

sportology

Sarah & the sportologists



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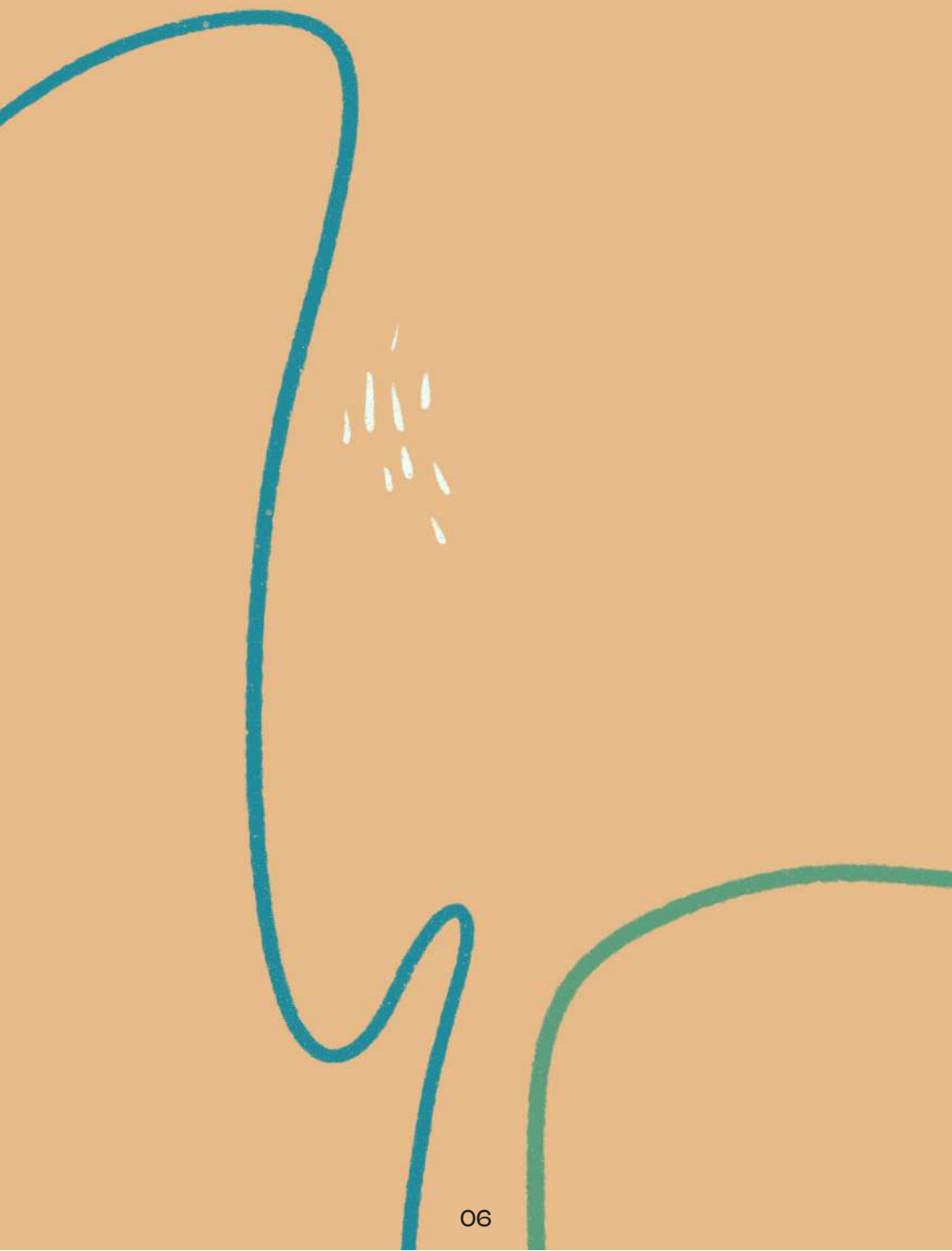
Hello! Nice to meet you, I'm Sarah.


In this little booklet, I'm going to share some anecdotes about my friends and me related to sports.

Next, you'll find scientific answers to the questions we've asked ourselves with my pals.

These explanations have been written by 4 great lecturers from Sorbonne Paris Nord University: Nathalie Lidgi-Guigui, Delphine Chadeaux, Jérémy Vanhelst and Alice Bellicha.

As well as this paper edition, you'll find a website you can open with your phone to have fun with me!





chapter 1

measurement

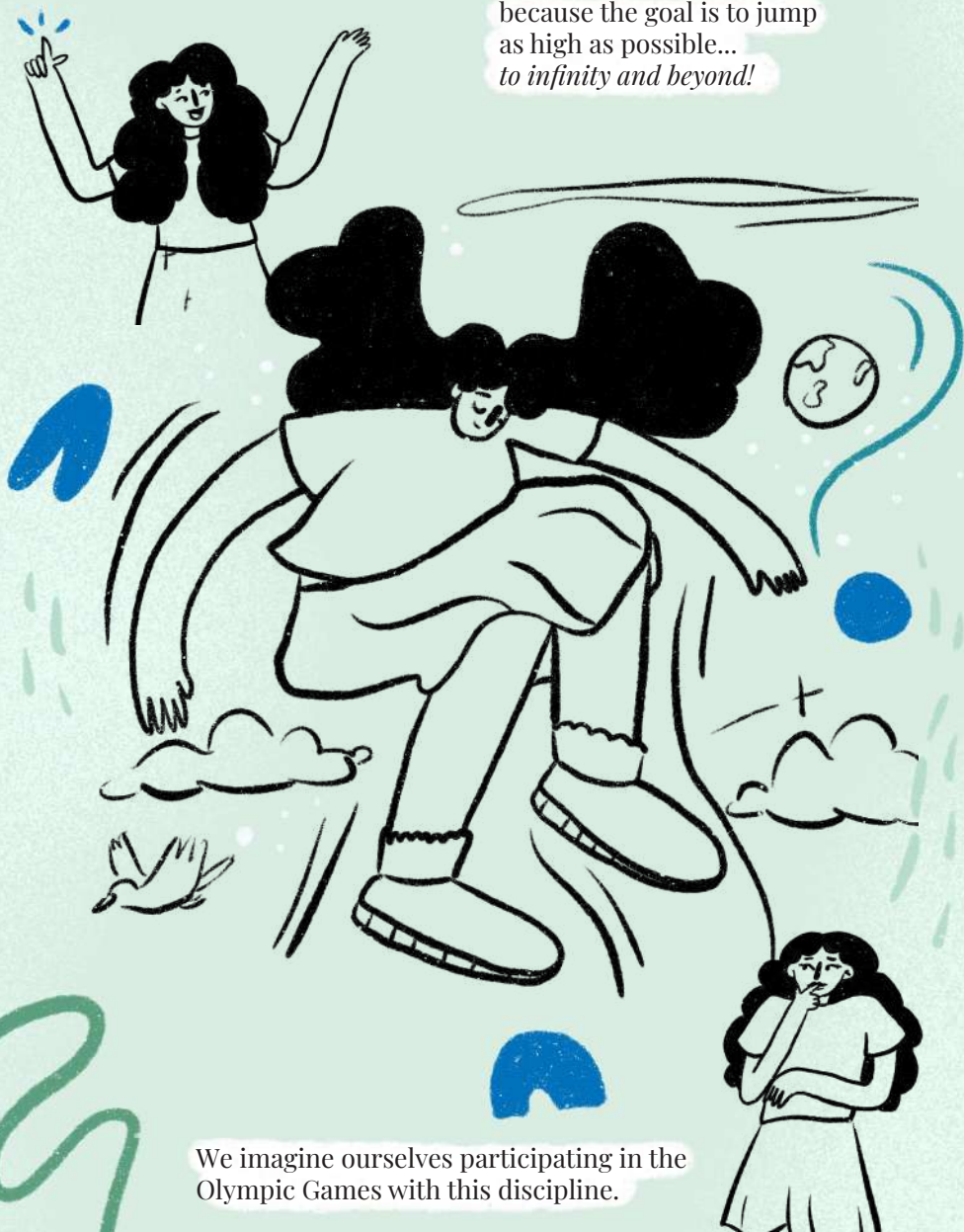
Nathalie Lidgi-Guigui



measuring your record

With my friends, we invented a game that we called "Buzz Lightyear"

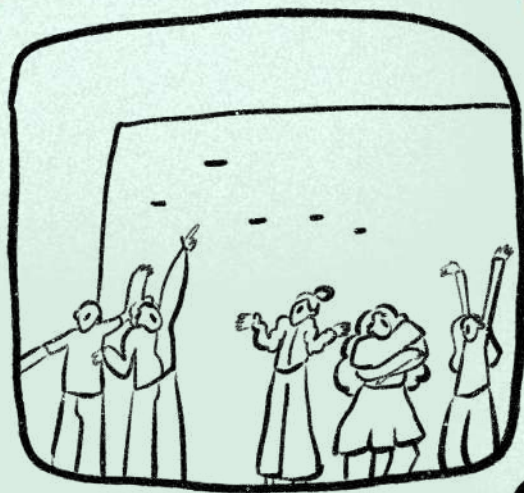
because the goal is to jump as high as possible...
to infinity and beyond!



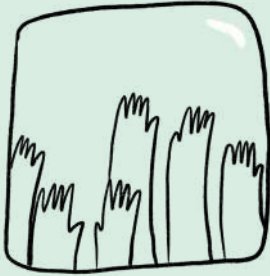
We imagine ourselves participating in the Olympic Games with this discipline.

For now, Antoine claims he holds the record, but I'm not so sure about that.

Actually, I wonder how we could truly measure a jump.



We tried to establish rules, but didn't quite succeed.
Could you help us?



First, we all jumped at the same time. In your opinion, who jumped the highest?

- a. The tallest person
- b. The one with a red t-shirt
- c. Impossible to know



Then, we jumped one after the other. Personally, I already forgot Emma's jump; do you remember who jumped the highest?

- a. The tallest person
- b. The one with a red t-shirt
- c. Impossible to know



Well, then we thought it wasn't fair; Assane is much taller than Chloé. How could we measure the height of the jump without considering the person's height?

- a. No, the tallest one wins for sure
- b. To know, we have to measure the distance between the ground and the feet
- c. We need to create size categories for comparison





debrief

Through these little tests, we realized that measuring the height of a jump wasn't so simple. We understand that determining who jumps the highest is primarily a matter of **comparison**.

To be able to compare, one must keep track of the height at which one has jumped. It is also necessary to define what one wants to compare: individuals in the same height category? The height at which the feet rise, or, on the contrary, the height that the hand can reach? It's up to you to set the rules!

how it's actually done?

units

In sports, only three units are used for measuring records:

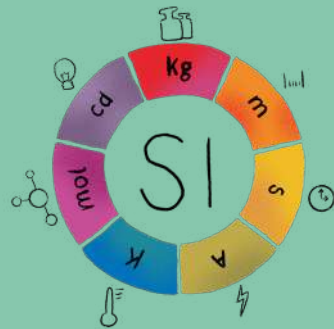
- **Kilogram** (mass): In weightlifting, the goal is to determine who lifts the heaviest load based on the athlete's weight category.

- **Second** (time): In all races, distances are known in advance, and the aim is to see who covers it the fastest. Although the winner is the fastest, it's a time, not a speed, that is measured!

- **Meter** (distance): In long jump, high jump, pole vault, and even throwing disciplines, the focus is on what goes the farthest or highest.

By the way, the measurement of height or length uses the same unit; scientists say it's the same **dimension** being measured.

Scientists worldwide regularly gather to define measurement units. There are six units brought together in the International System; can you recognize them all?

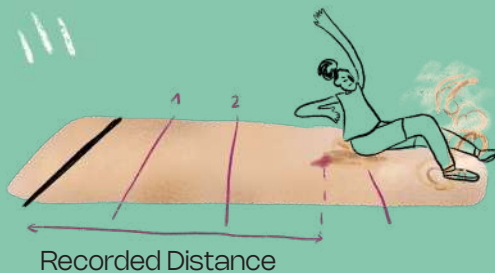


measurement

Once the correct unit is chosen, rules must be established so that the measurement can be done in the same way for all participants; it's the only way to compare results.

In the example of the long jump, it was decided that each athlete must jump from a mark in a sand pit. Athletes are allowed six jumps, and the best performance is recorded.

- **The mark in the sand** provides a reference for the jump result.
- **The measured distance** is the shortest distance between the takeoff and the mark in the sand.





what is it for?

In sports, knowing how to measure is important for assessing records or simply tracking the progress one makes. But measurement is all around us: speed limits on the road, a kilo of strawberries at the market, or even in our health records! Having common conventions for measurement allows for **comparison, tracking developments...**

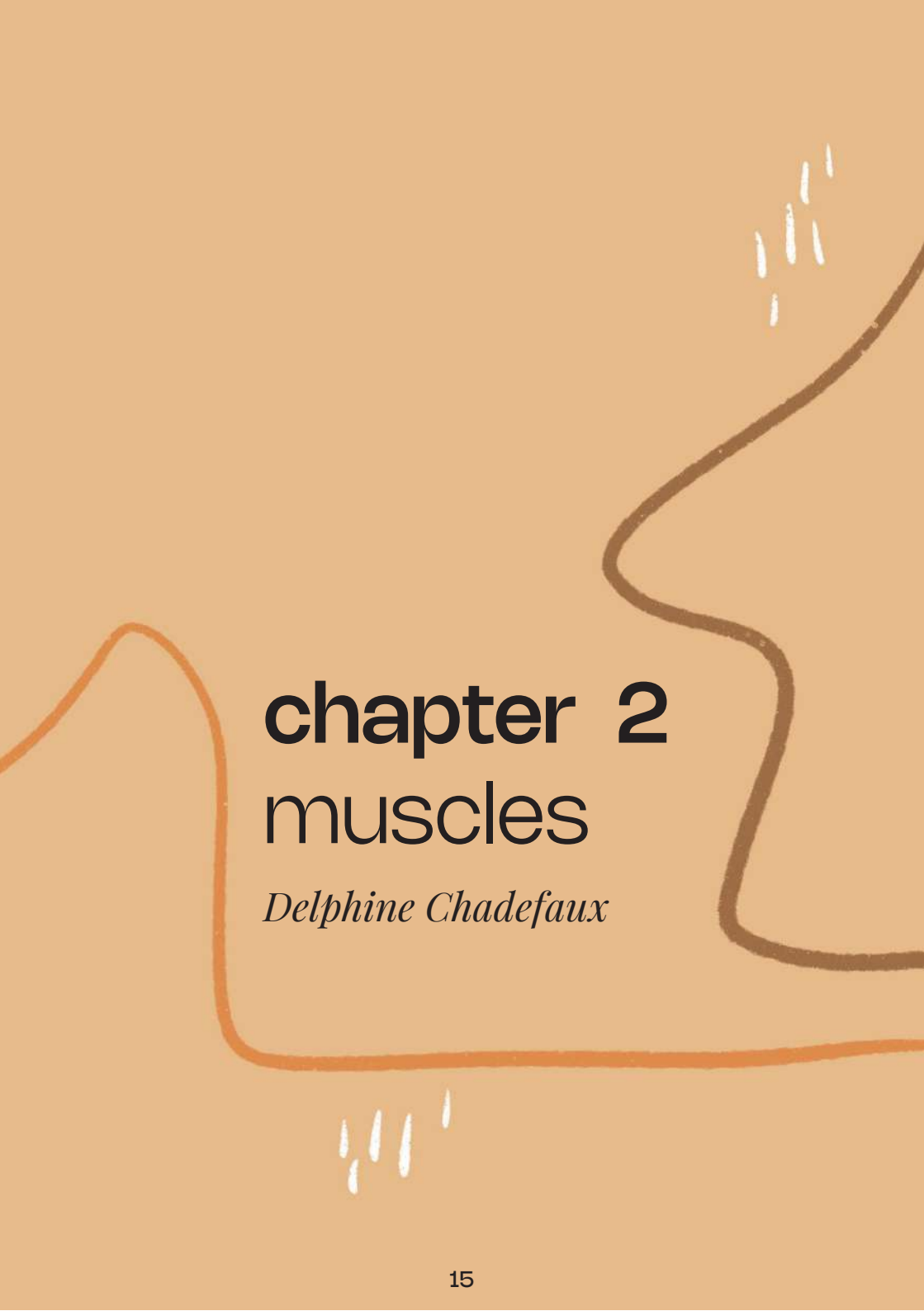
It's crucial for living in society, evolving, and innovating.

There's one thing we haven't discussed: **the measuring instrument.** For vertical jumps, a ruler or a tape measure could be used. But there are other tools that could be interesting. It's important to choose wisely as it allows for precision. Here too, there's a whole science dedicated to evaluating errors and uncertainties during measurements: quite a program!

What if you tried other ways to measure the jump?







chapter 2
muscles

Delphine Chadefaux

muscles, what are they for?

As we continued playing "Buzz", we realized that the starting position also helped improve our jump.



For example, Emma manages to jump to the same height as Assane.



Even though he is taller than her, she uses her muscles much more effectively.



And what if you tried?



Let's try 2 techniques.

First test

Stand with your feet shoulder-width apart. Keep your back straight! You are allowed to bend your knees but not too much.

Second test

Bend down by flexing your knees and hips as if you were sitting on a chair (this is the squat position).

So, in which situation did you jump the highest? Why?

Surround on the illustration on the left the muscles that you think worked.



debrief ←

To understand why you can jump higher from a squat position, think about what happens with a **spring**.

When you are in a **squat** position, your muscles are a bit like a **compressed spring**. Squatting bends your knees and hips, storing energy in your muscles. It's like **crushing the spring**.

Now, when you want to **jump**, you release this spring by rapidly stretching your legs and hips. It's like **letting the spring unfold all at once**. This release of energy gives a great boost to your jump, **propelling you upward**.

Starting from a **standing** position, your muscles are already somewhat stretched. It's like starting with the **spring already unfolded**. This means you have less stored energy and thus **less energy** to expend in your jump.

In summary, starting from a squat position allows you to compress your muscles like a spring before jumping, giving you more energy to reach impressive heights!

understanding your body

muscles, but which ones?

There are over **600 muscles** in the human body, including **about a hundred in each of your lower limbs** (foot + leg + thigh).

If you imagine yourself like a rocket at liftoff, many muscles will work to propel you upward, but not all at the same time:

- **Quadriceps** (muscles at the front of the thigh): They are like the engines of your rocket, helping to extend your knees during the jump.

- **Hamstrings** (muscles at the back of the thigh): These muscles work in tandem with the quadriceps. They assist in bending your knees during the squat and contribute to the power of the jump.

- **Gluteal muscles:** They are like the rear thrusters of your rocket. They contract to extend your hips and give you a boost upward.

- **Trunk muscles:** They act as the hull of your rocket, providing the necessary stability during the movement. A strong core helps maintain proper posture and transfer power efficiently.

- **Calves:** These muscles play a crucial role when you push hard against the ground to gain altitude during the jump.



how to study the functioning of muscles?

Electromyography (EMG) is the gadget of secret agents who want to eavesdrop on the conversation between the brain and muscles without being detected. It is a powerful tool to understand how your muscles work.

Here's how it works:

1. **Sensors**, resembling stickers, are placed on your skin **above the muscles you want to spy on**.

2. When you decide to move, your brain sends **electrical signals** to your muscles, telling them to work. These messages are secret codes that **make your muscles move**.

3. **EMG sensors pick up these messages without being detected**. Then, they transform them into **signals** that scientists can understand.

4. The captured information can be displayed in the form of **graphs**. The harder the muscle works, the higher the **peaks** shown on the graph.



Help Sarah exercise her muscles!



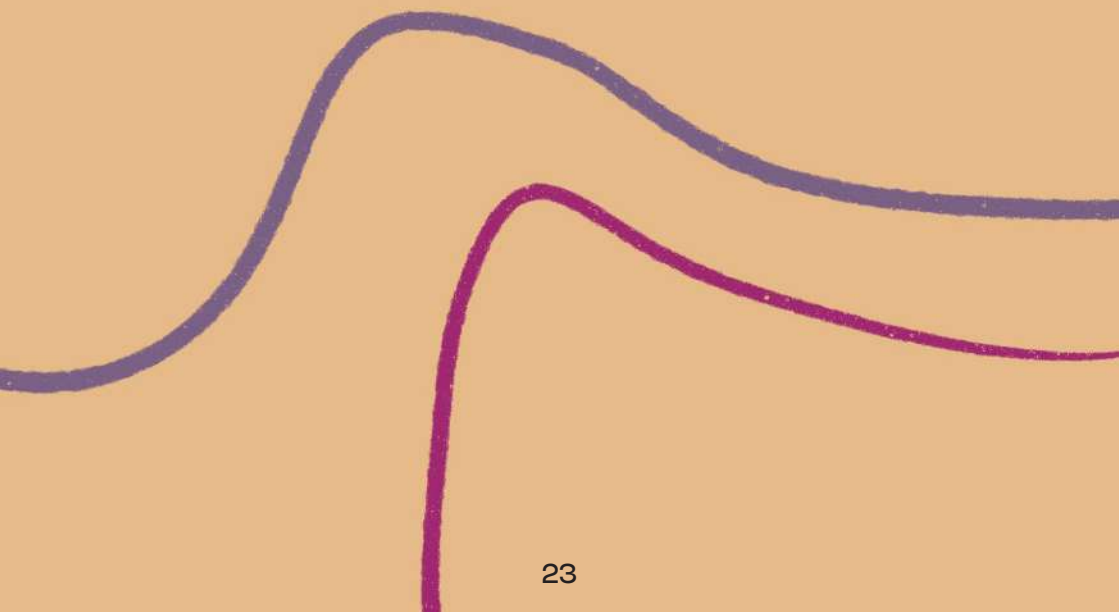




chapter 3

physical activity

Jérémy Vanhelst



are you physically active?

Antoine and I are currently in a period where we don't feel like going to exercise. We've kind of locked ourselves into our comfort zone.



Last time, our friends criticized us for it. It wasn't very cool, but they are right...



Emma came to talk to us; she was gentler.

Honestly, it's important to move a bit, to be active. Not only for your health but also to feel good in your mind.



Recommended Activity



< 1 YEAR OLD

At least 30 minutes/day, be as active as possible



1-2 YEARS OLD

At least 180 minutes/day at various intensities



3-4 YEARS OLD

At least 180 minutes/day, including 60 minutes at moderate to vigorous intensity






5-17 YEARS OLD

At least 60 minutes/day at moderate to vigorous intensity, with 3 activities at vigorous intensity per week

So, Antoine and I went online to gather information.



Moderate activity	Vigorous activity
 Mild breathlessness	High breathlessness
 Heart beats slightly faster	Heart beats faster
 Conversation is possible	Conversation is difficult

And you? How much physical activity do you perform?



Indicate in this table the duration of your moderate and sustained activities during the week.

Activity name	Duration

what does science say?

definitions & recommendations

Physical activity corresponds to **any movement of the body produced by muscles that results in energy expenditure greater than that at rest**. Physical activity refers to all movements carried out in daily life, particularly in the context of leisure, sports, school, at home, or for moving from one place to another.

In case of illness, functional limitation, deficiency, or disability, a healthcare professional can specify the type of activity to practice, its duration, and frequency. This is then referred to as **Adapted Physical Activity (APA)**. The World Health Organization (WHO) recommends varying amounts of moderate to vigorous physical activity depending on age.

(see previous page)

how is it measured?

Physical activity can be measured by different methods: **questionnaires**, **electronic devices** like the heart rate monitor (measuring heartbeats), **pedometer** (measuring the number of steps), **accelerometer** (measuring body movements). **Connected devices** (watches or smartphone apps) offer these tools that you can use.

in the global ranking

A study made on 146 countries in the world, reports that the most active teenage boys are found in Bangladesh, Ireland, USA, Slovakia and Bulgaria while the most active teenage girls are found in Bangladesh, India, Slovakia, Moldova and Greenland.

move for your health!

Physical activity is beneficial for the **lungs, heart, bones, joints, and the brain**. It increases muscle mass and, combined with a balanced diet, decreases fat mass and thus the risk of **overweight** and **obesity**. It is also a good **remedy for stress, isolation, low self-esteem, anxiety, and depression** because it increases the secretion of **endorphins**, hormones of well-being. It also reduces the risk of several **cancers**.

Attention, not moving enough is considered the **4th risk factor for premature death in the world**, after smoking, excess alcohol, and poor diet.



*What about running together?
Calculate your physical effort!*





The background is a solid light orange color. It features several abstract, hand-drawn style lines. A thick blue line starts from the top left, curves down and then right. A thick white line starts from the top left, curves down and then right, following a similar path to the blue line but lower. Another thick white line starts from the bottom left, curves up and then right, following a similar path to the blue line but higher. In the upper right quadrant, there are several small, white, vertical, slightly curved lines, resembling a stylized signature or a cluster of marks.

chapter 4

hydration

Alice Bellicha

water, the athlete's ally!

Chloé and I motivated each other,
we started running!



I think I've never sweated so
much in my life!

When I got home, I drank at least 3
bottles of water all by myself.

Hahaha! Don't worry, it's normal!
Our body is composed of 65% water, and since
you sweat, you need to compensate for what
you've lost.

For example, if you weigh 40 kg, your body
contains 26 kg of water!



What about you, what do you think?



Why do we sweat when we exercise?

Choose 1 option among the following three.

- a. To eliminate toxins
- b. To dissipate the heat produced by our body in motion
- c. It serves no purpose, and it smells bad

In your opinion, up to what amount of water can one lose through sweating during intense exercise?

Choose 1 option among the following 3.

- a. 125 g per hour (= a yogurt pot)
- b. 500 g per hour (= a small 500 mL water bottle)
- c. 750 g per hour (= a 750 mL water bottle)

What are the two foods or drinks containing the most water?

Choose 2 options among the following.

- a. 100 g of orange juice
- b. 100 g of water
- c. 100 g of zucchini
- d. 100 g of milk



debrief ←

When engaging in physical activity, our body generates **heat**. This heat **must be dissipated** to keep the temperature of our vital organs (such as our brain) constant. Indeed, humans tolerate temperature variations very poorly, as is the case when we have a fever.

Fortunately, the human body is well-designed: **when the temperature rises, we sweat**. The water contained in sweat, when it comes into contact with the air, evaporates. This is how we eliminate the heat produced by our body!

Some people can lose up to 750 g of water per hour during physical exertion. This indicates that they adapt well to heat.

To **compensate** for water losses, it is essential to **drink a lot of water**. However, other foods are also very rich in water, such as zucchini in particular, or more generally, all vegetables and fruits. Let's now discover some tips for rehydrating like a champion!

staying well hydrated



the quantity

We've understood that it's important to drink a lot of water when engaging in sports. But how much exactly? The answer isn't simple because **it varies for everyone**. Some people sweat more than others and, therefore, need to drink more!

In practice, you can rely on three methods:

- Your **sense of thirst**, of course. But beware, when you're thirsty, it means you're already dehydrated! Ideally, try to drink regularly and from the beginning of your sports activity.

- The **colour of your urine**. Yes, your urine! If it's dark, it means you haven't drunk enough. It's time to drink until it becomes clear again.

- The **professional method**, which involves weighing yourself before and after sports to precisely assess the amount of water lost. Let's take an example:

- If you weighed 40 kg before sports and now weigh 39.5 kg, you've lost 0.5 kg.

- If during your session, you drank 0.5 L of water, it means you've lost a total of 1 L of water.

- Ideally, you should drink 1 L of water during your sports session.

water, but not only !

Water is also found in foods! Did you know that fruits, vegetables, and fresh dairy products are filled with water?

In addition to containing a lot of water, fruits, vegetables, and dairy products contain essential nutrients for your health.

Recommendations:

5 servings of fruits and vegetables per day
3 dairy products per day



Create Sarah's
balanced snack!



[answers]

measuring your record

1. c.
2. c.
3. c.
4. b.

muscles, what are they for?

The position in which you are supposed to jump the highest is the squat position. Indeed, starting from a squat position allows you to compress your muscles like a spring before jumping, giving you more power to reach impressive heights!

water, the athlete's ally!

1. b.
2. c.
3. b et c.

> go further!

Find more activities on the website

Join Sarah at
<https://sportologie.univ-spn.fr>
or by scanning the QR code:

You'll find lots of fun activities and additional information to help you understand the science of sport!



See you soon!

/ acknowledgments

merci!

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idea and direction by

Manon Boucher &

Nathalie Lidgi-Guigui



In the midst of the excitement surrounding the 2024 Olympic and Paralympic Games, Sorbonne Paris Nord University wants to share with you the scientific aspects of the world of sports. Our goal is to enlighten you on the scientific aspects of performance measurement, the biomechanics of the human body, as well as the crucial importance of hydration and physical activity for maintaining good health.

We invite you to a sporty and playful reading, where you will discover the scientific mysteries behind each athletic movement. Through this initiative, we invite you to dive into the captivating universe where sports meet science and health.

co-written
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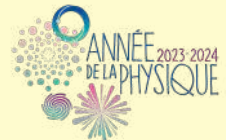


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And don't get discouraged!
Keep moving for good health.