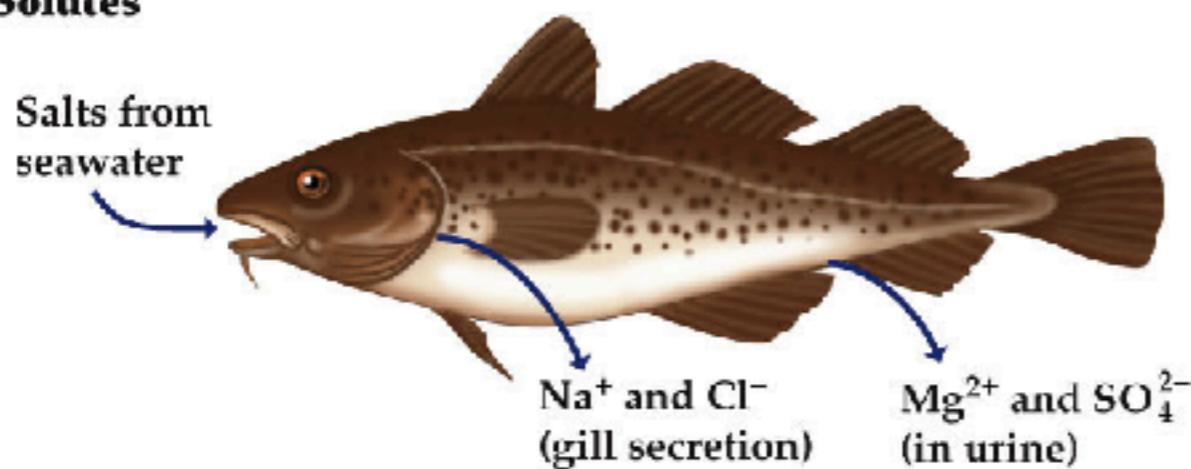
(A) Marine teleosts



(B) Freshwater teleosts

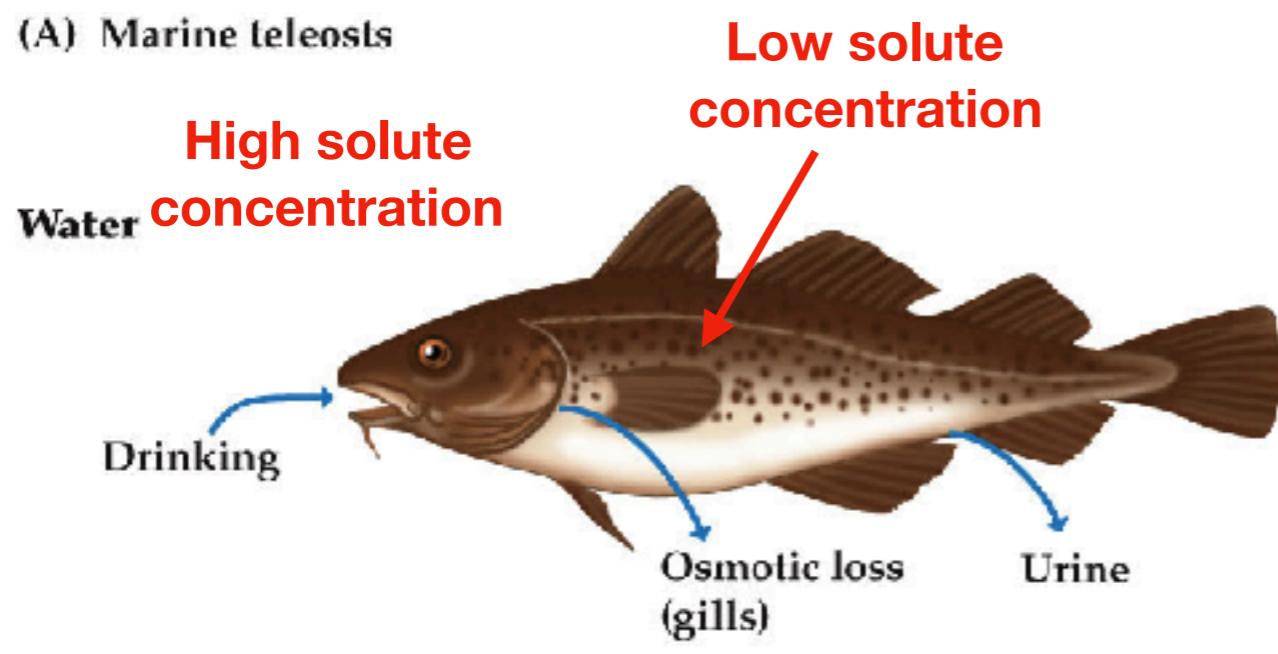


Solutes

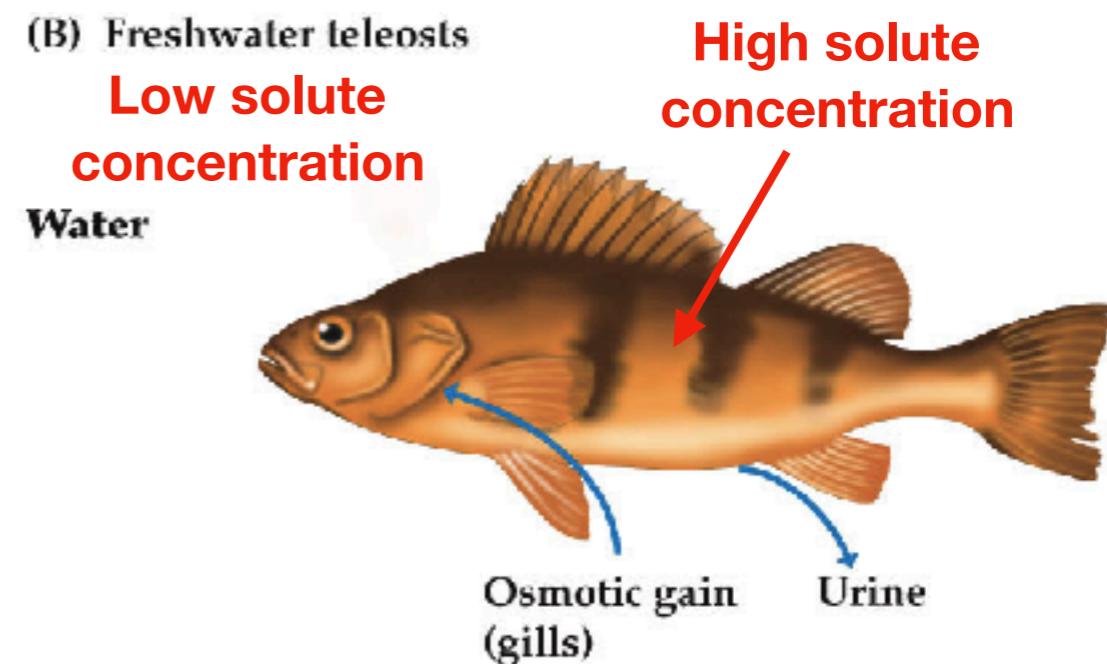


Water balance: animals

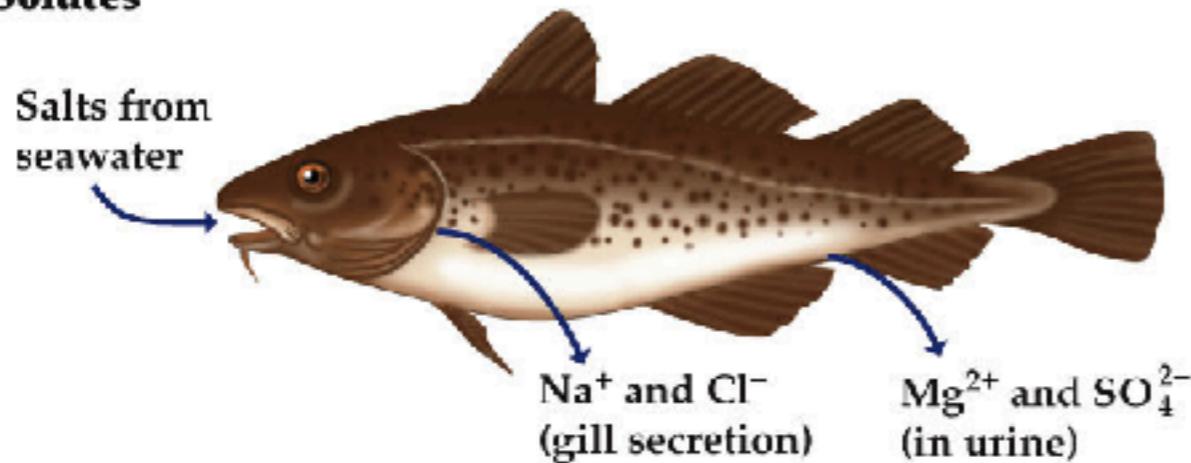
(A) Marine teleosts



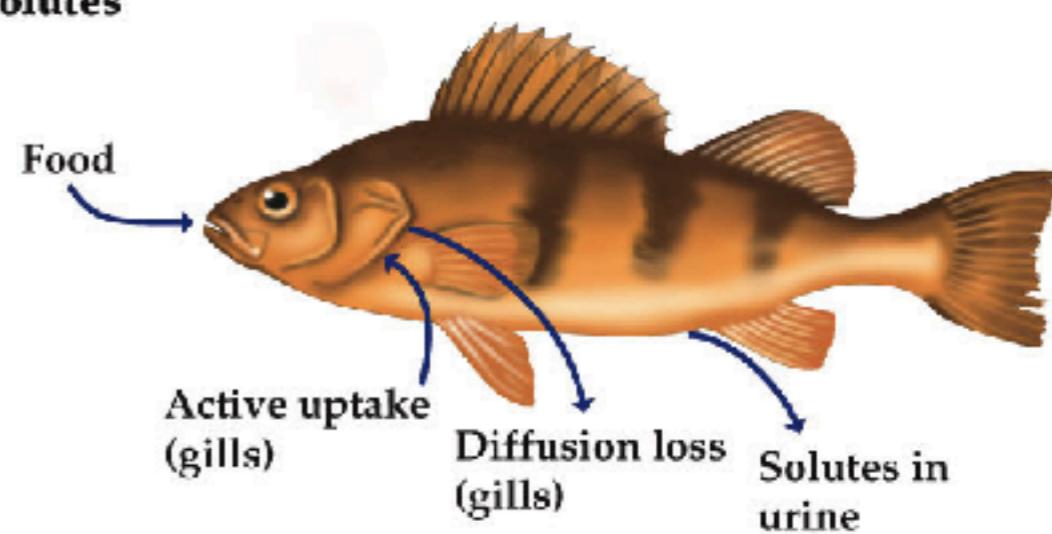
(B) Freshwater teleosts



Solutes



Solutes

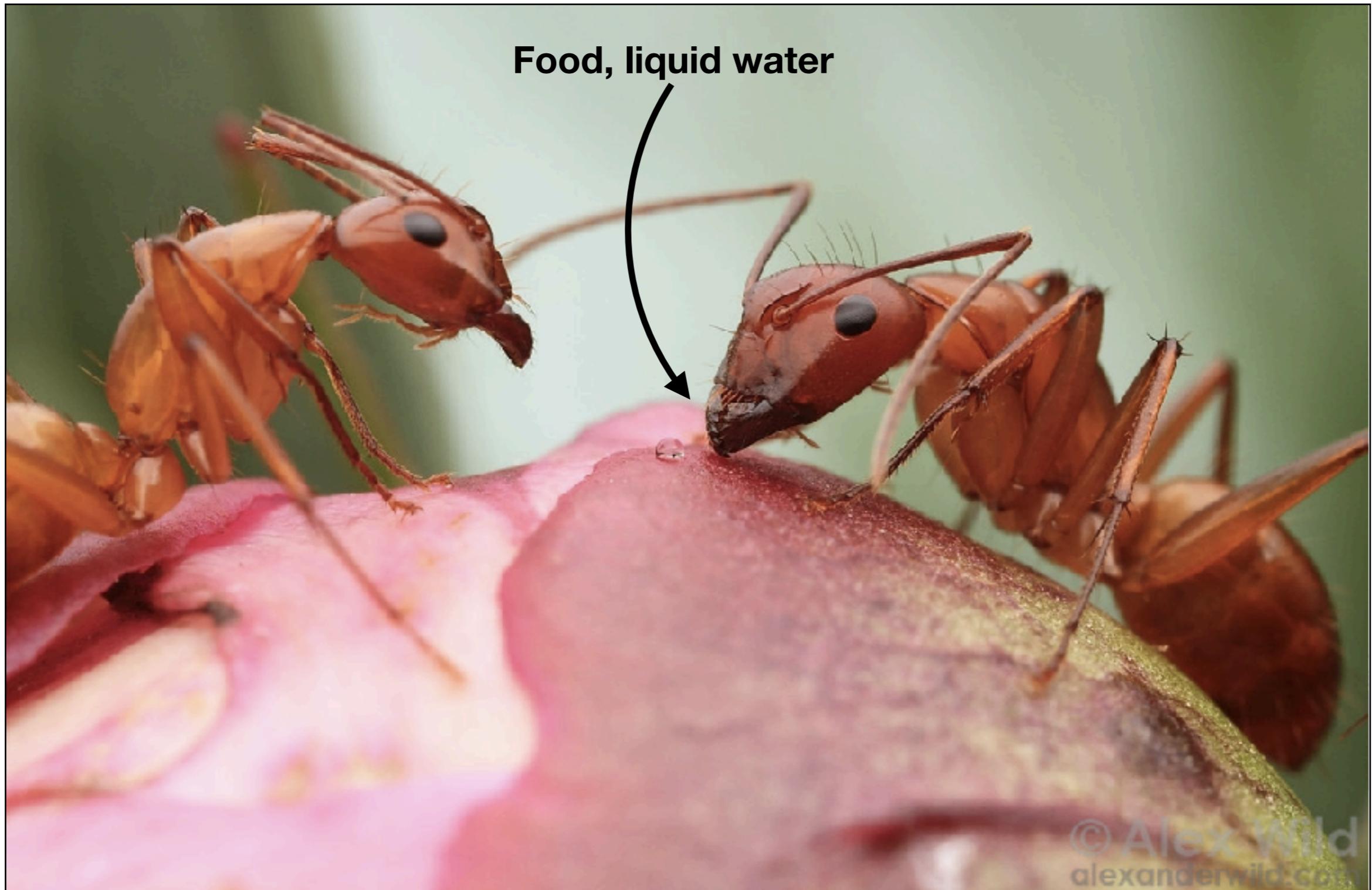


Water balance: animals

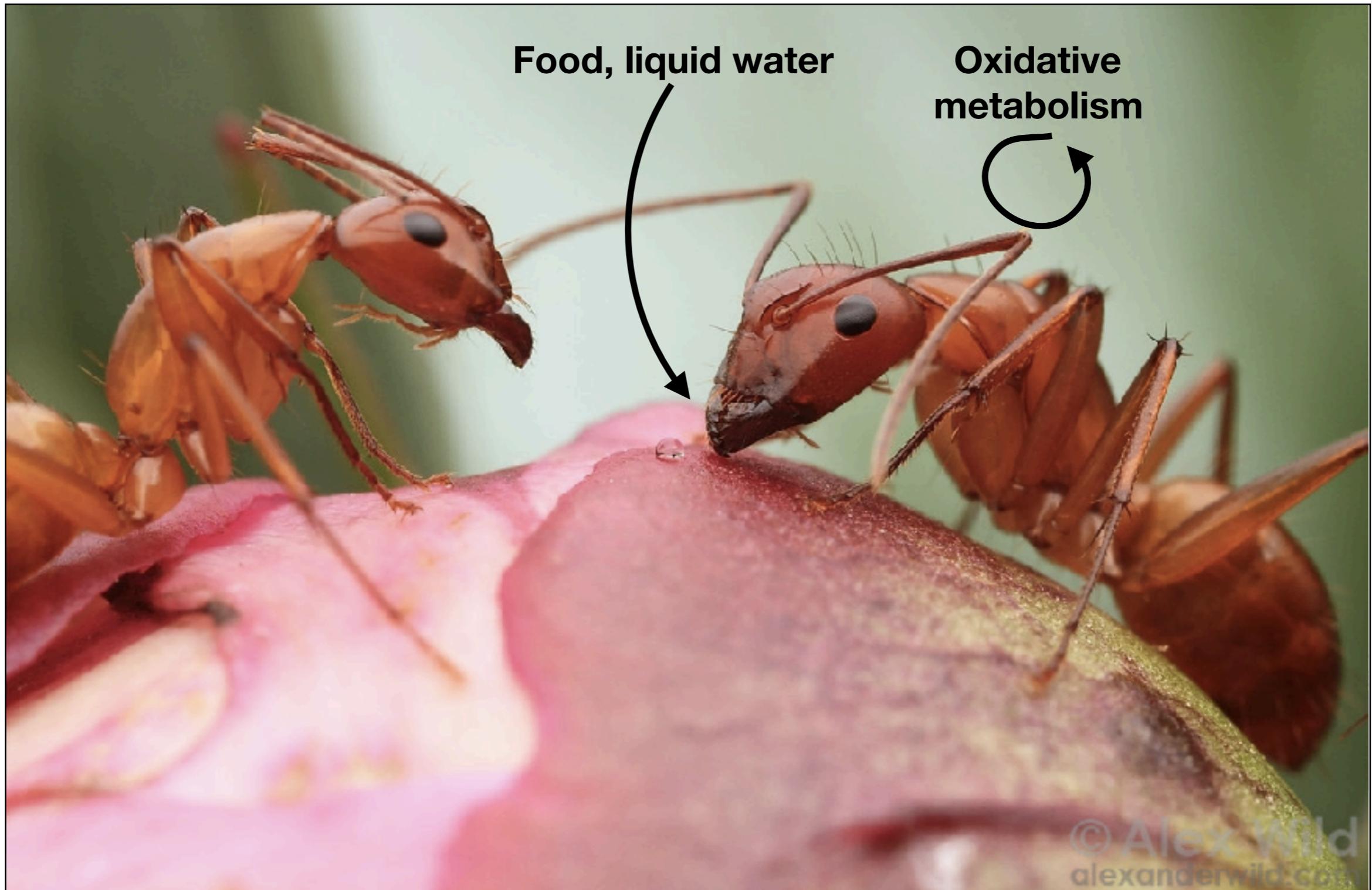


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alexanderwild.com

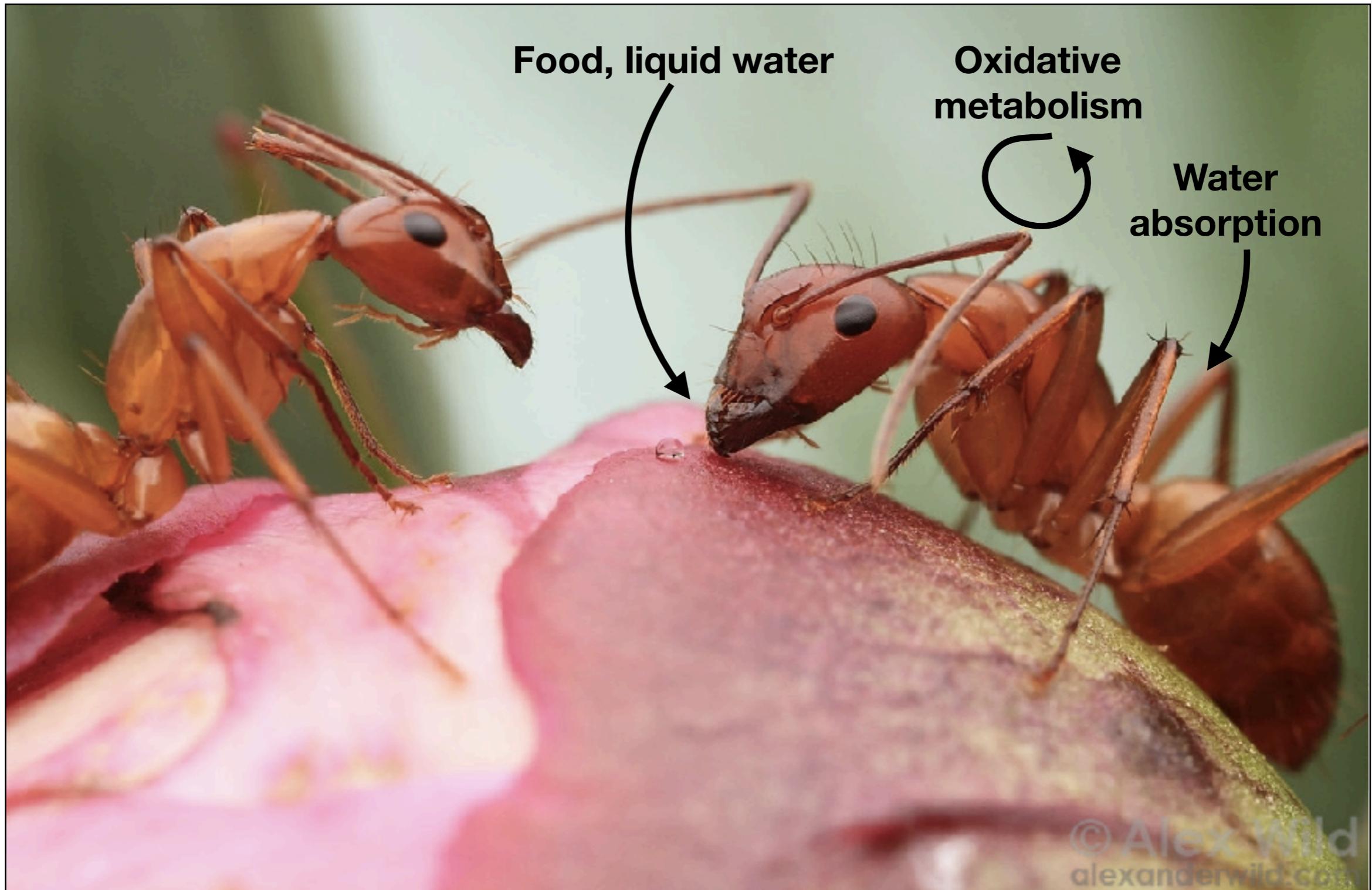
Water balance: animals



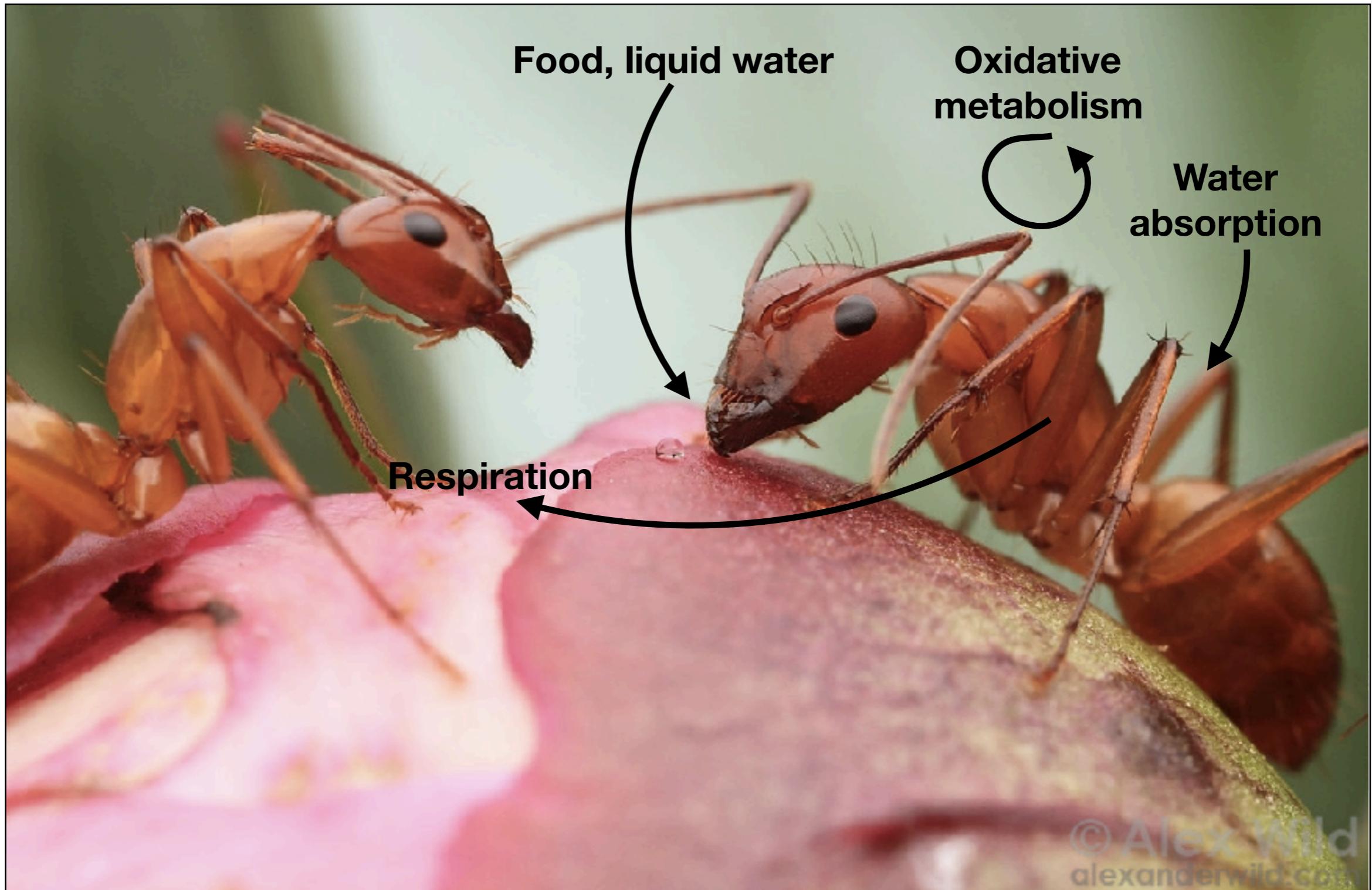
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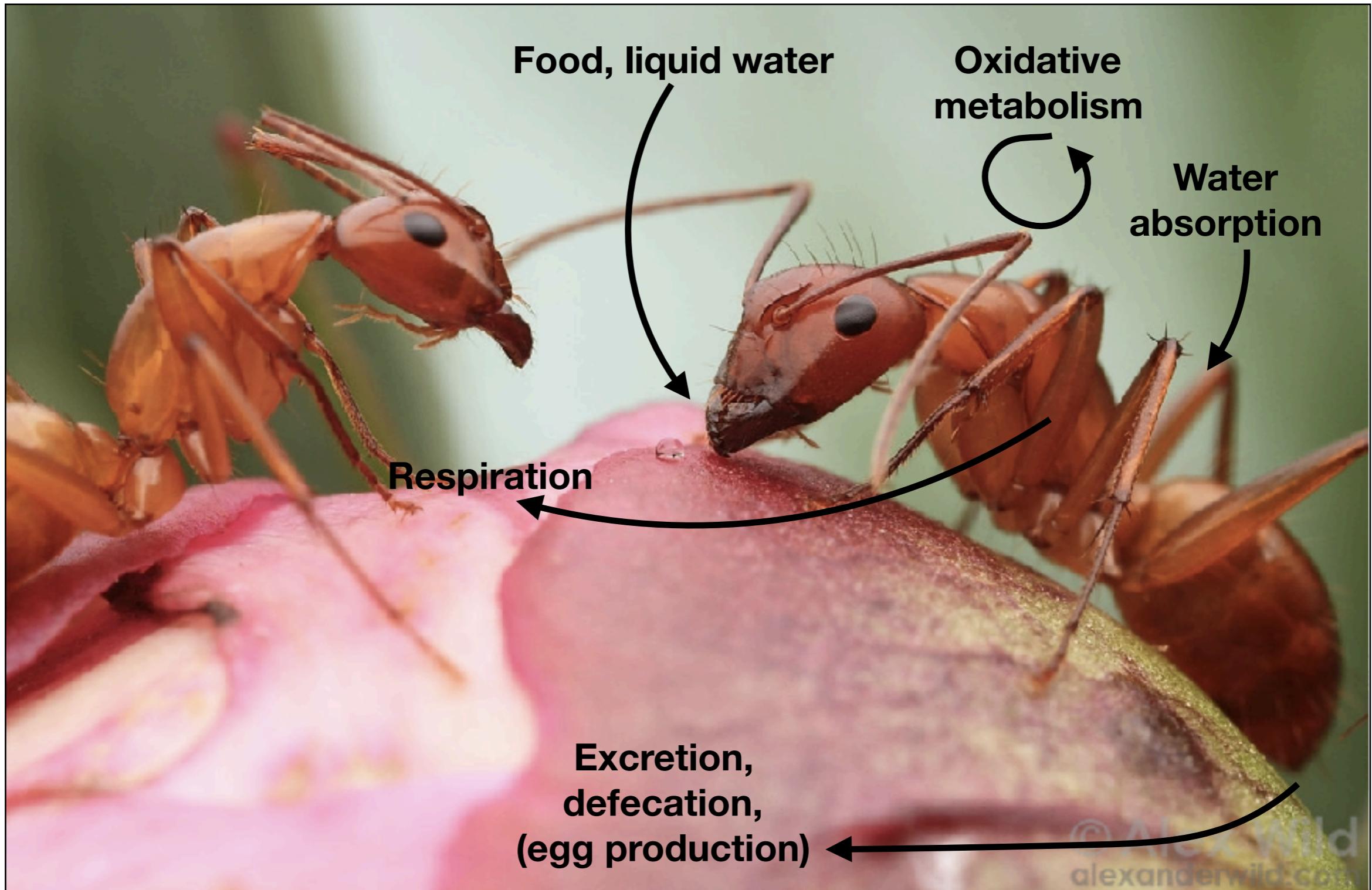
Water balance: animals



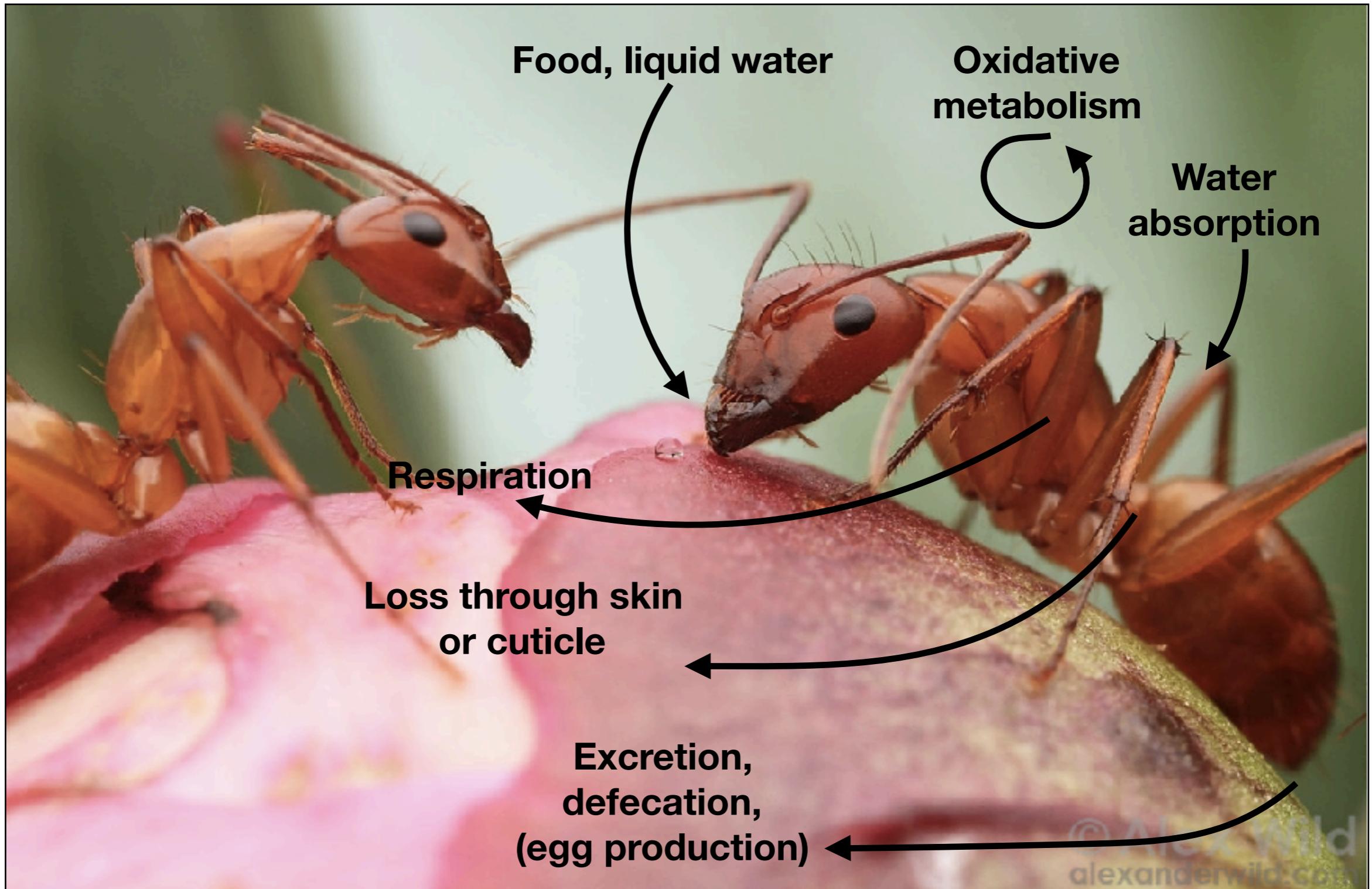
Water balance: animals



Water balance: animals



Water balance: animals



Water balance: animals



Water balance: animals

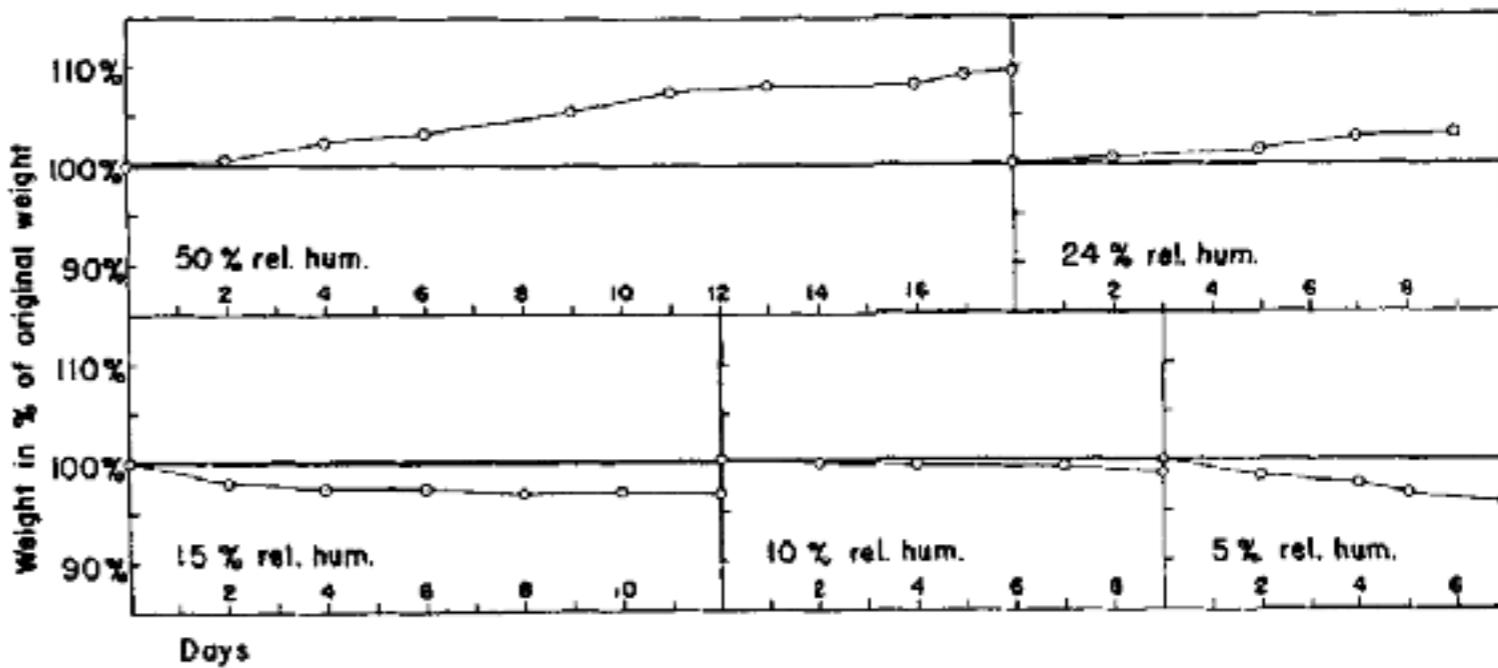


Water balance: animals

A COMPLETE ACCOUNT OF THE
WATER METABOLISM IN KANGAROO RATS AND
AN EXPERIMENTAL VERIFICATION

BODIL SCHMIDT-NIELSEN AND KNUT SCHMIDT-NIELSEN

Kettering Laboratory, University of Cincinnati, Cincinnati, Ohio

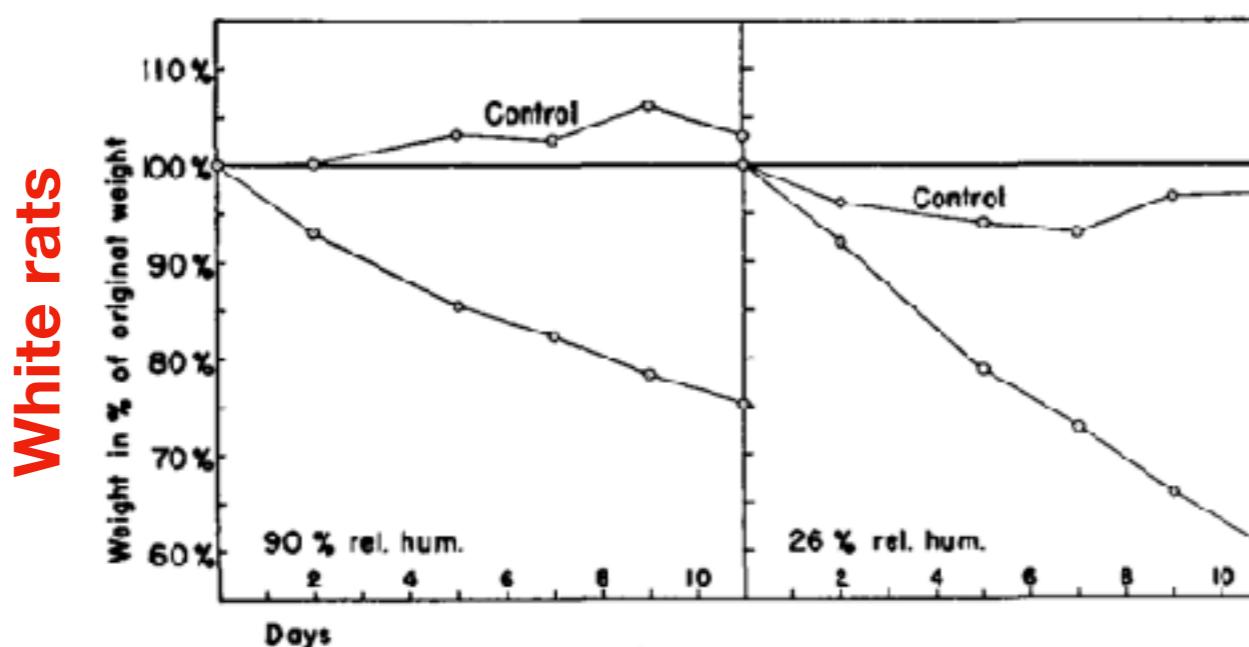
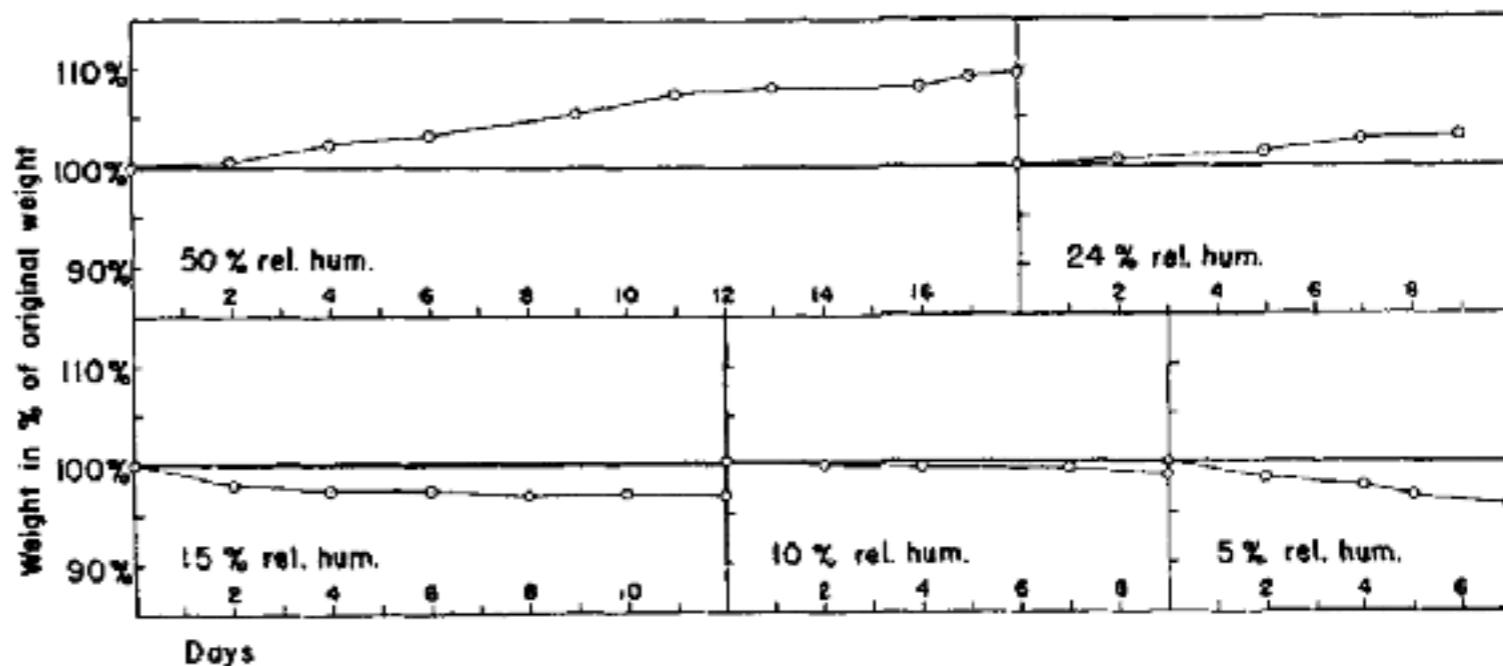


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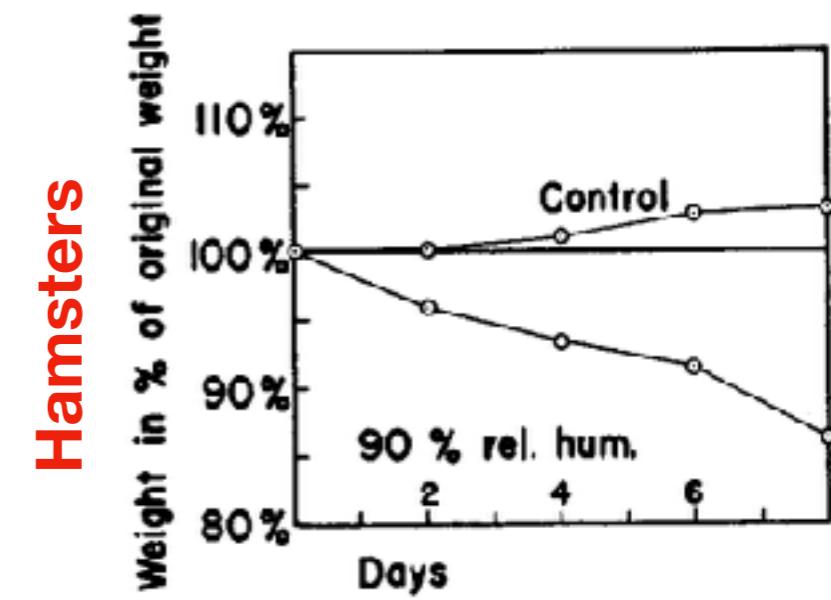
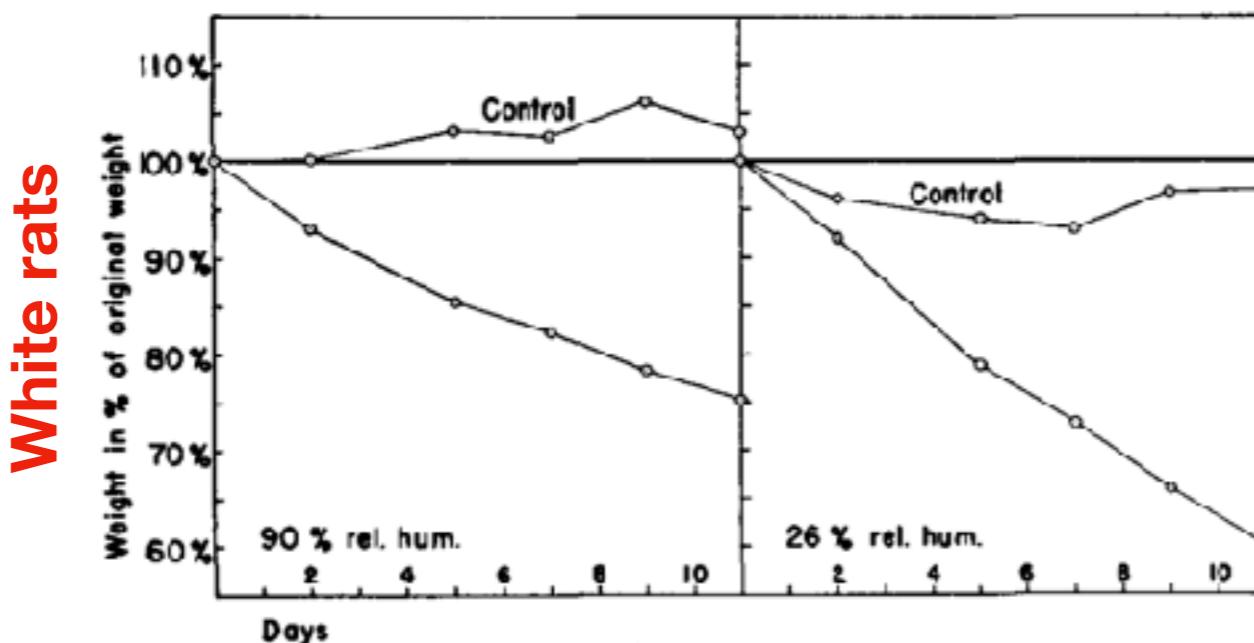
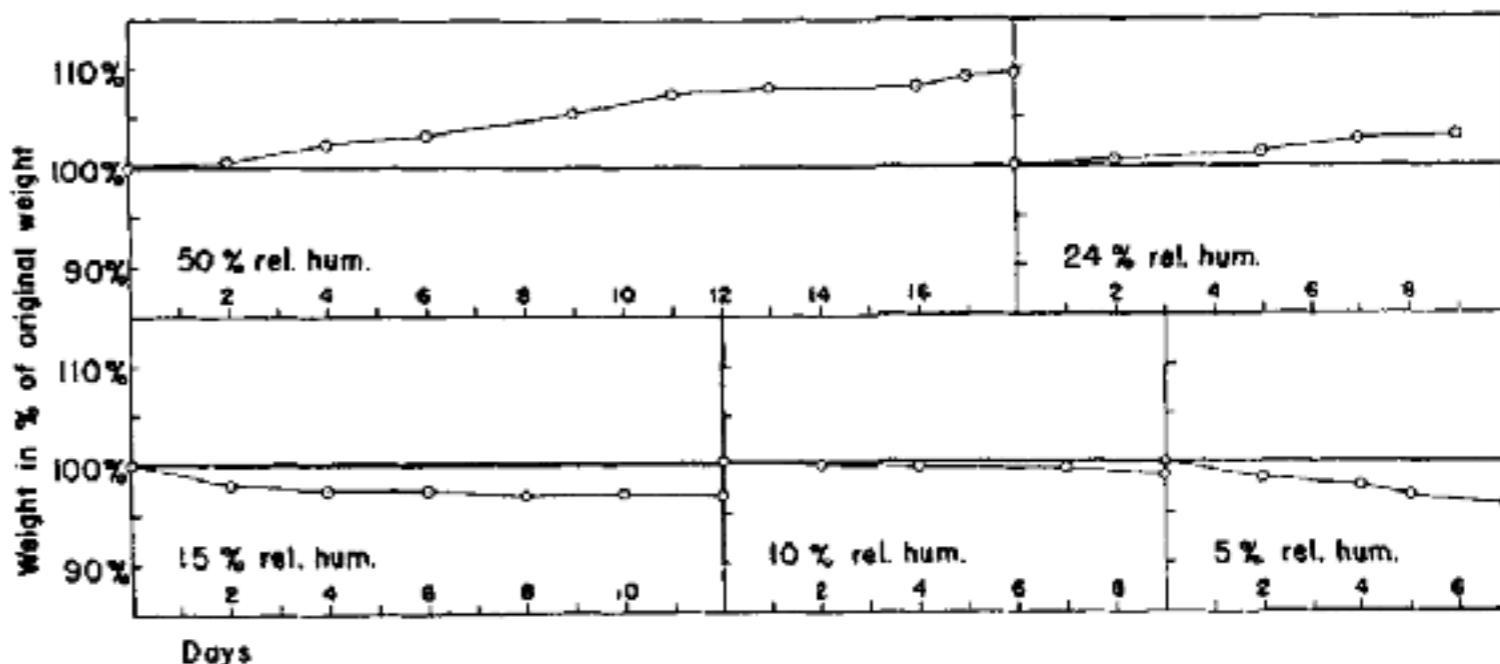


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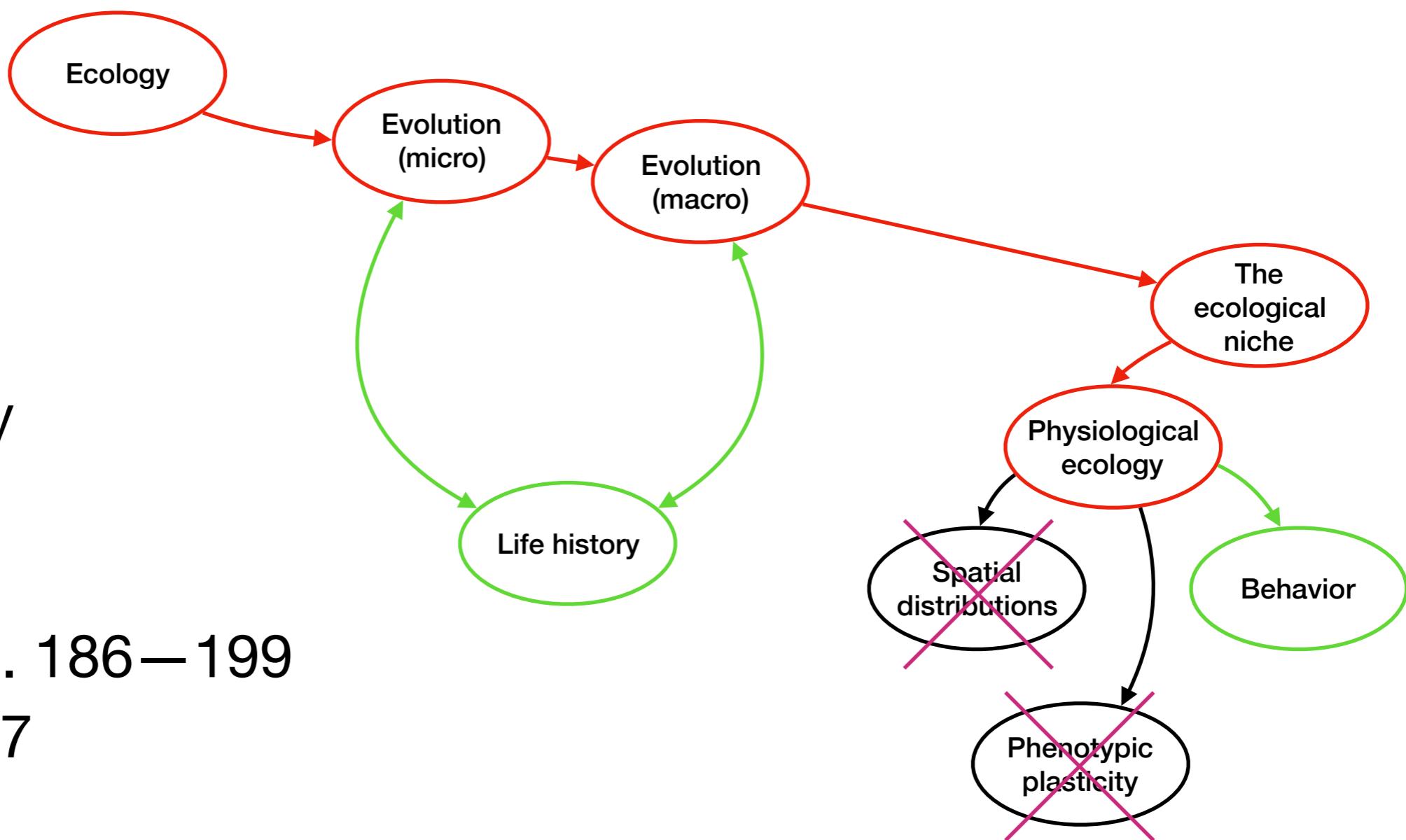
This week

Topics

1. Behavior
2. Life history

Readings

1. CBH: pgs. 186–199
2. CBH: ch. 7



Assignment

1. Assigned Problem set I