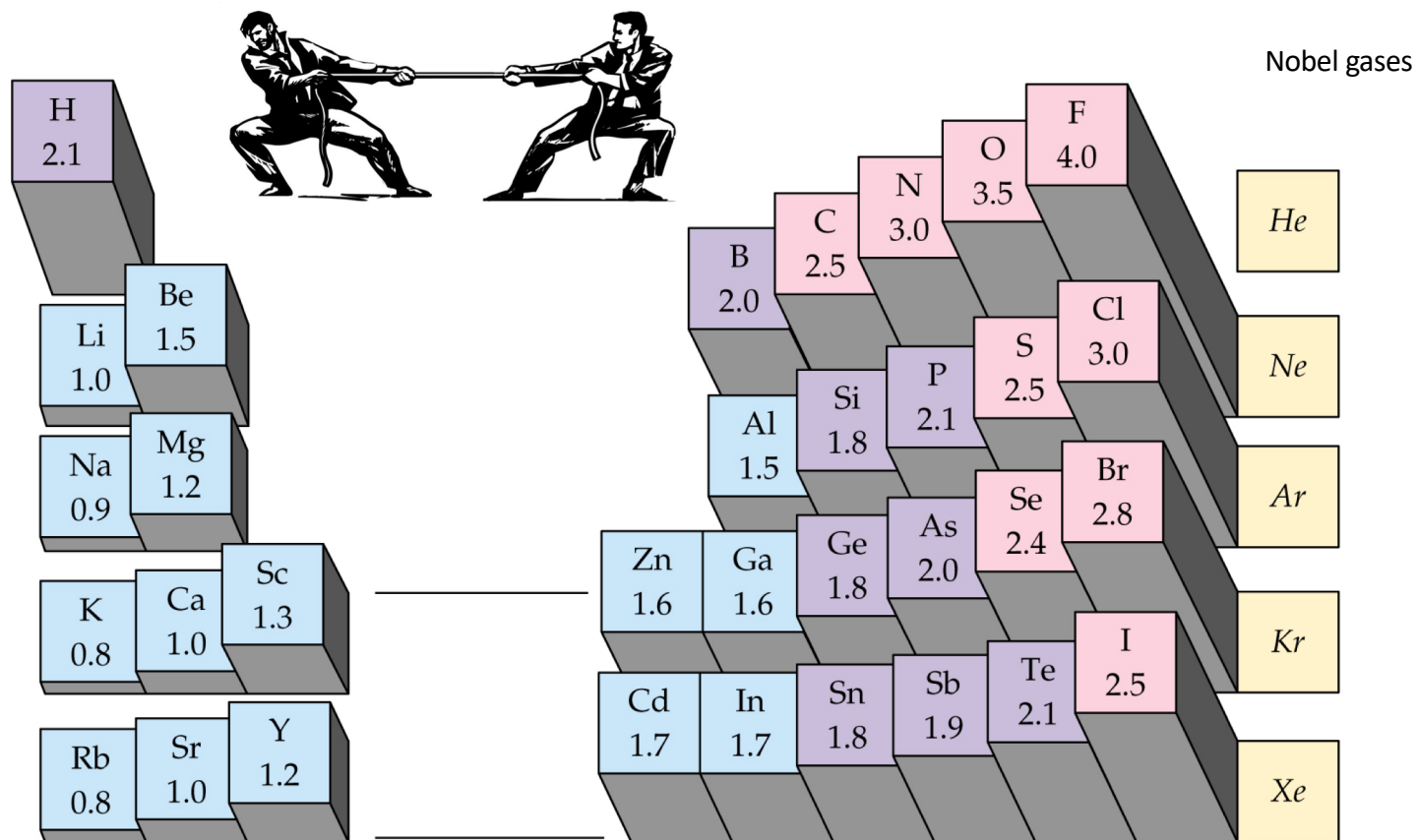


Electronegativity

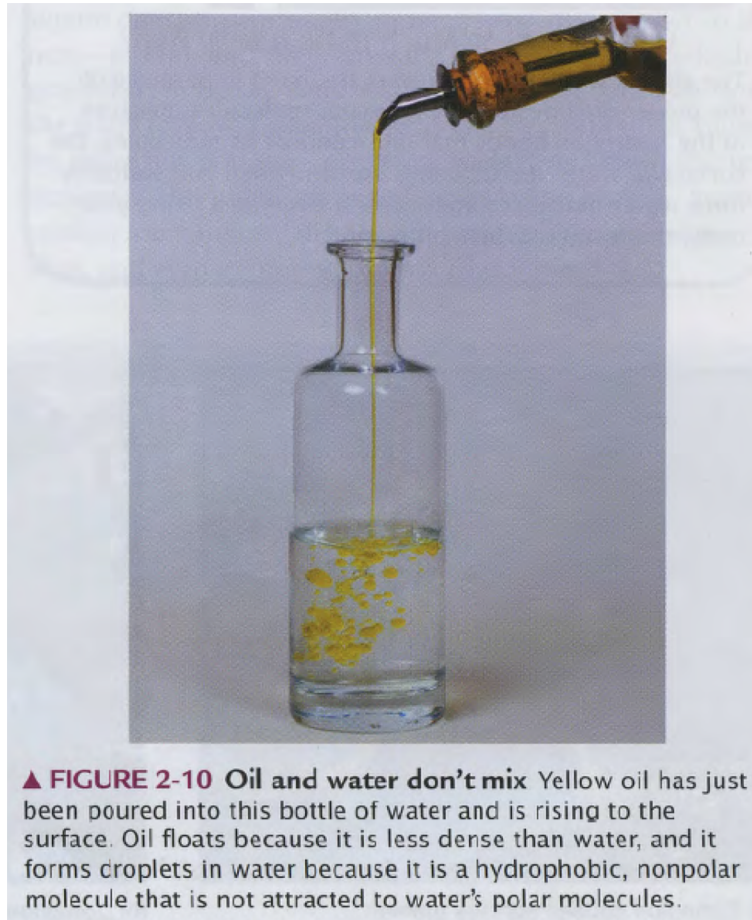


Electronegativity difference : $3.5 - 2.1 = 1.4$

Polarity and solubility

Water :

- polar
- hydrophilic



▲ **FIGURE 2-10 Oil and water don't mix** Yellow oil has just been poured into this bottle of water and is rising to the surface. Oil floats because it is less dense than water, and it forms droplets in water because it is a hydrophobic, nonpolar molecule that is not attracted to water's polar molecules.

Oil :

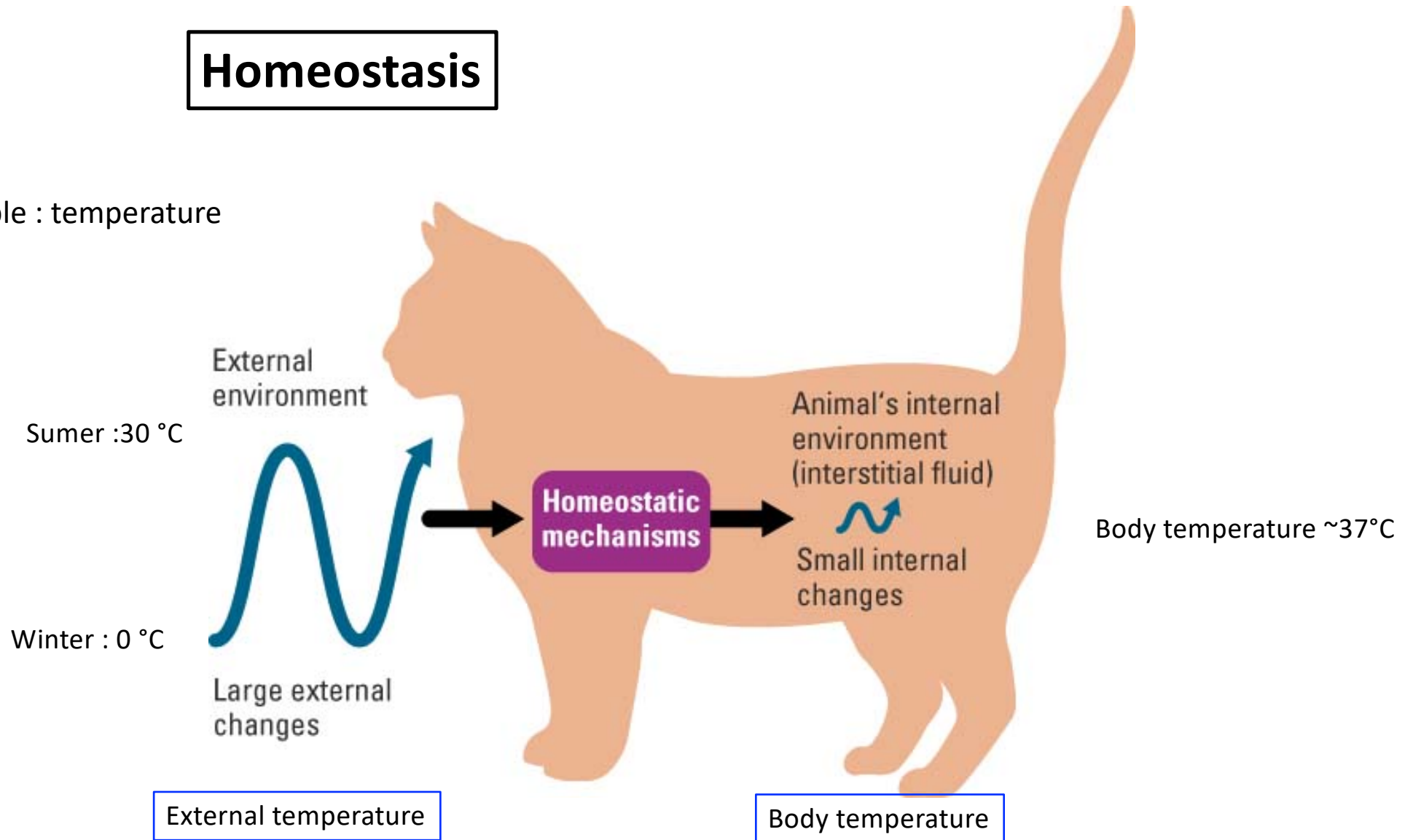
lipid

nonpolar

hydrophobic

Homeostasis

Example : temperature



Homeostasis of water content



High
water intake



Low
water intake

External
environment

Large external
changes

Homeostatic
mechanisms

Animal's internal
environment
(interstitial fluid)

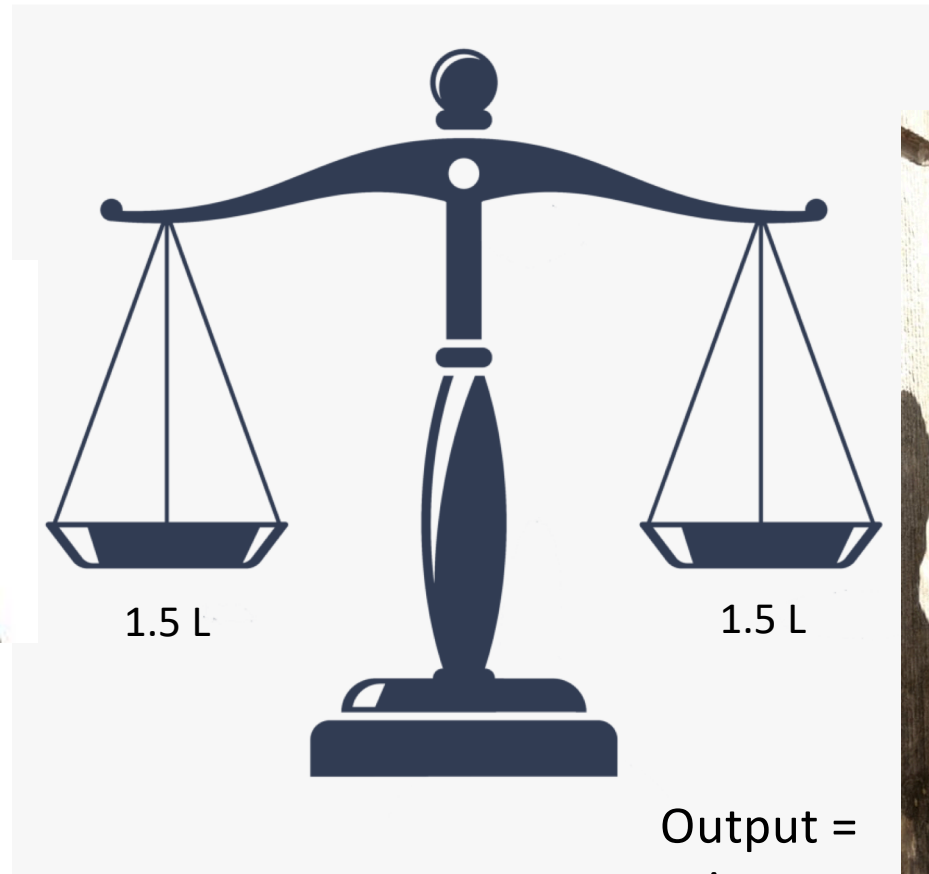
Small internal
changes

Water content ~65 %

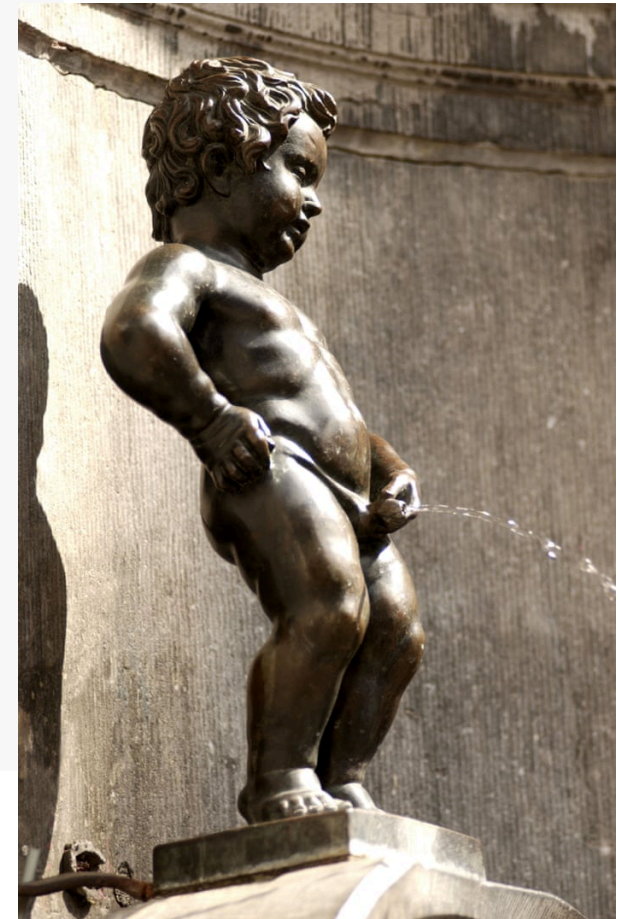
Physiology of **water balance** is not as simple as many think.



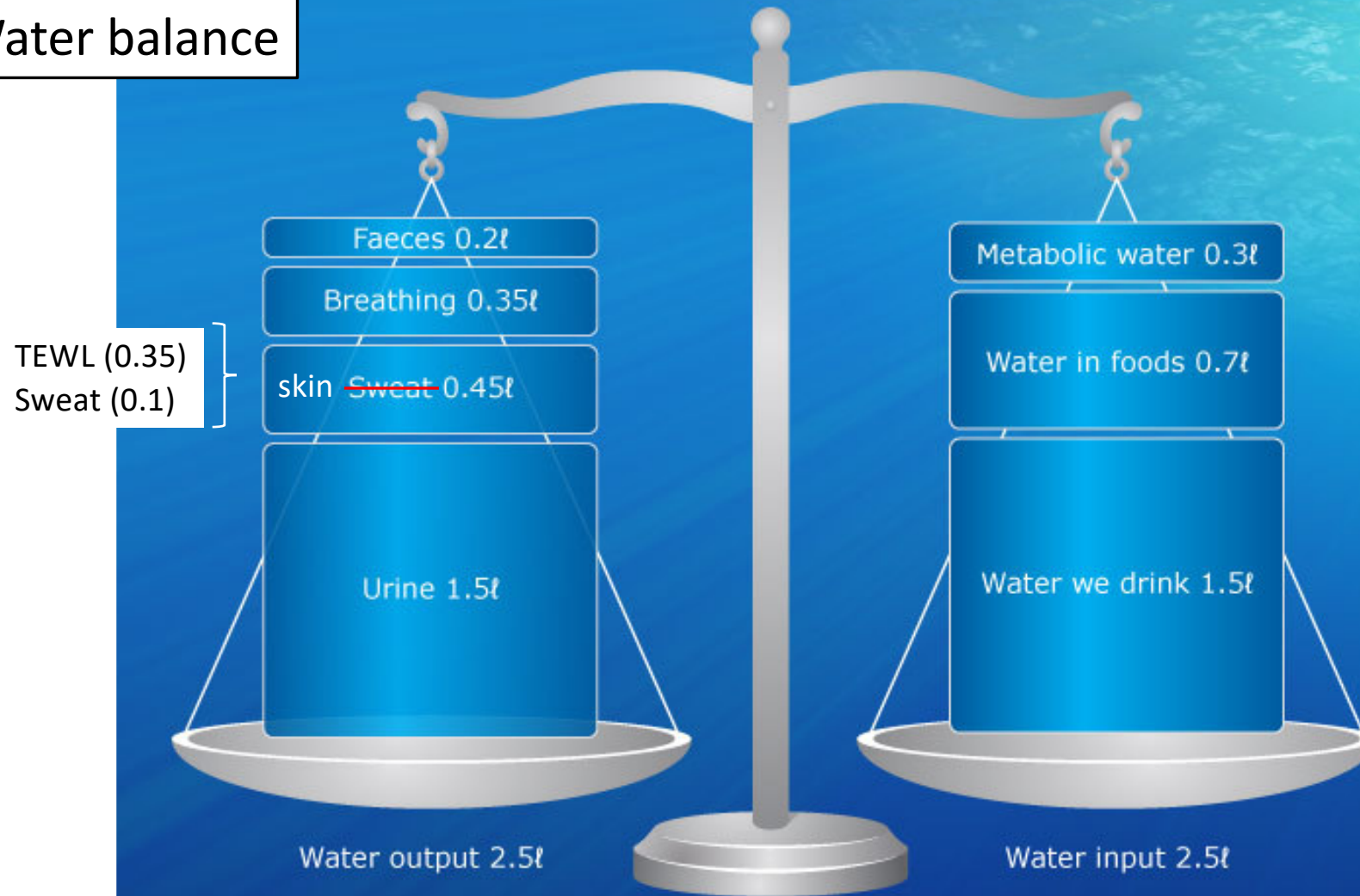
Input = beverage

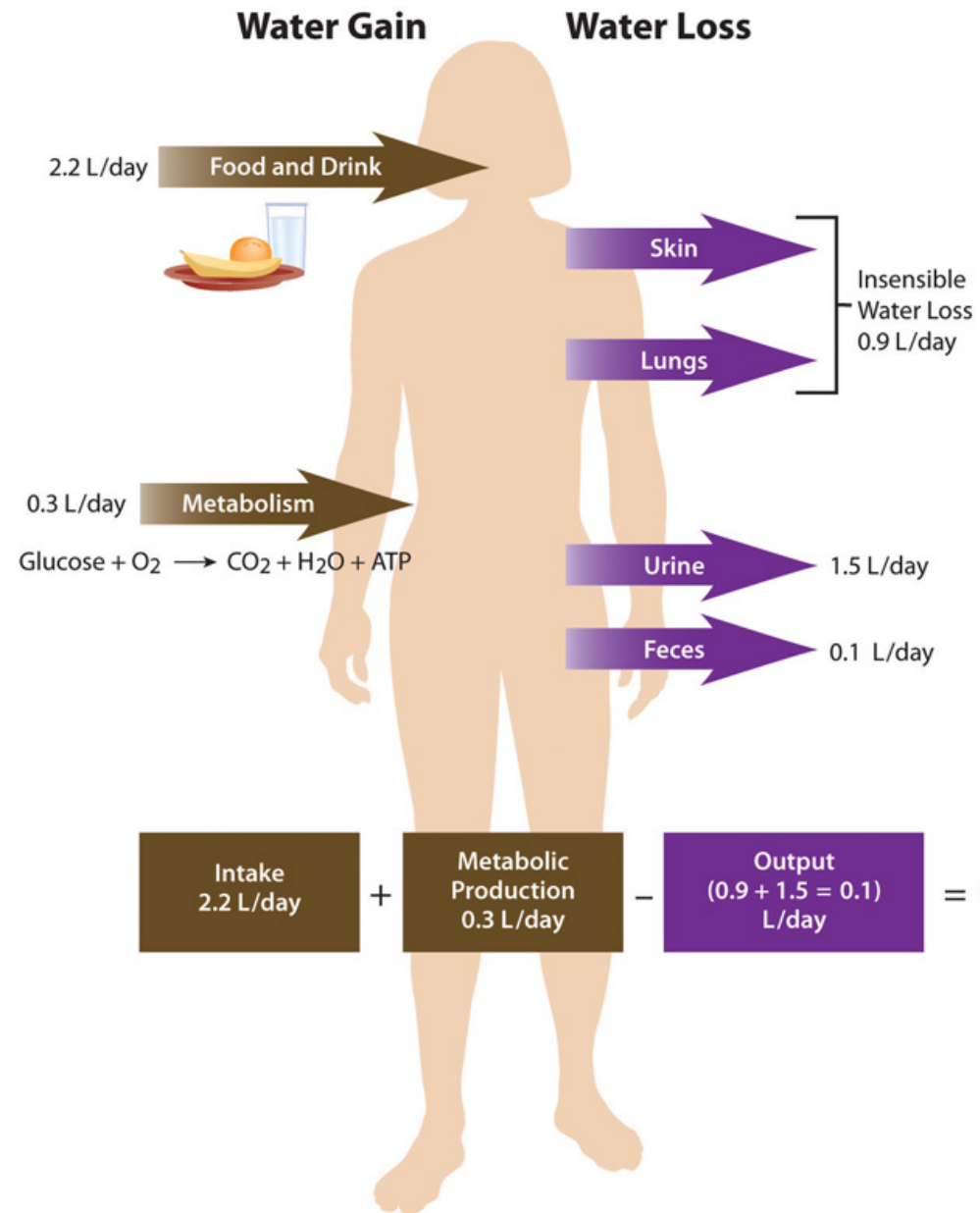


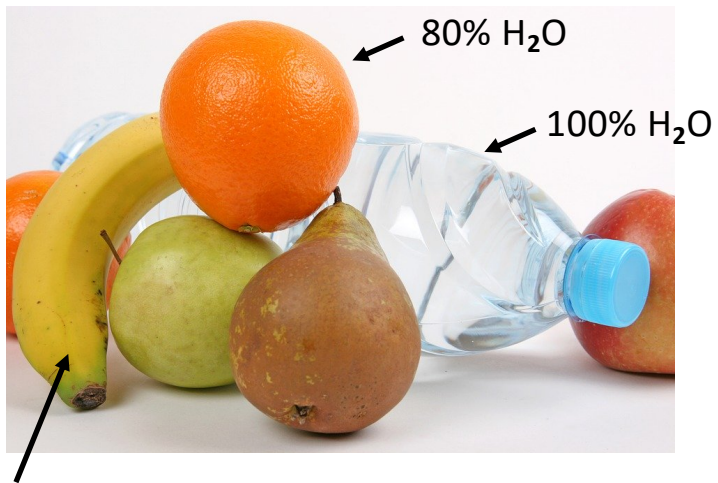
Output =
urine



Water balance



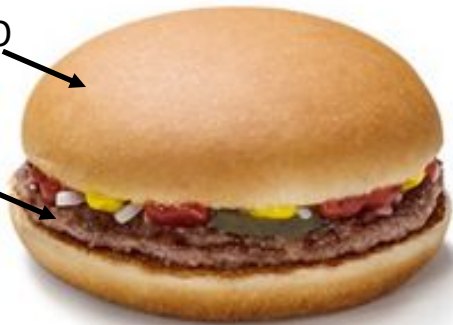




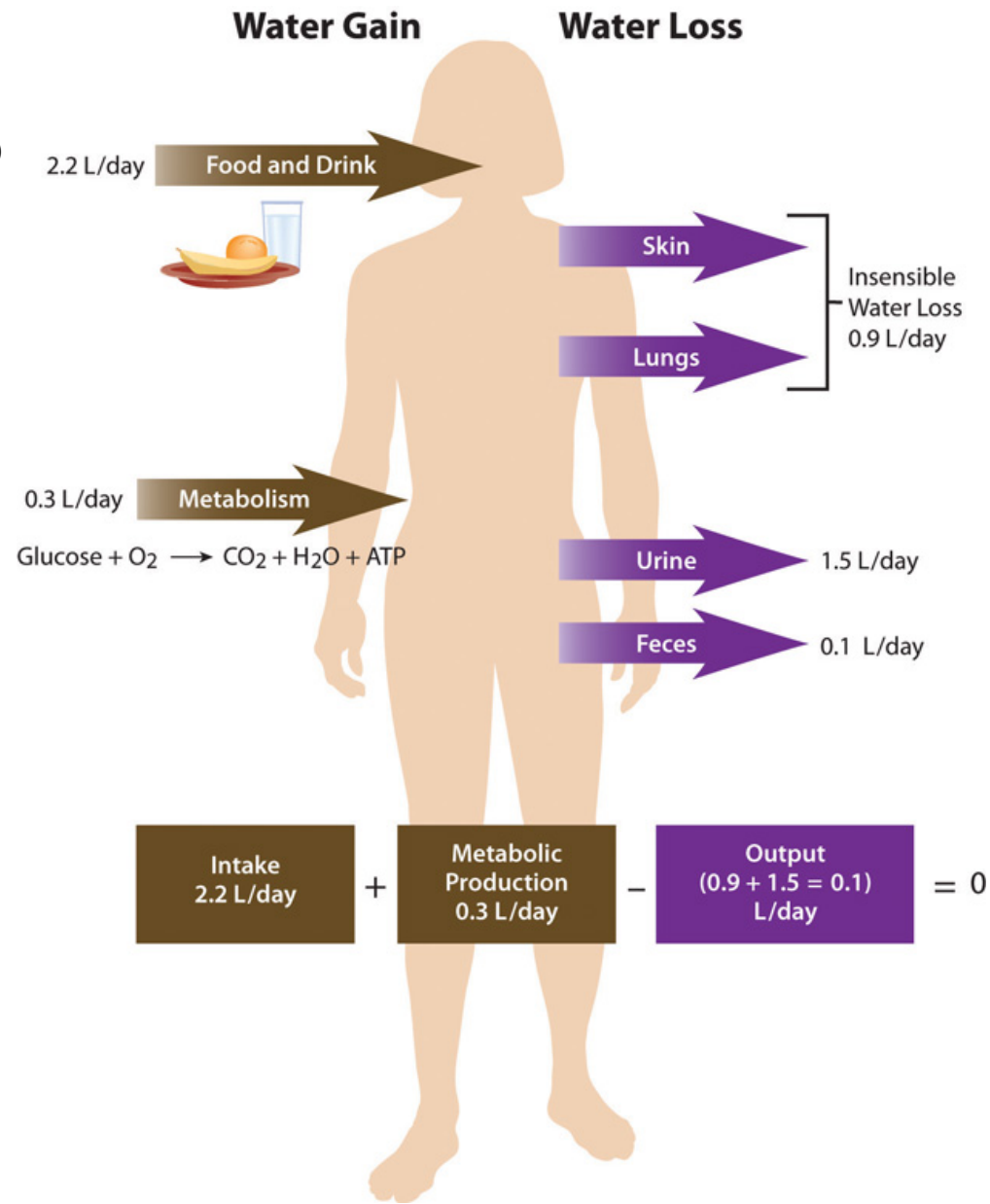
70% H₂O

40% H₂O

60% H₂O



Water from solid food



How much water in solid foods ?

Table 8.5.1: Water Content in Foods.

Percentage	Food Item
90–99	Nonfat milk, cantaloupe, strawberries, watermelon, lettuce, cabbage, celery, spinach, squash
80–89	Fruit juice, yogurt, apples, grapes, oranges, carrots, broccoli, pears, pineapple
70–79	Bananas, avocados, cottage cheese, ricotta cheese, baked potato, shrimp
60–69	Pasta, legumes, salmon, chicken breast
50–59	Ground beef, hot dogs, steak, feta cheese
40–49	Pizza
30–39	Cheddar cheese, bagels, bread
20–29	Pepperoni, cake, biscuits
10–19	Butter, margarine, raisins
1–9	Walnuts, dry-roasted peanuts, crackers, cereals, pretzels, peanut butter
0	Oils, sugars

Source: National Nutrient Database for Standard Reference, Release 23. US Department of Agriculture, Agricultural Research Service. <http://www.ars.usda.gov/ba/bhnrc/ndl>. Updated 2010. Accessed September 2017.

How much water in bred ?

Water is not indicated in the composition but you can find out.

Nutrition Facts		Amount/Serving	% Daily Value*	Amount/Serving	% Daily Value*
Serving Size 1 Slice (34g)		Total Fat 0.5g	1%	Total Carb. 15g	5%
Servings Per Container About 20		Saturated Fat 0g	1%	Dietary fiber 3g	11%
Calories 80		Trans Fat 0g		Sugars 0g	
Calories from Fat 5		Cholesterol 0mg	0%	Protein 4g	8%
Calories from Saturated Fat 0		Sodium 75mg	3%	Potassium 80mg	
*Percent Daily Values are based on a 2,000 calorie diet.		Vitamin A 0%	• Vitamin C 0%	• Calcium 0%	• Iron 4%
**This is a Condensed Nutritional Facts Panel: For More Nutritional Information Please Contact Us*					

$$15 + 4 + 0.5 + 0.08 + 0.075 + \text{WATER} = 34 \text{ g}$$

Water content : 42.2 %

$$19.655 + 14.345 = 34 \text{ g}$$

Nutrition Facts			
Serving Size 1 slice (38g)			
Servings per container 18			
Amount Per Serving			
Calories 70 Calories from Fat 10			
% Daily Value *			
Total Fat	1g		2%
Saturated Fat	0g		0%
Trans Fat	0g		
Polyunsaturated Fat	0g		
Monounsaturated Fat	0.5g		
Cholesterol	0mg		0%
Sodium	160mg		7%
Total Carbohydrate	15g		5%
Dietary Fiber	3g		12%
Sugars	less than 1g		
Protein	4g		
Vitamin A 0% • Vitamin C 0%			
Calcium	4%	• Iron	4%
Thiamin	8%	• Niacin	6%
Riboflavin	2%	• Folate	4%
*Percent Daily Values are based on a 2000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:			
	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat. Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

How much water in bred ?

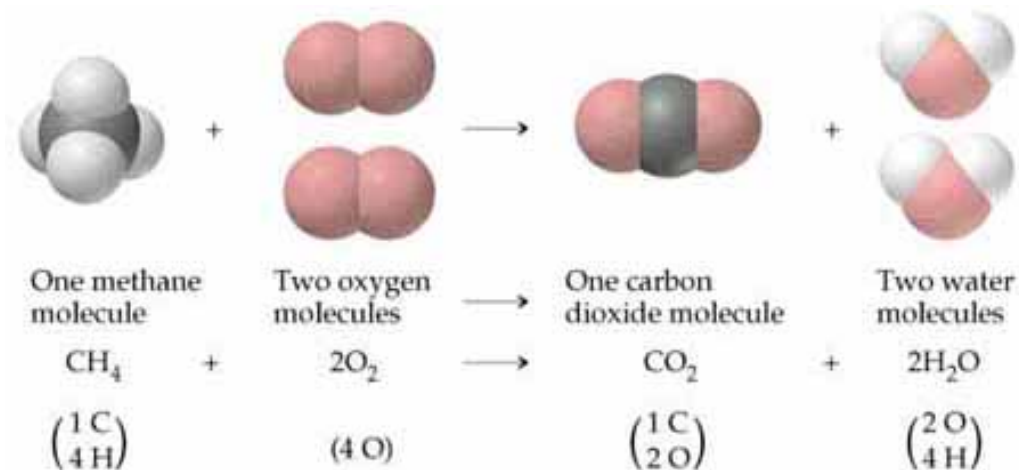


fresh bred : 38 g
old bred : 23 g

Evaporation of
15 g = 15 ml of water

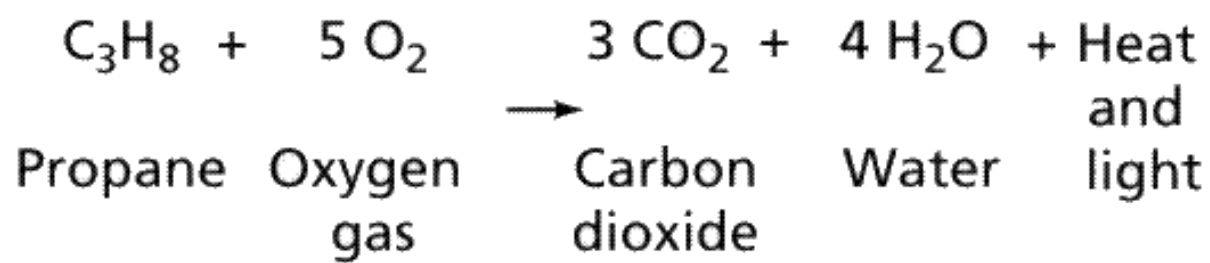
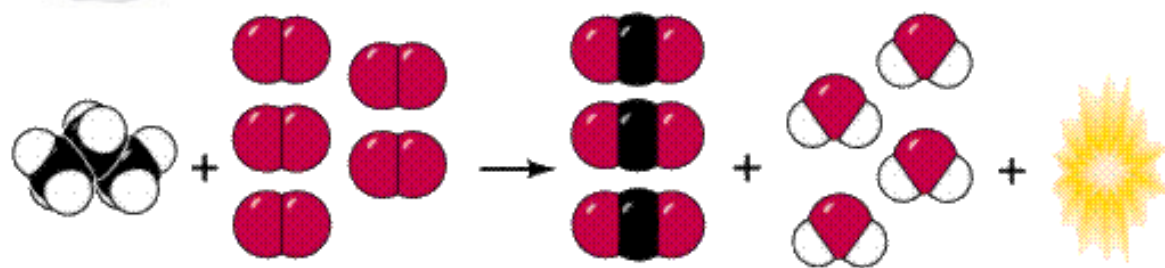
Combustion is a chemical reaction that generates water.

Example : combustion of methane.

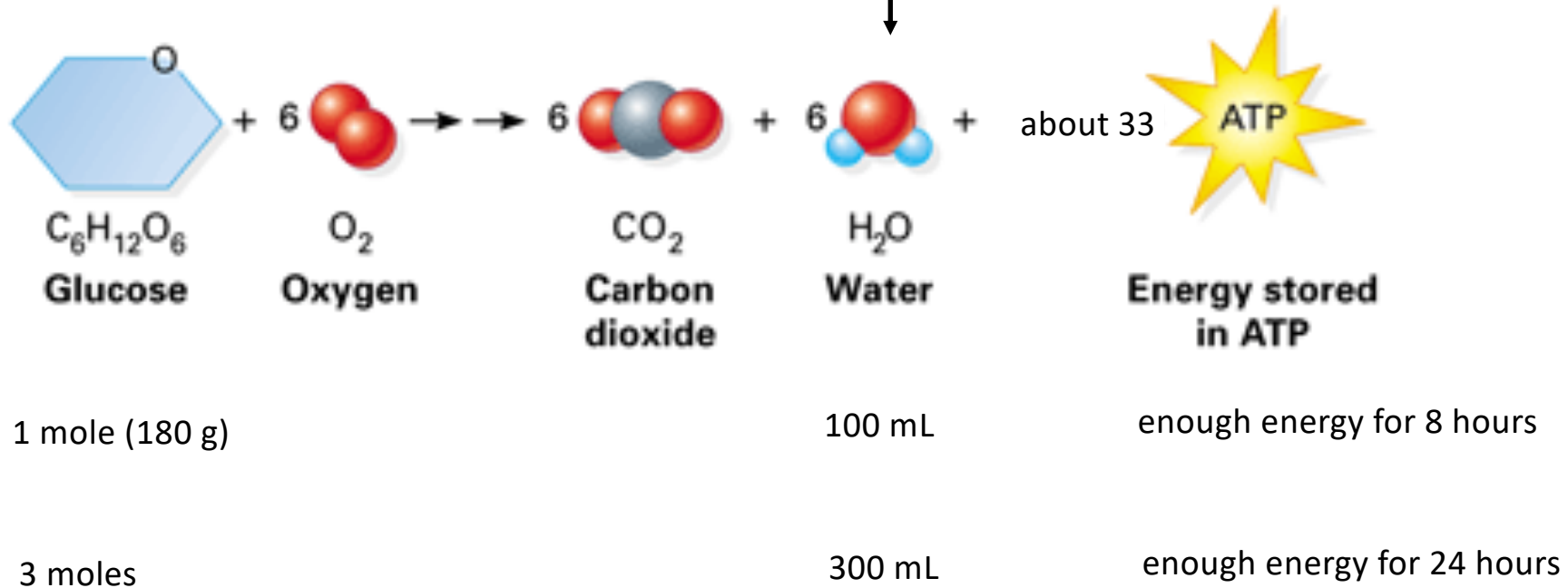


Note :

1. combustion requires O₂
2. combustion generate CO₂ and H₂O
3. combustion is exergonic
once initiated (e.g. by a sparkle) it proceeds spontaneously and rapidly
it releases energy, mostly heat and light

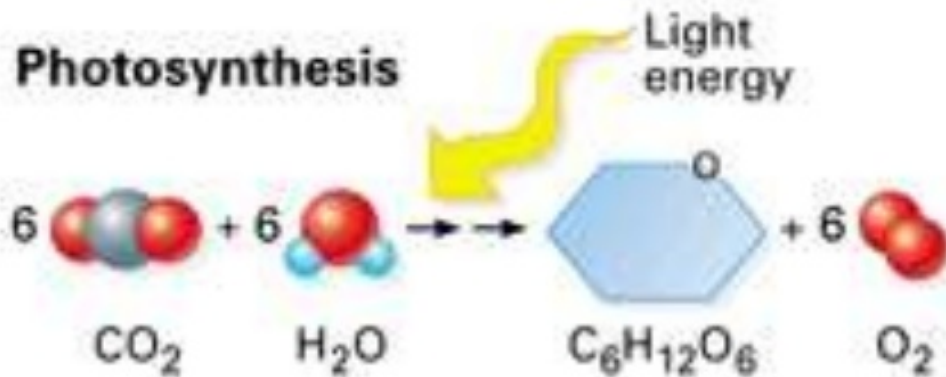


Metabolic water is water produced by the “combustion” of glucose.



(Cellular respiration will be studied later; today we focus on water.)

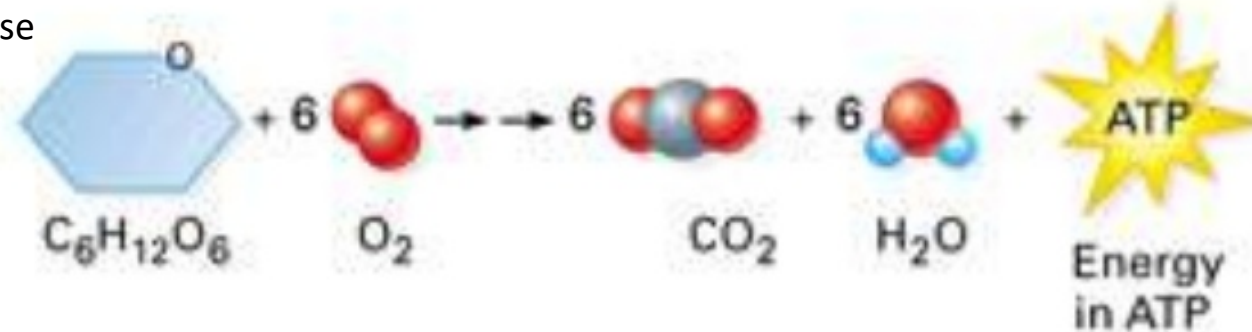
Water gain : 3. metabolic water



Everyday a human being (50 kg) produces 50 kg of ATP or 100 moles.

Cellular Respiration

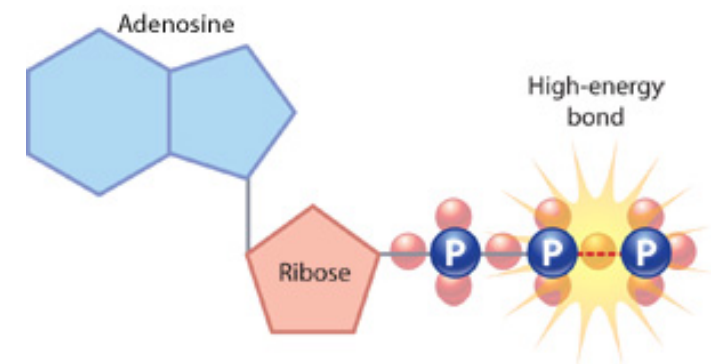
glucose



~33 moles

180 g/mol

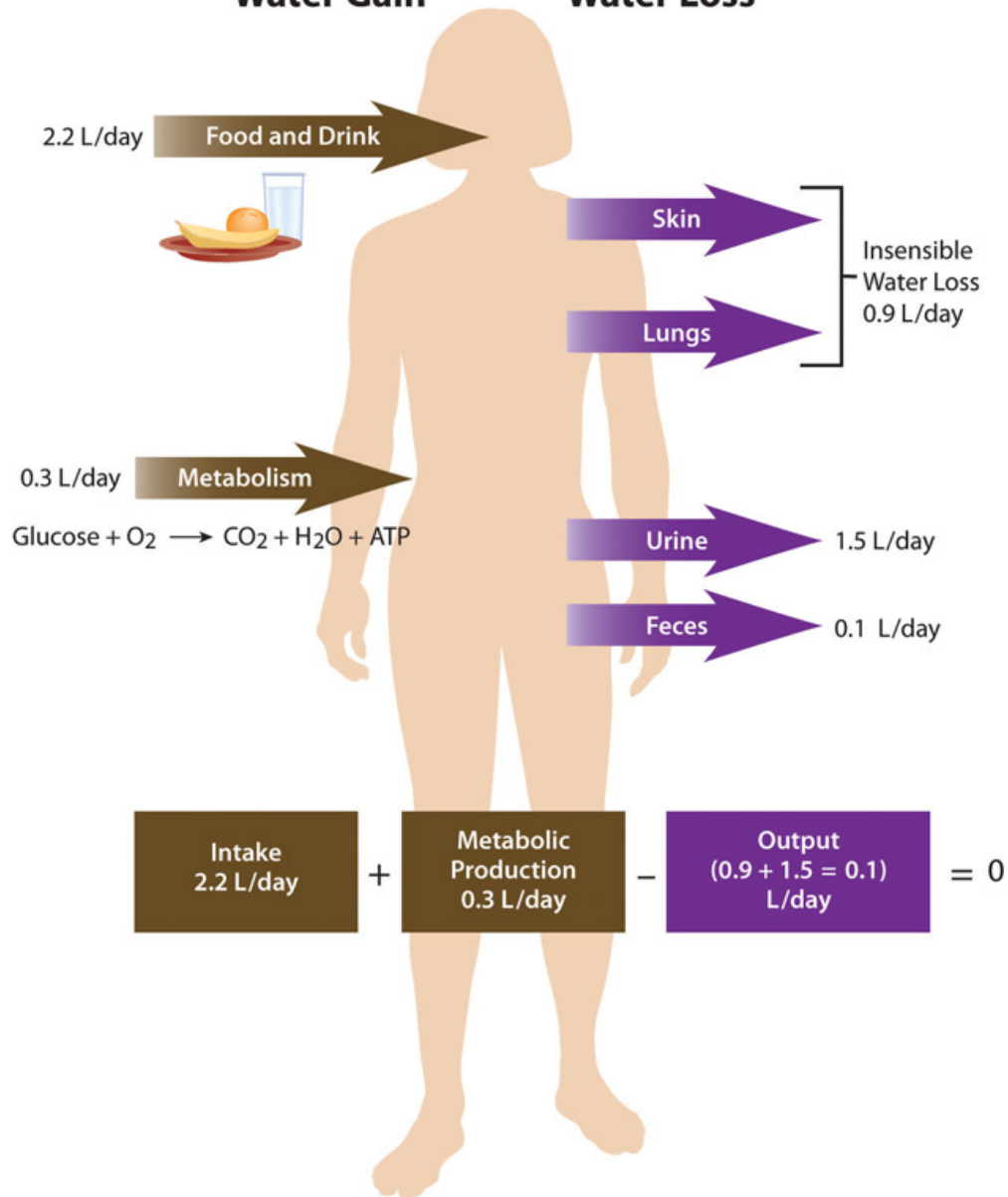
18 g/ 1 mol
108 g / 6 mol



500 g/ mol

Water Gain

Water Loss

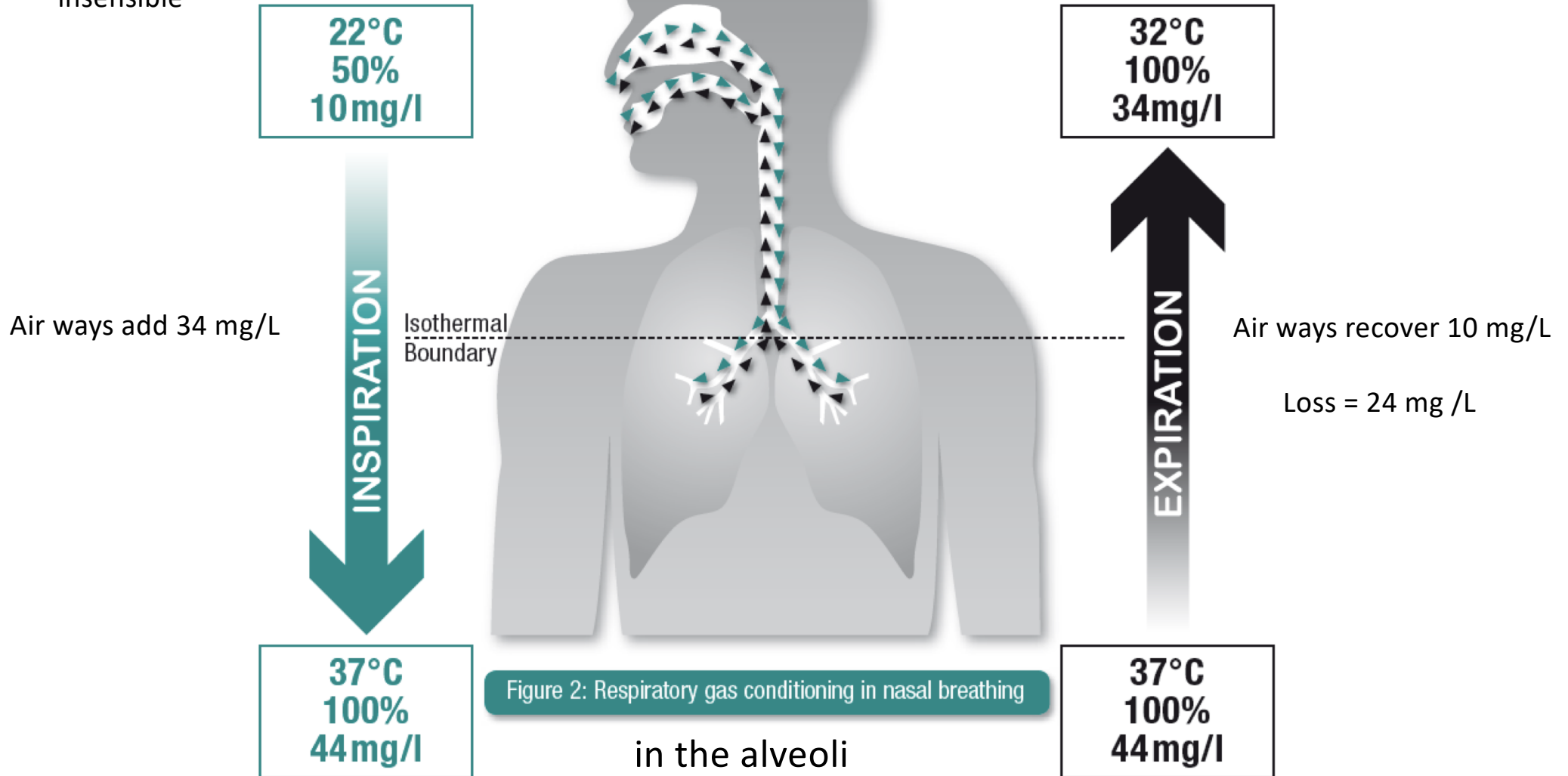


Water loss through the air ways :



Water loss : air ways

insensible



Number of respiratory cycles in 1 day

$$12 \times 60 \times 24 = 17\,280$$

8'640 Liters

$$30 \text{ mg/L} \cdot 8640 \text{ L} = 259.2 \text{ mL}$$

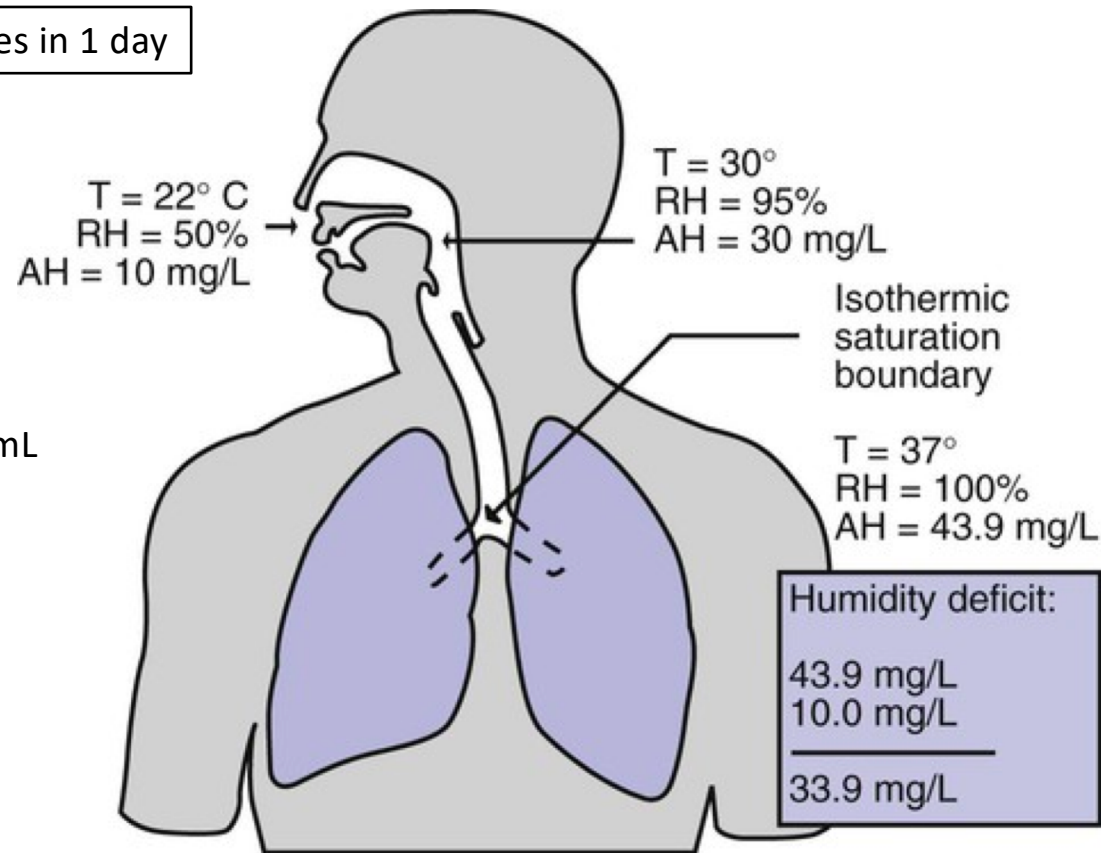
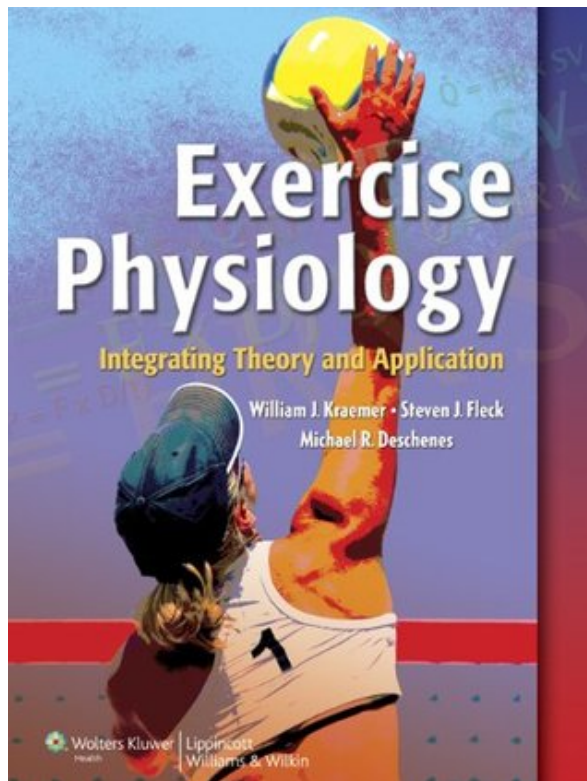


FIGURE 35-1

As a person breathes typical ambient air, the upper airway adds 20 mg/L of water vapor, and the lower airway adds 13.9 mg/L. If all of that humidity were exhaled, this would represent a 33.9 mg/L humidity deficit. (From Fink J: Humidity and aerosol therapy. In Cairo J, Pilbeam S, editors: Mosby's respiratory equipment, ed 8, St. Louis, 2010, Mosby.)



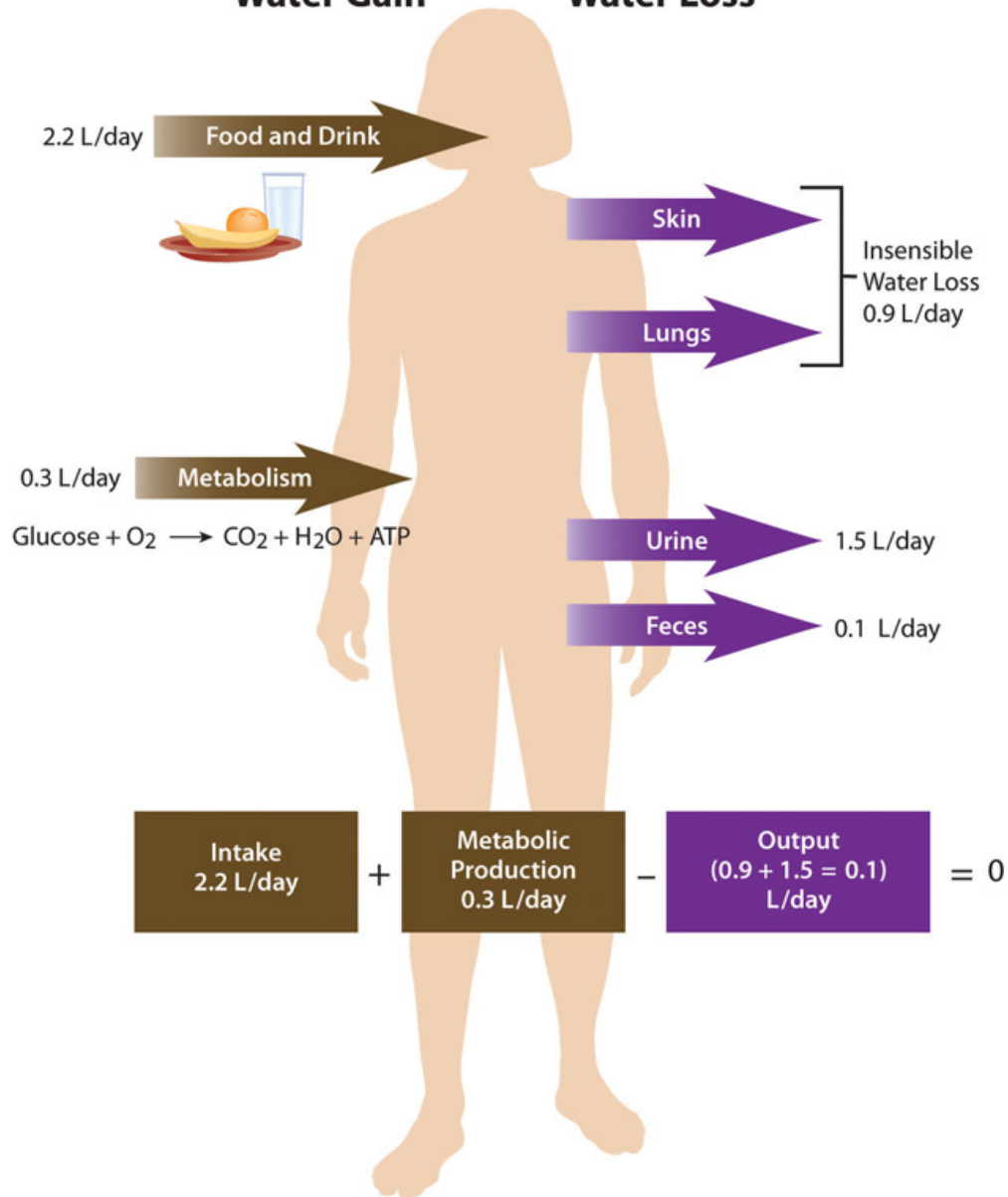
Humidifying, Warming, and Filtering of Air

Besides being conduits through which air travels, the structures prior to the respiratory bronchioles also humidify, warm, and filter the air. All three of these processes are necessary to protect the delicate membranes of the respiratory bronchioles and alveoli, where capillary gas exchange takes place. **Humidifying** the air prevents the membranes from damage due to drying out or desiccation. Increasing the water vapor content of the air is especially important in low-humidity or dry climates. Properly moistening the air as it travels into the lungs is also important in very cold climates, especially during the winter, since cold air is typically very dry.

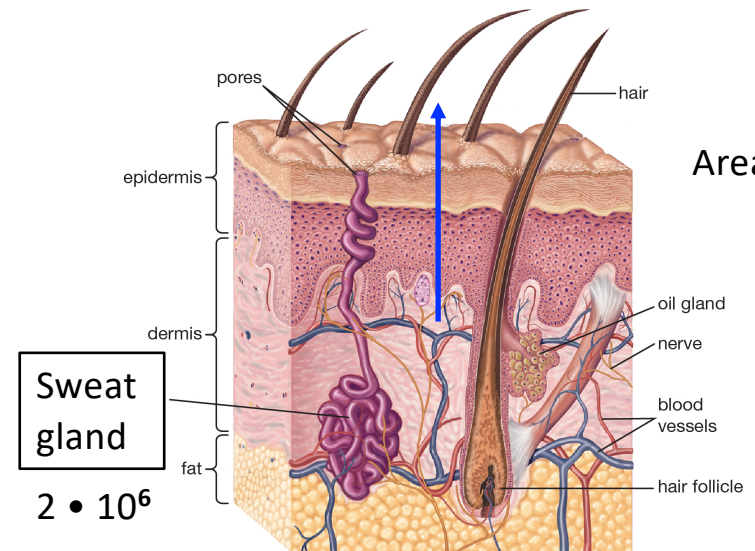
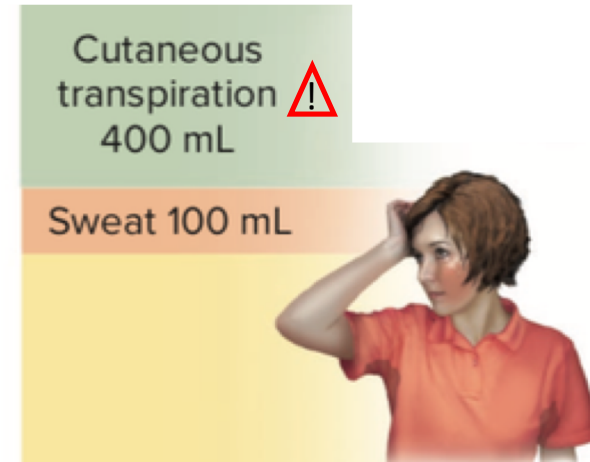
Warming of the air helps to maintain body temperature of the lungs as well as the temperature of the structures where capillary gas exchange takes place. Warming of the air is probably most important in cold environments.

Water Gain

Water Loss



Water loss through the skin :



Sweating versus Water Loss

There are two ways in which water can be eliminated at the skin surface level.

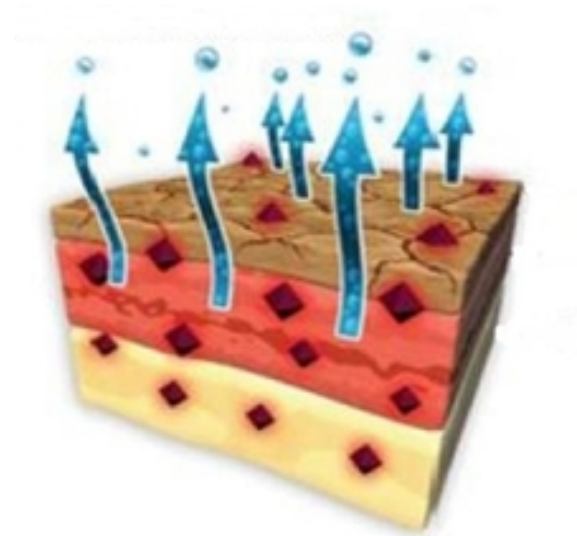
The first is **sweating**, a process with which we are all relatively familiar.

Sweating is an 'active' process and responds to nerve impulses when the core body temperature increases (e.g. exercise, stress, warm environment).

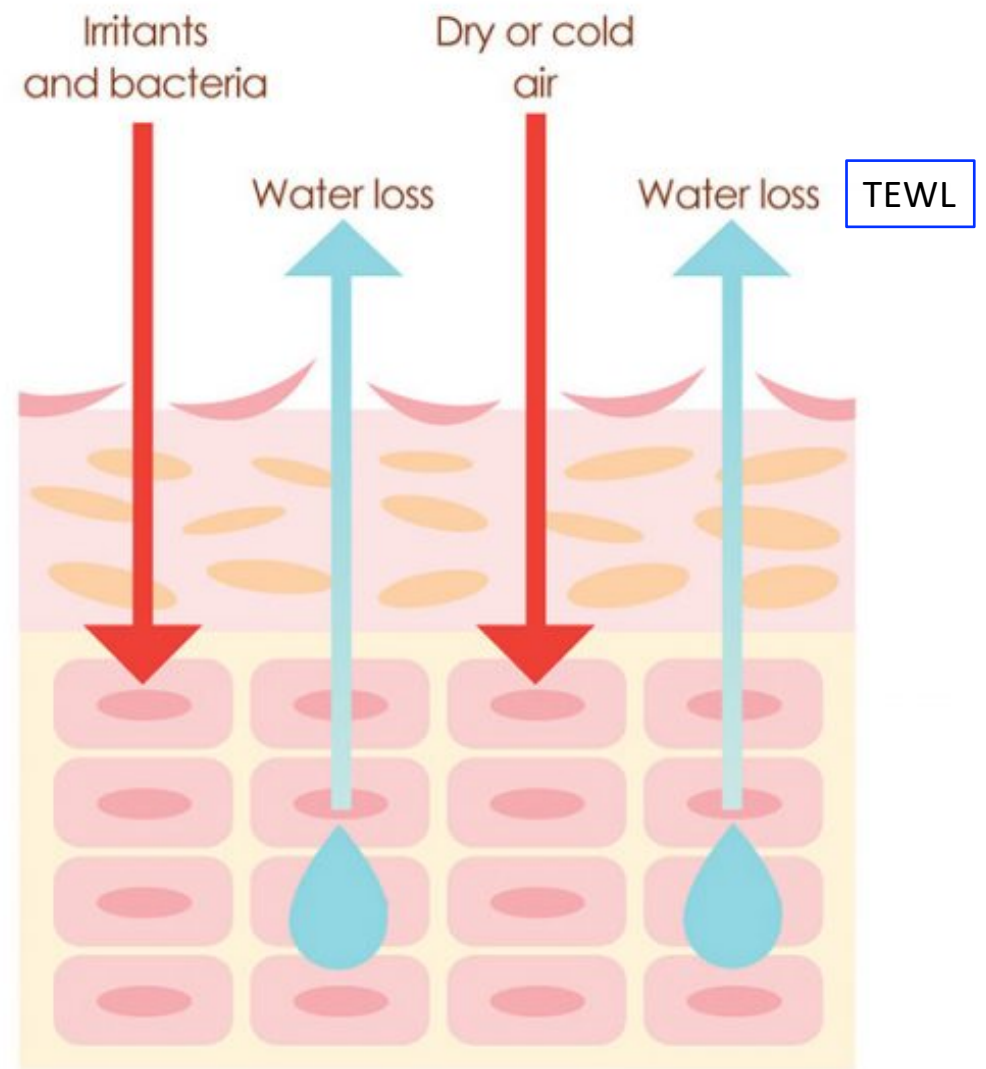
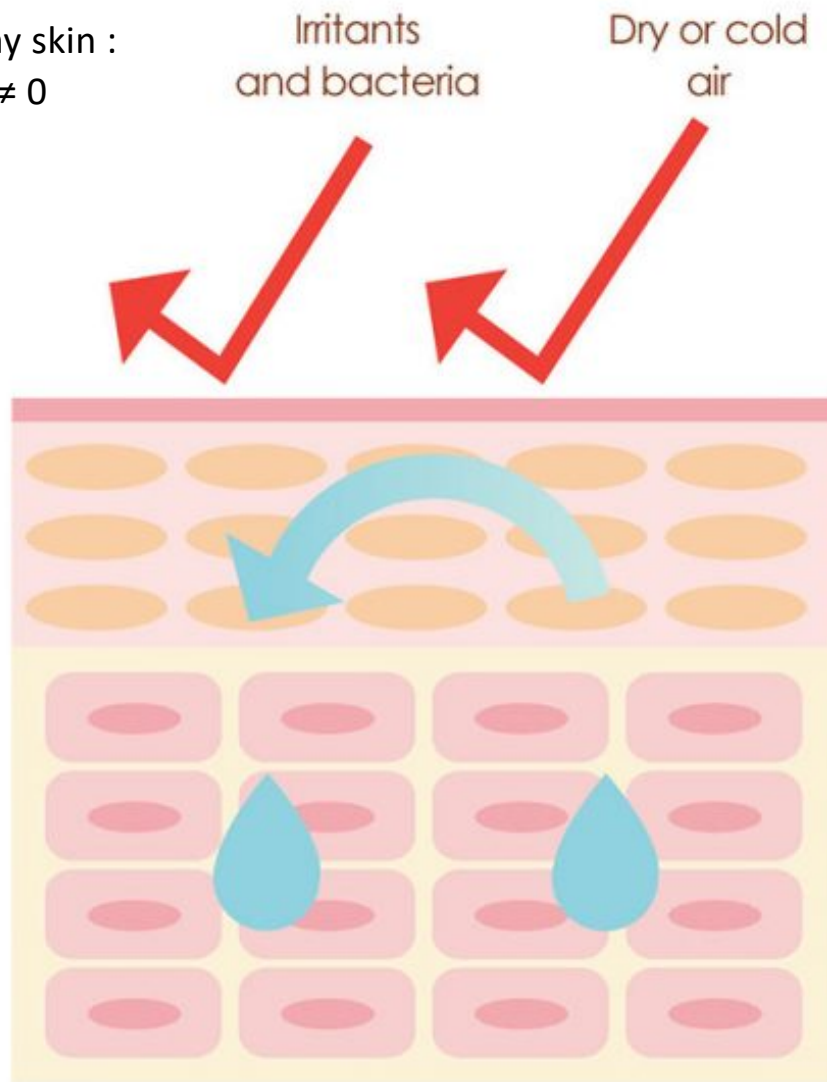
Having said this, there also exist a 'passive' or insensible (or imperceptible) process which is referred to as **transepidermal water loss** (TEWL). This is essentially the passage of water across the skin's surface. This form of water loss does not involve the sweat glands.

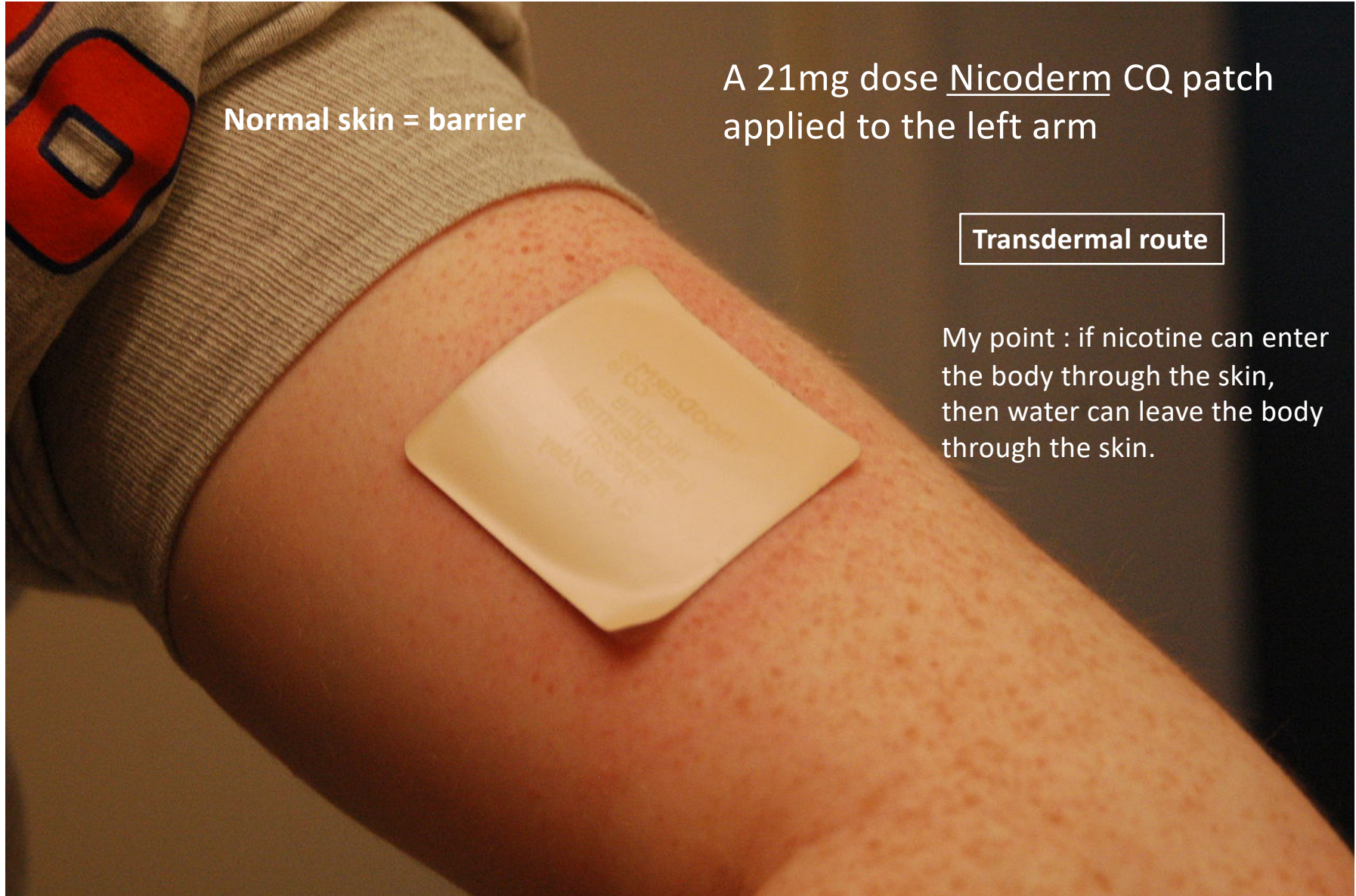
If you think **transepidermal water loss** (TEWL) is insignificant, think again. Under normal circumstances, the body sheds about 30g of water per hour. That's about an ounce of water per hour or the equivalent of one can of soda every half day. We often refer to TEWL when we treat dry skin. In fact, skin creams are essentially barriers that we apply to prevent TEWL. By doing so, we allow the skin to remain hydrated.

<http://www.drypharmacist.com/sweating-vs-water-loss.html>



Healthy skin :
TEWL $\neq 0$





Normal skin = barrier

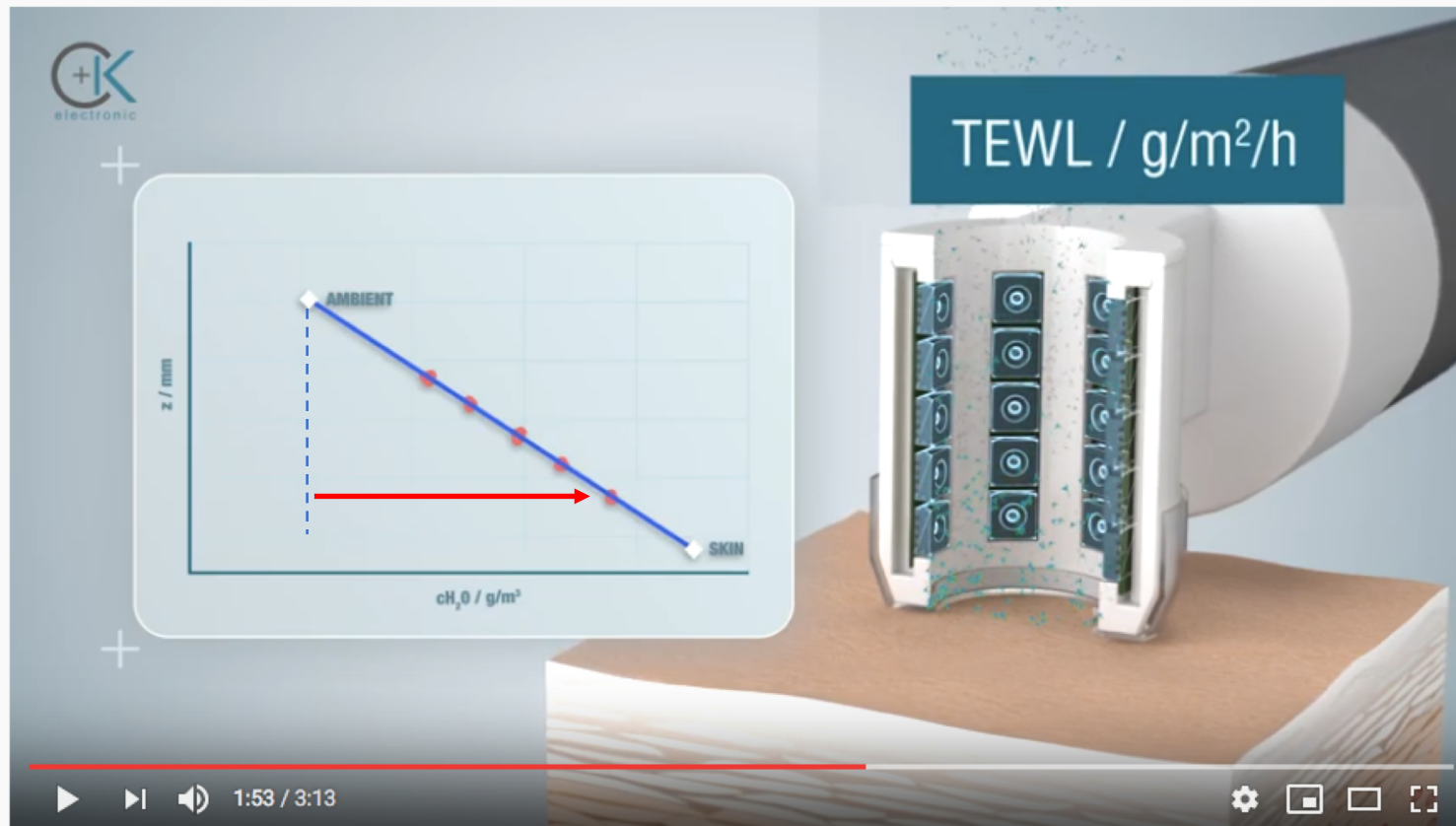
A 21mg dose Nicoderm CQ patch
applied to the left arm

Transdermal route

My point : if nicotine can enter
the body through the skin,
then water can leave the body
through the skin.

Device to measure TEWL :

Link to the video on Moodle



Tewameter® TM Hex - Ultimate Measurement of Transepidermal Water Loss and Beyond

661 views • Mar 13, 2020

7 0 SHARE SAVE ...

Thermography

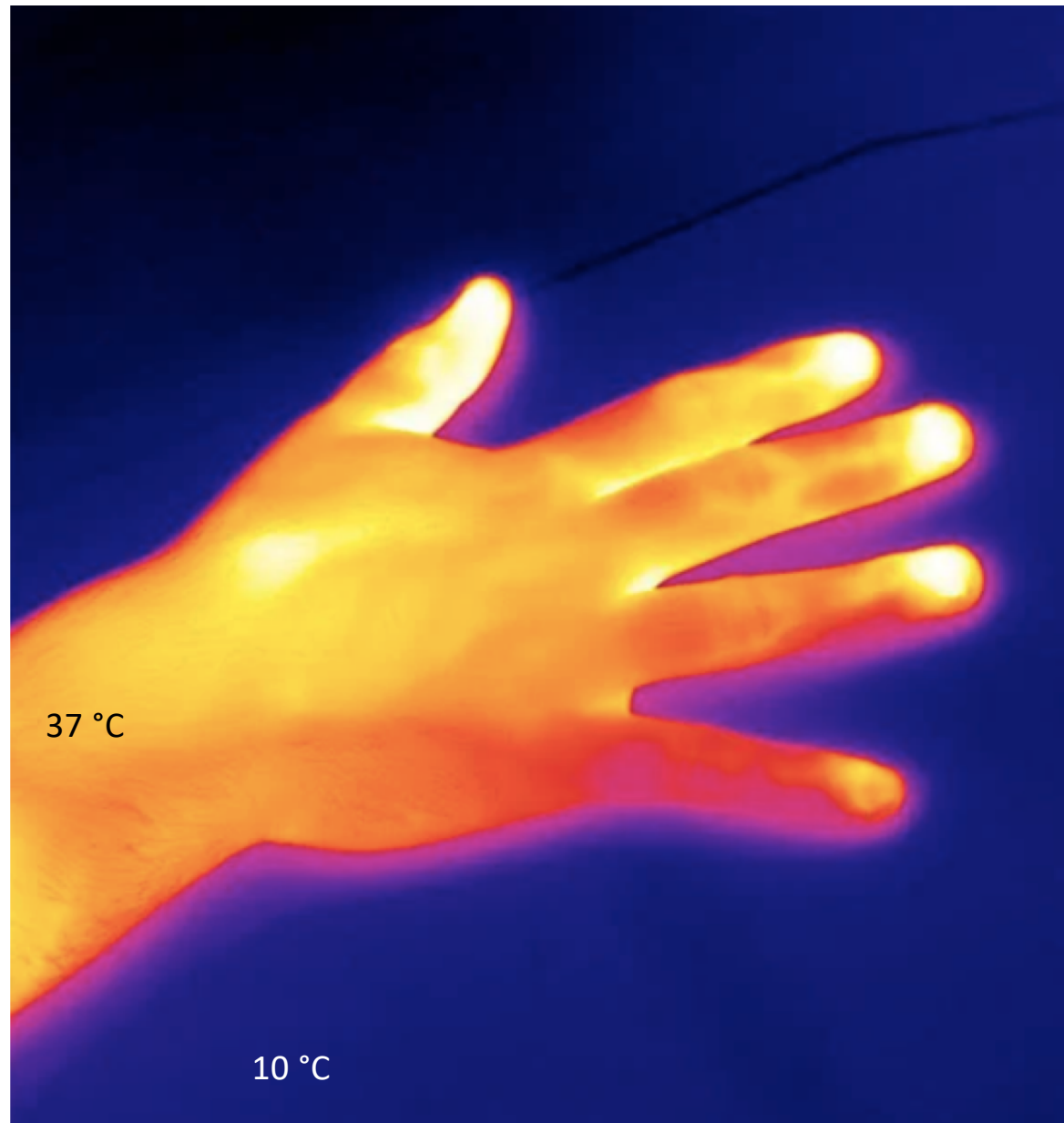


Table 34-2. Effect of Environmental Temperature and Exercise on Water Loss and Intake (mL/day) in Adults

	23 °C	Normal Temperature	Hot Weather*	Prolonged Heavy Exercise*
Water Loss				
Insensible Loss				
Skin	Transepidermal water loss	350	350	350 constant
Lungs		350	250 !	650
Sweat		100	1400	5000 variable
Feces		200	200	200
Urine*		1500	1200	500
Total Loss		2500	3400	6700
Water Intake to Maintain Water Balance		2500	3400	6700

*In hot weather and during prolonged heavy exercise, water balance is maintained by increased water ingestion. Decreased excretion of water by the kidneys alone is insufficient to maintain water balance.

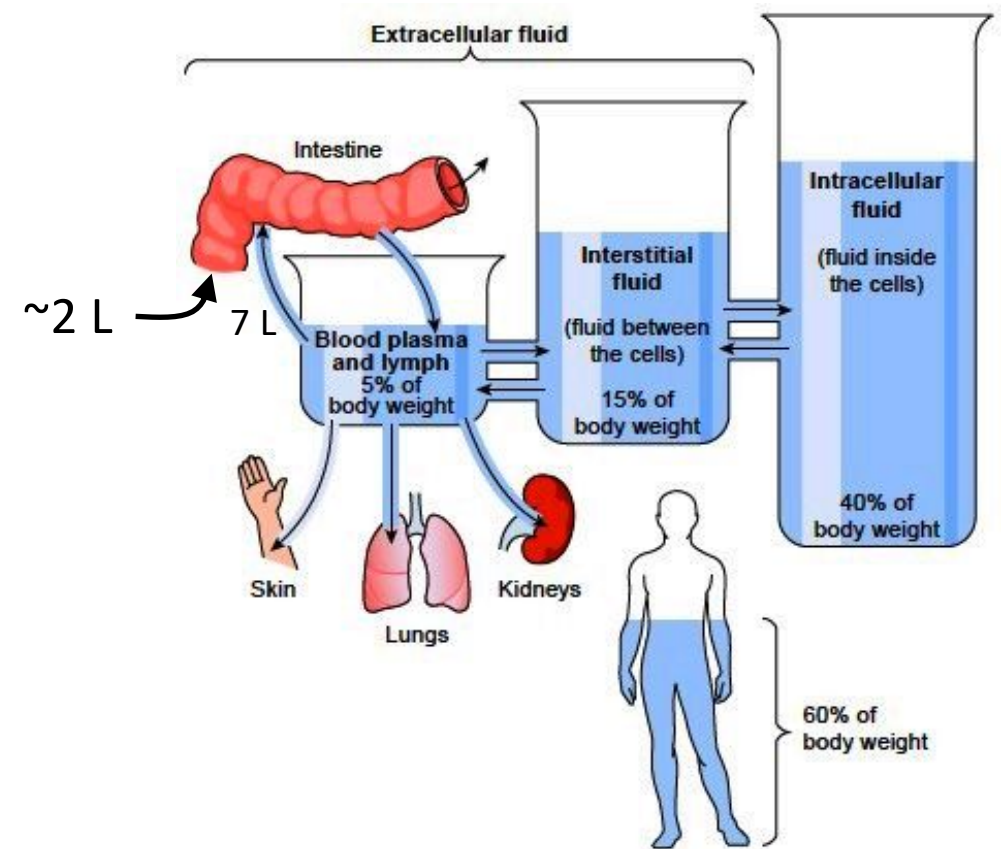
(Berne and Levy)

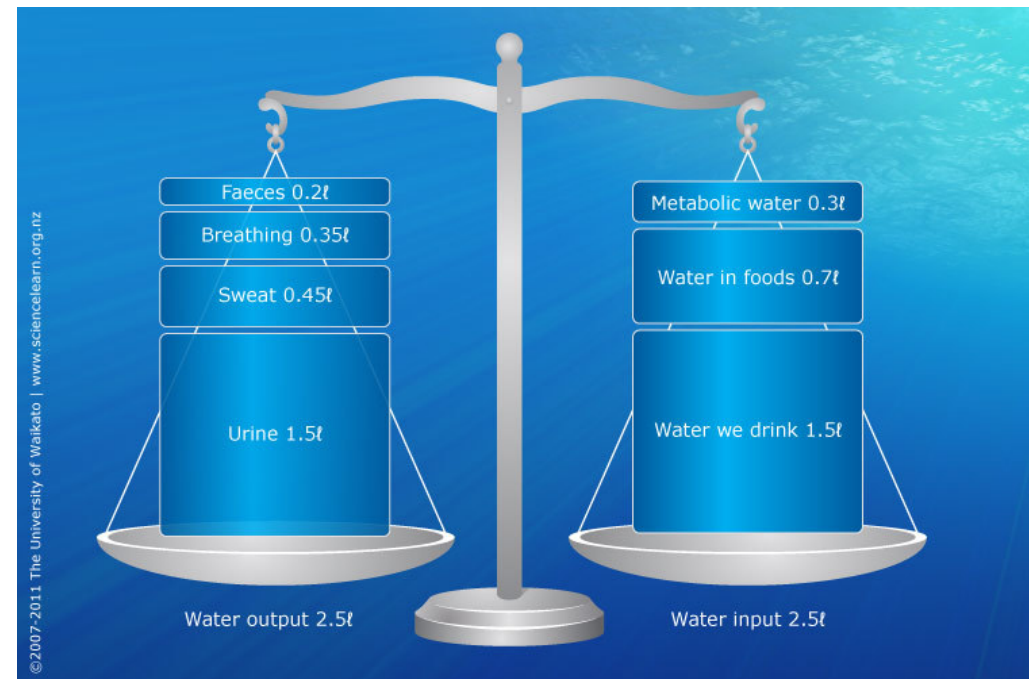
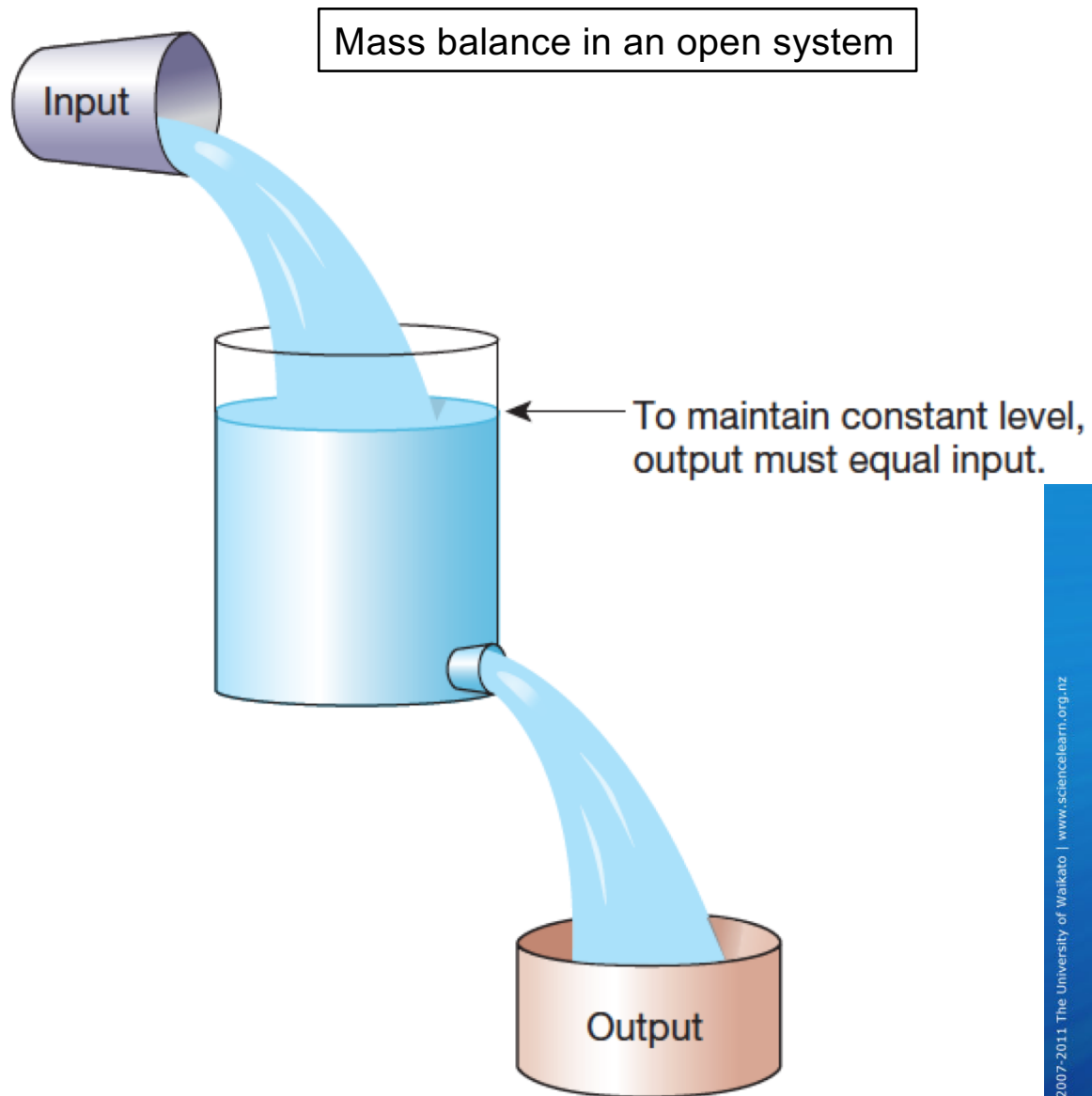
Approximately **9 L** of fluid enter the gastrointestinal tract daily, 2 L by ingestion and 7 L by secretion; almost 98% of this volume is absorbed, such that daily fecal fluid loss is only **100–200 mL**. Impaired gastrointestinal reabsorption or enhanced secretion of fluid can cause hypovolemia. Because gastric secretions have a low pH (high H^+ concentration), whereas biliary, pancreatic, and intestinal secretions are alkaline (high HCO_3^- concentration), vomiting and **diarrhea** are often accompanied by metabolic alkalosis and acidosis, respectively.

Water loss in the faeces

Secretions :

- Saliva
- Bile
- HCl
- Pancreatic juice
- etc.





Real story :

She drunk
2 gallon of water in 3 hours

7.5 Liters in 3 hours



two tickets to a
Justin Timberlake concert
that night in Sacramento.

Jennifer STRANGE died on January 12th 2007 due to **water intoxication**.

