How to use it ?

To connect (with concepts addressed in other grades)

To deepen (concepts and ideas implicitly addressed in the comic)

To address (alternative students ideas)

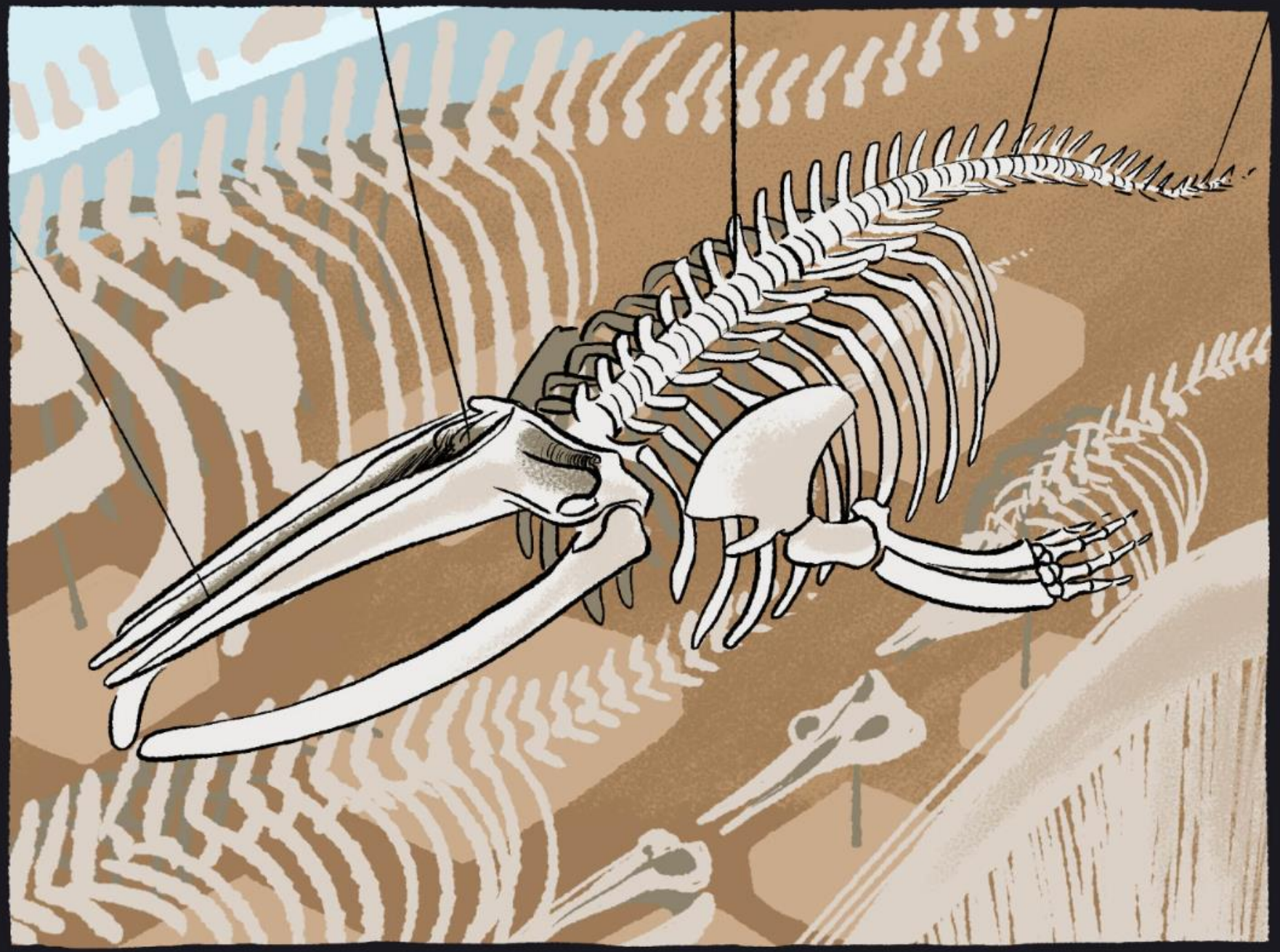
To enrich (through creative tasks)

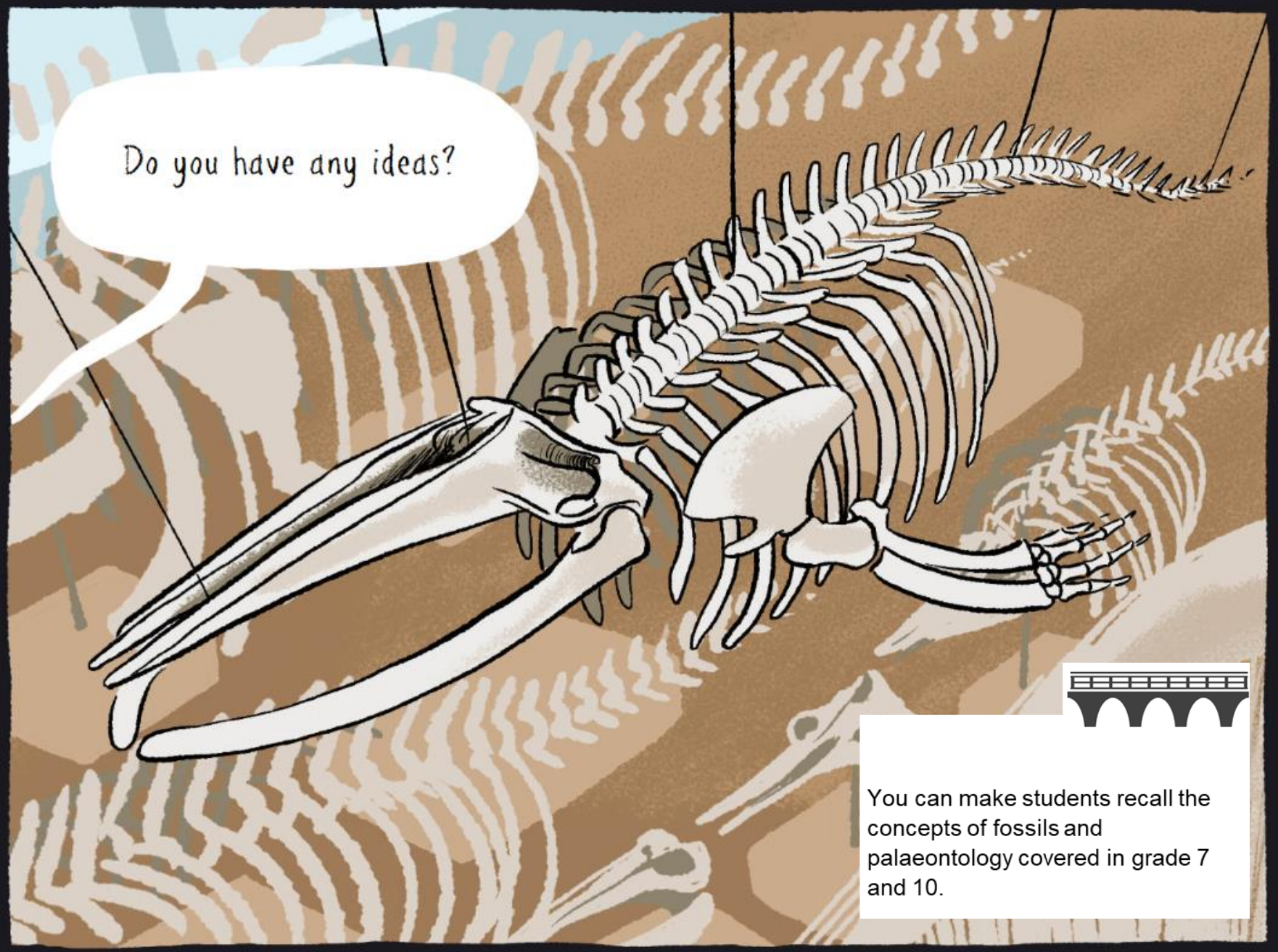
Chapter 1

I II III

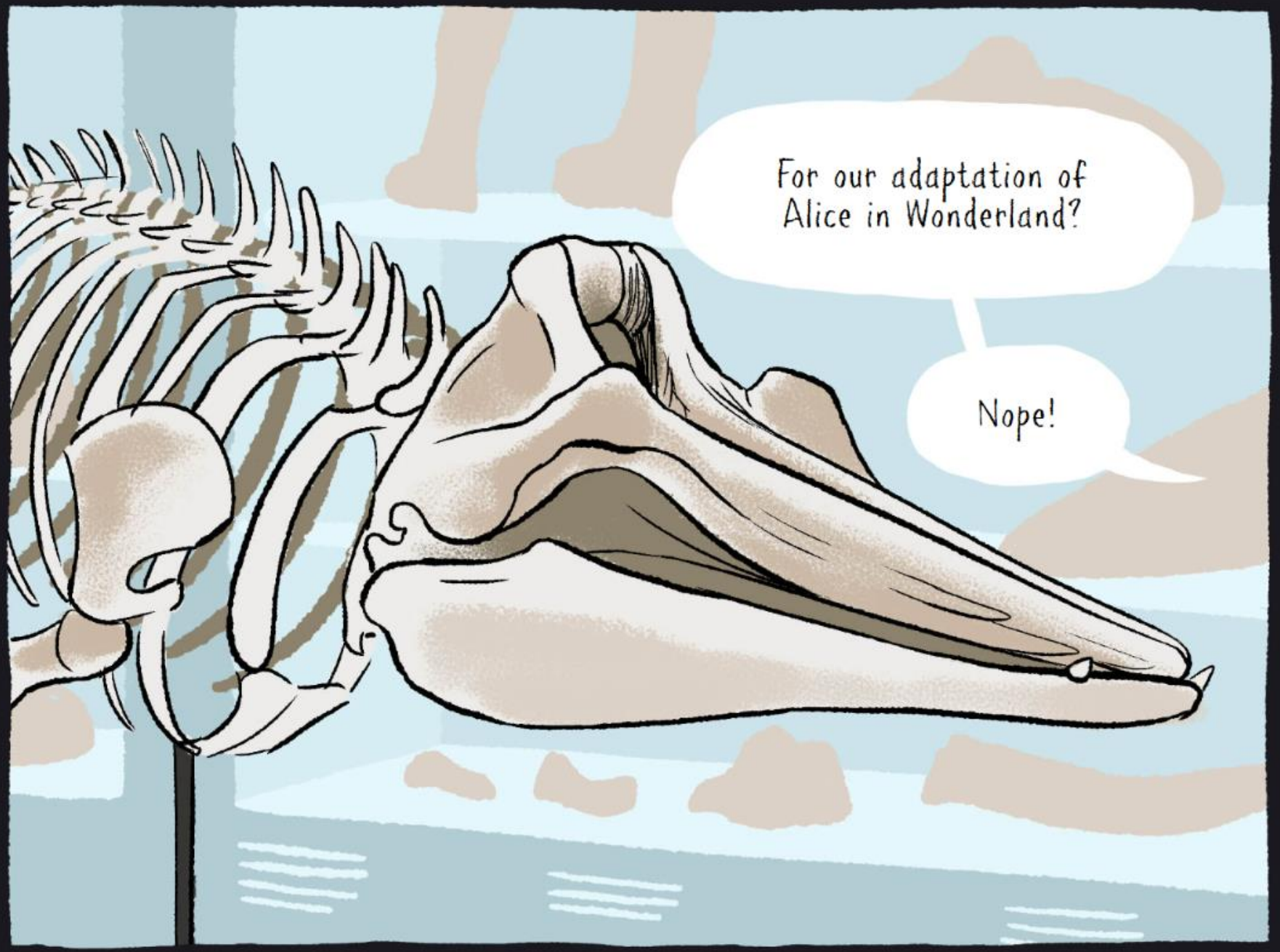
Start reading

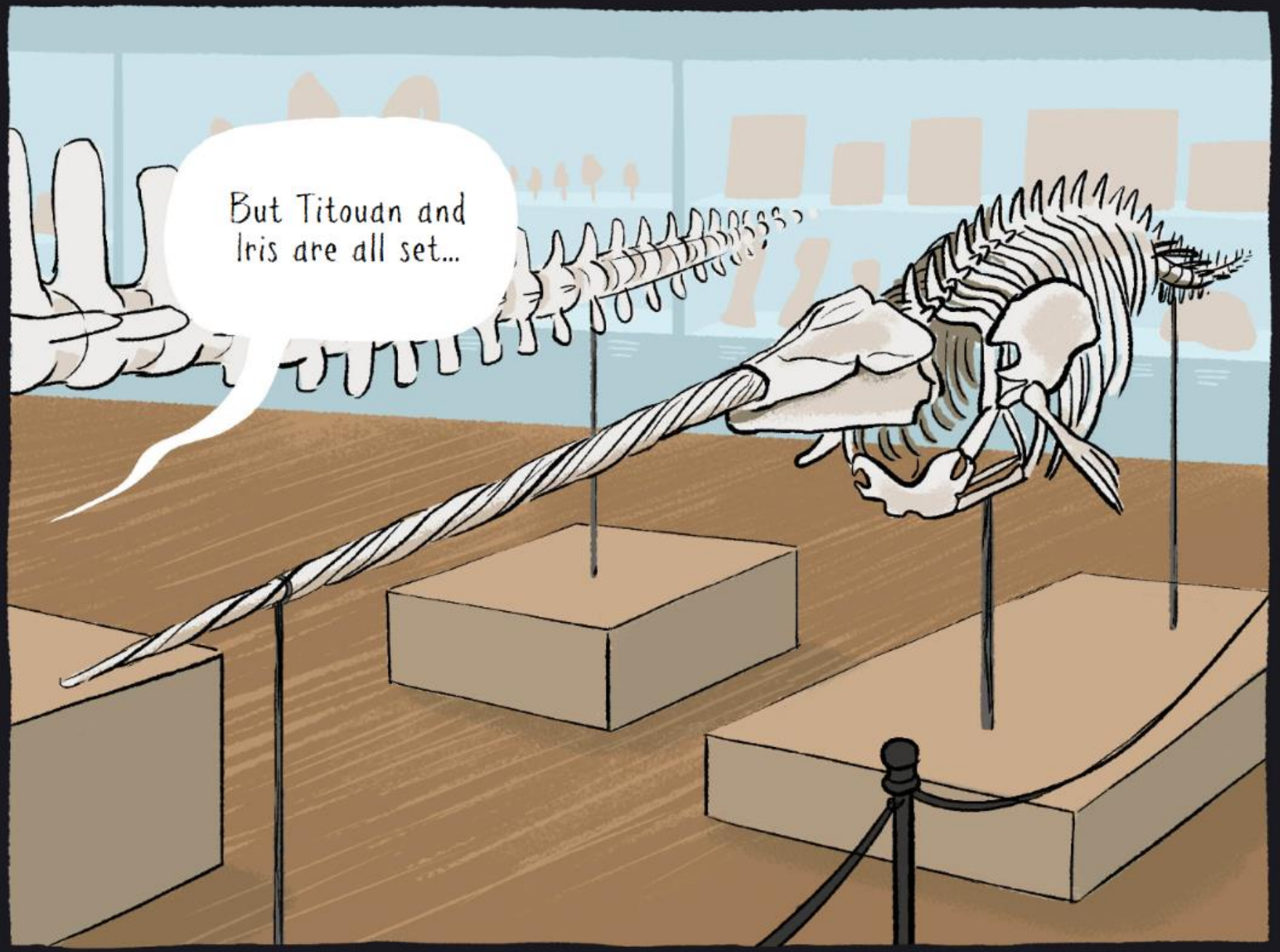
Menu

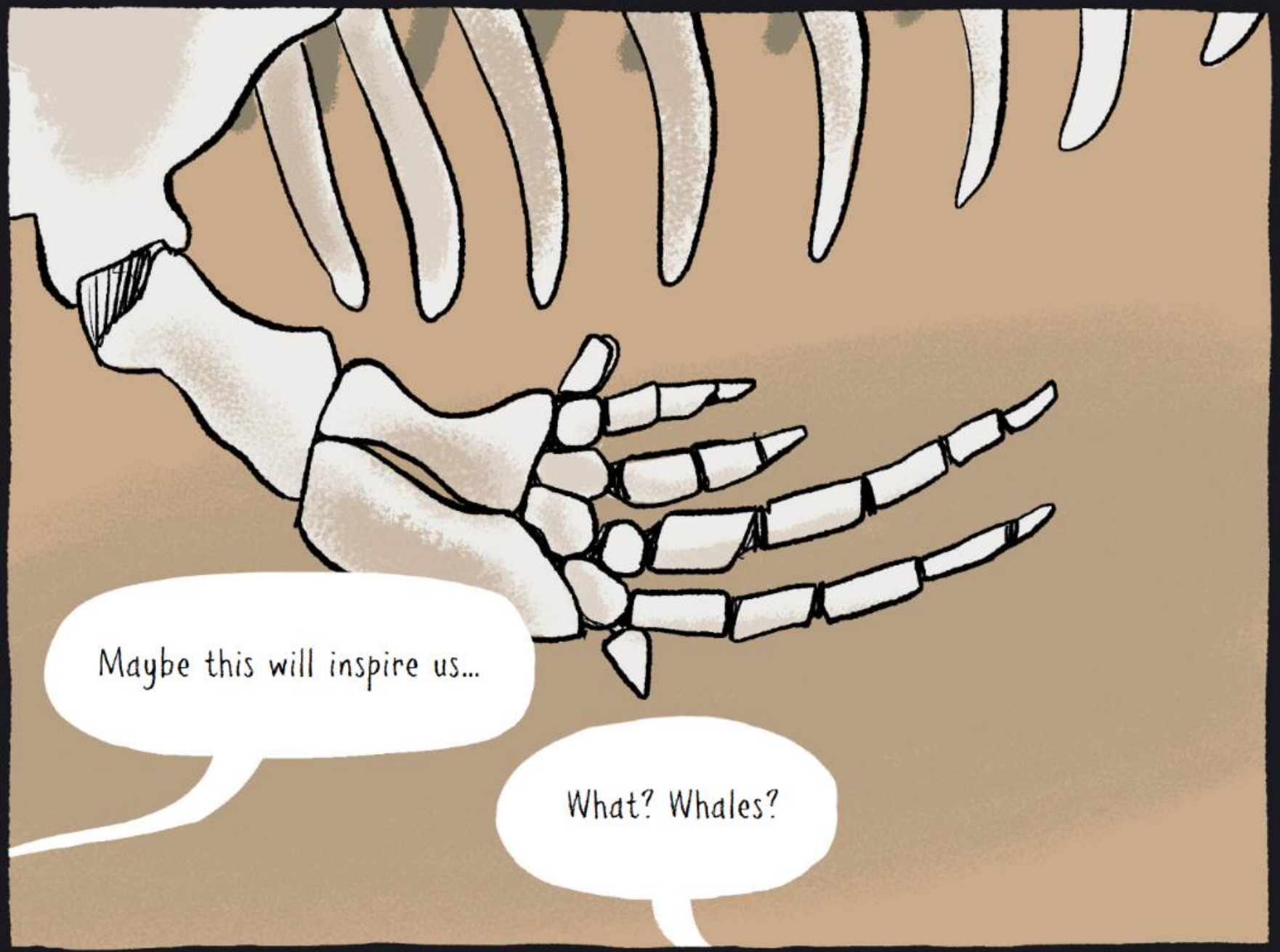


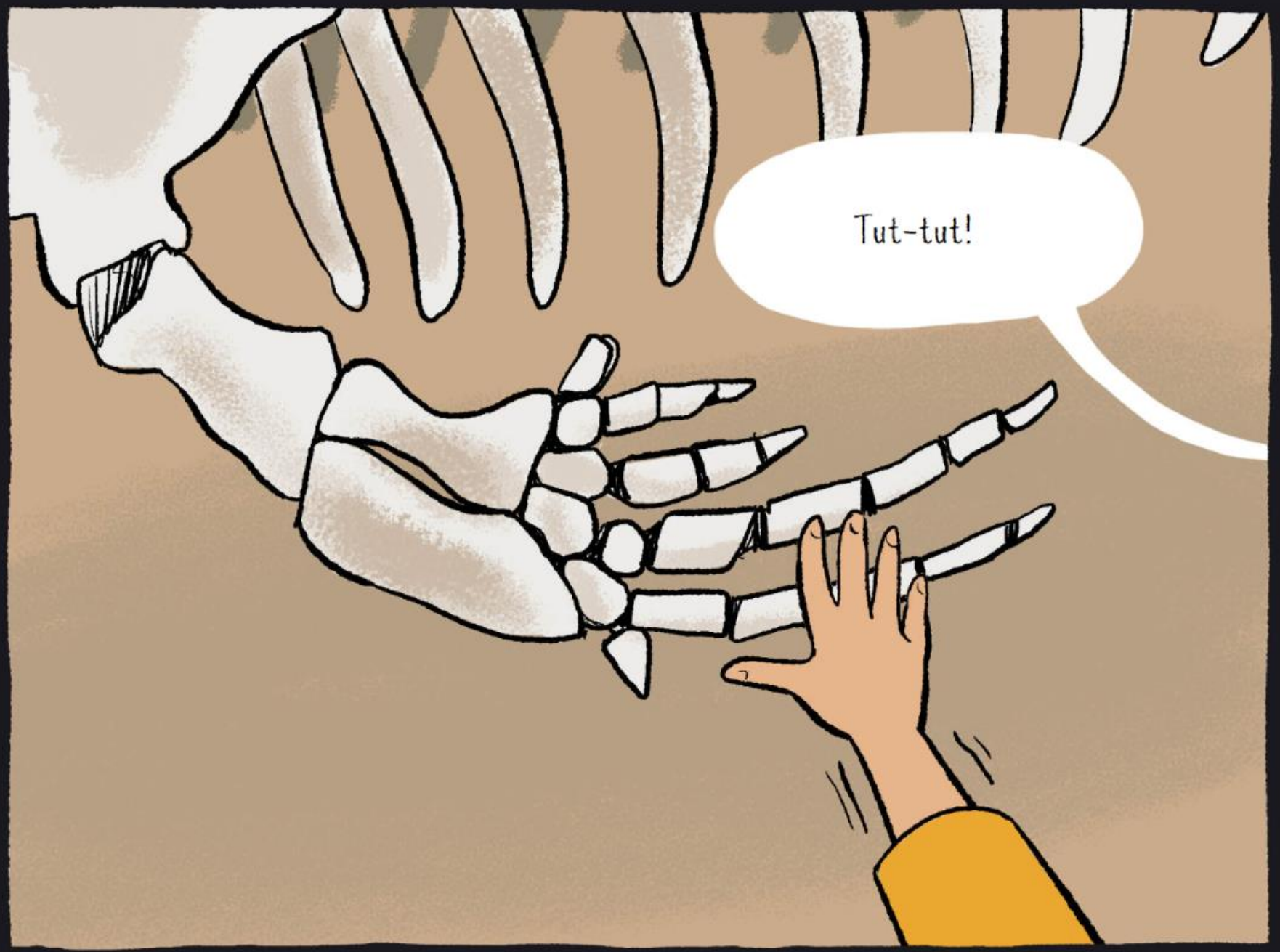


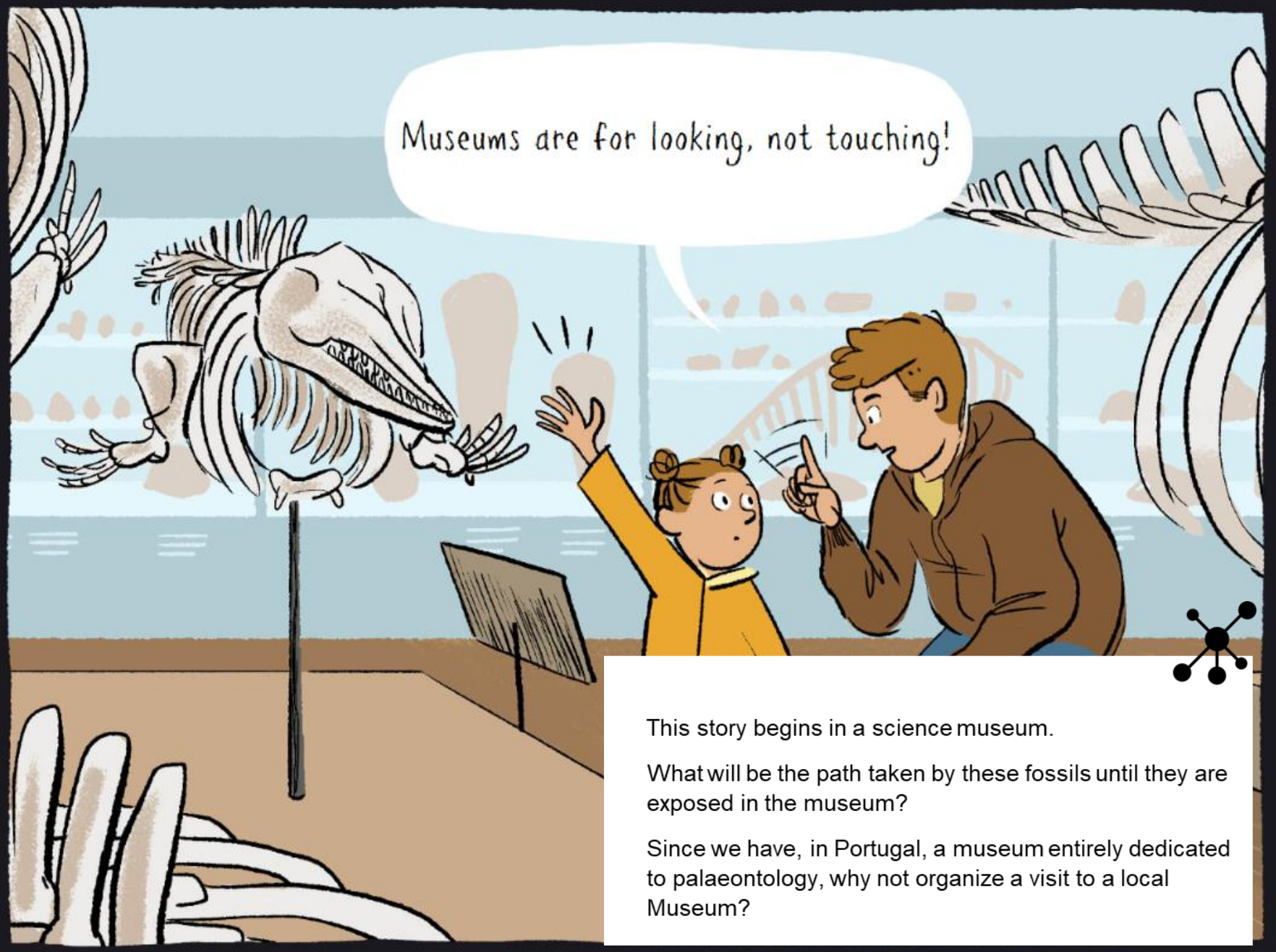
You can make students recall the concepts of fossils and palaeontology covered in grade 7 and 10.


For our adaptation of Alice in Wonderland?
Nope!


But Titouan and Iris are all set...


Maybe this will inspire us...
What? Whales?

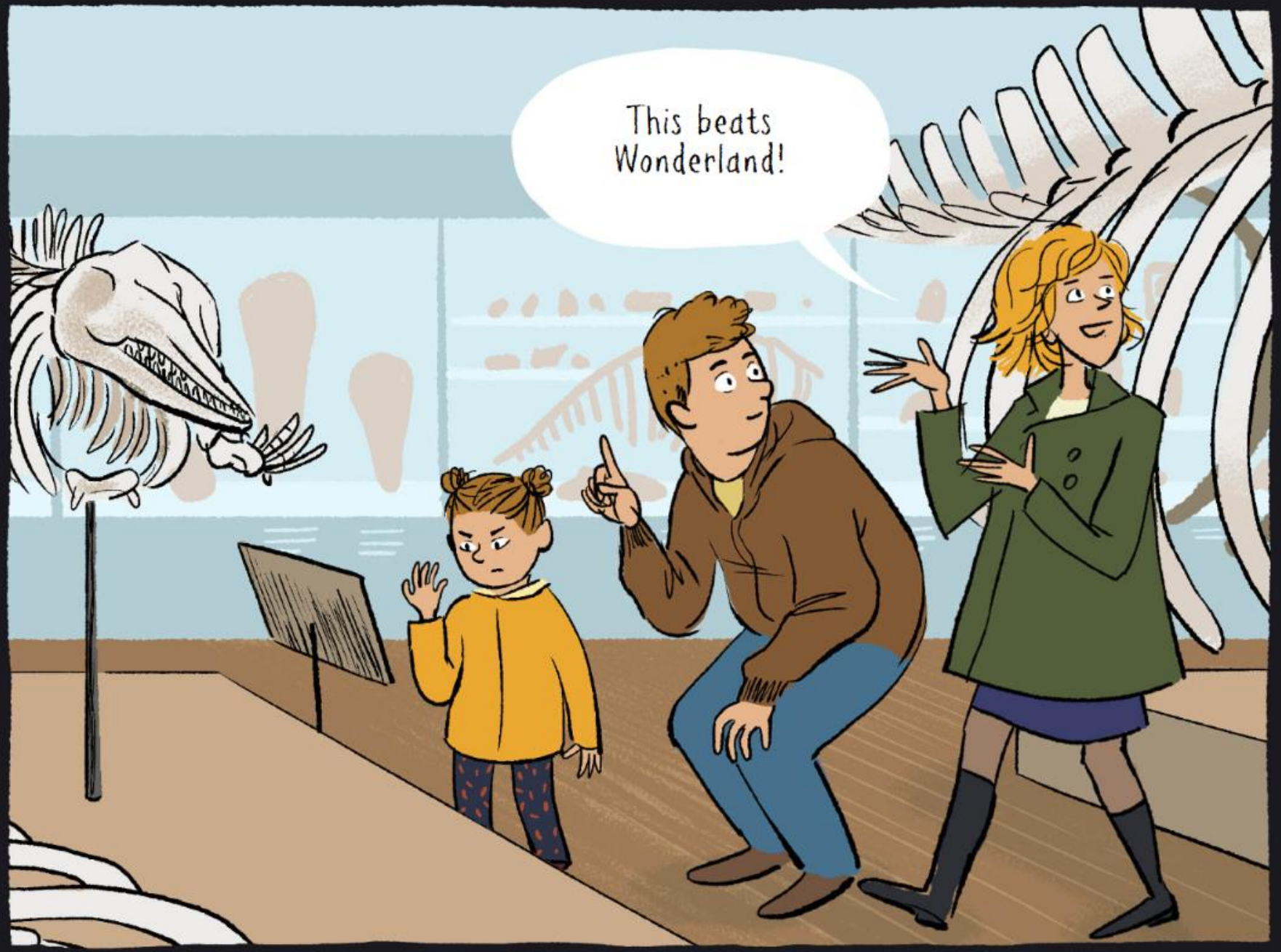

Tut-tut!



This story begins in a science museum.

What will be the path taken by these fossils until they are exposed in the museum?

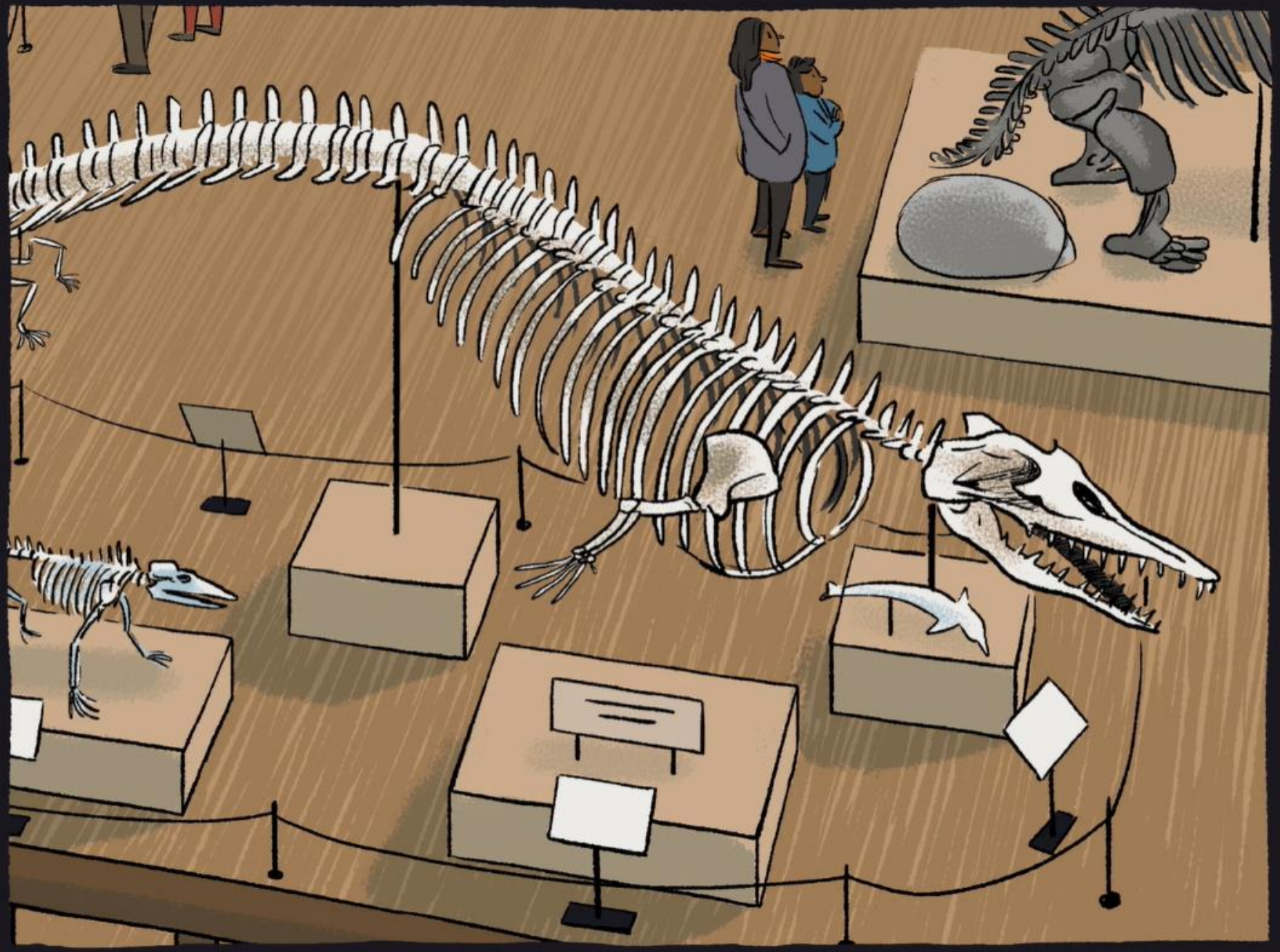
Since we have, in Portugal, a museum entirely dedicated to palaeontology, why not organize a visit to a local Museum?

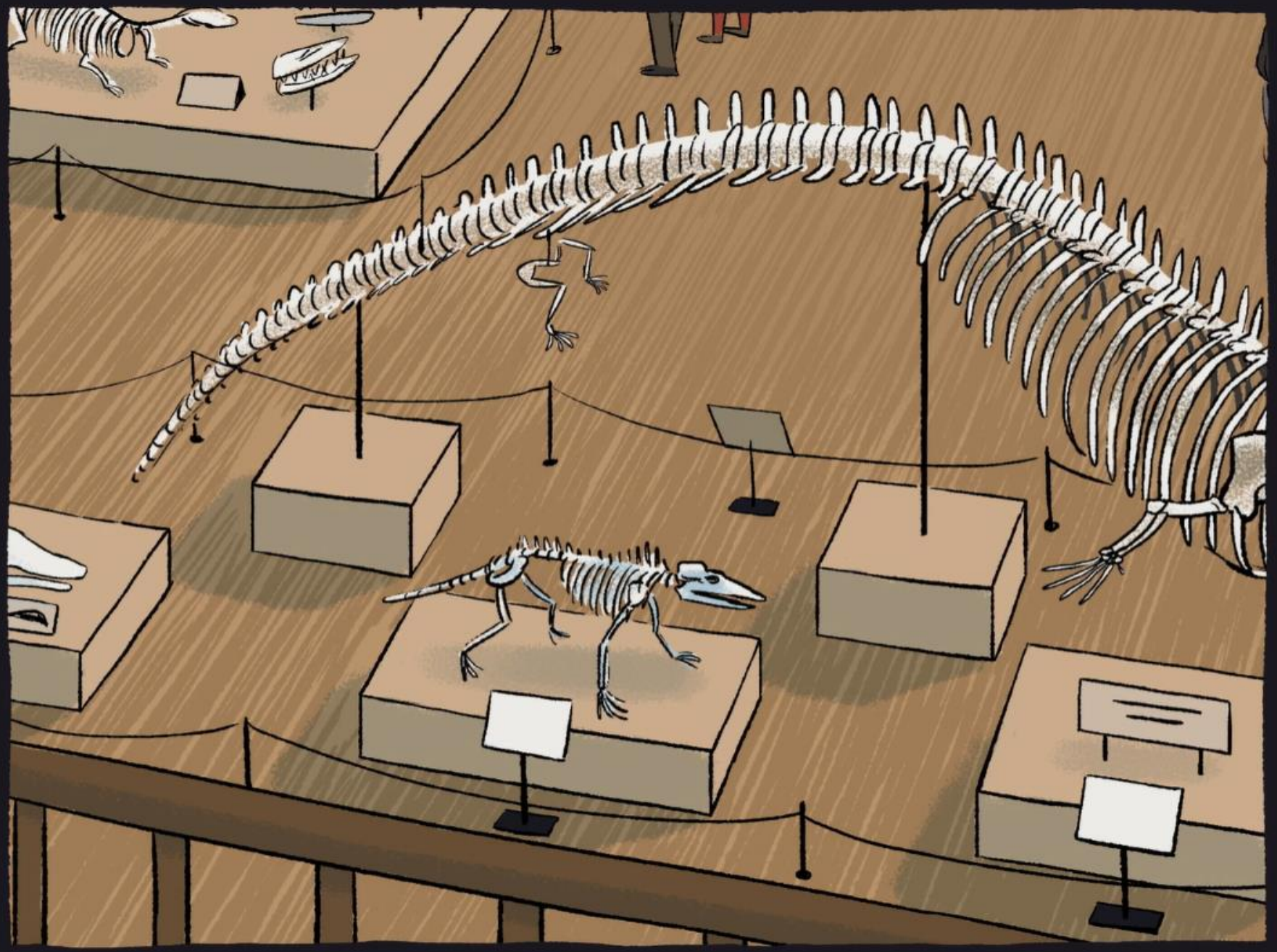

This beats Wonderland!

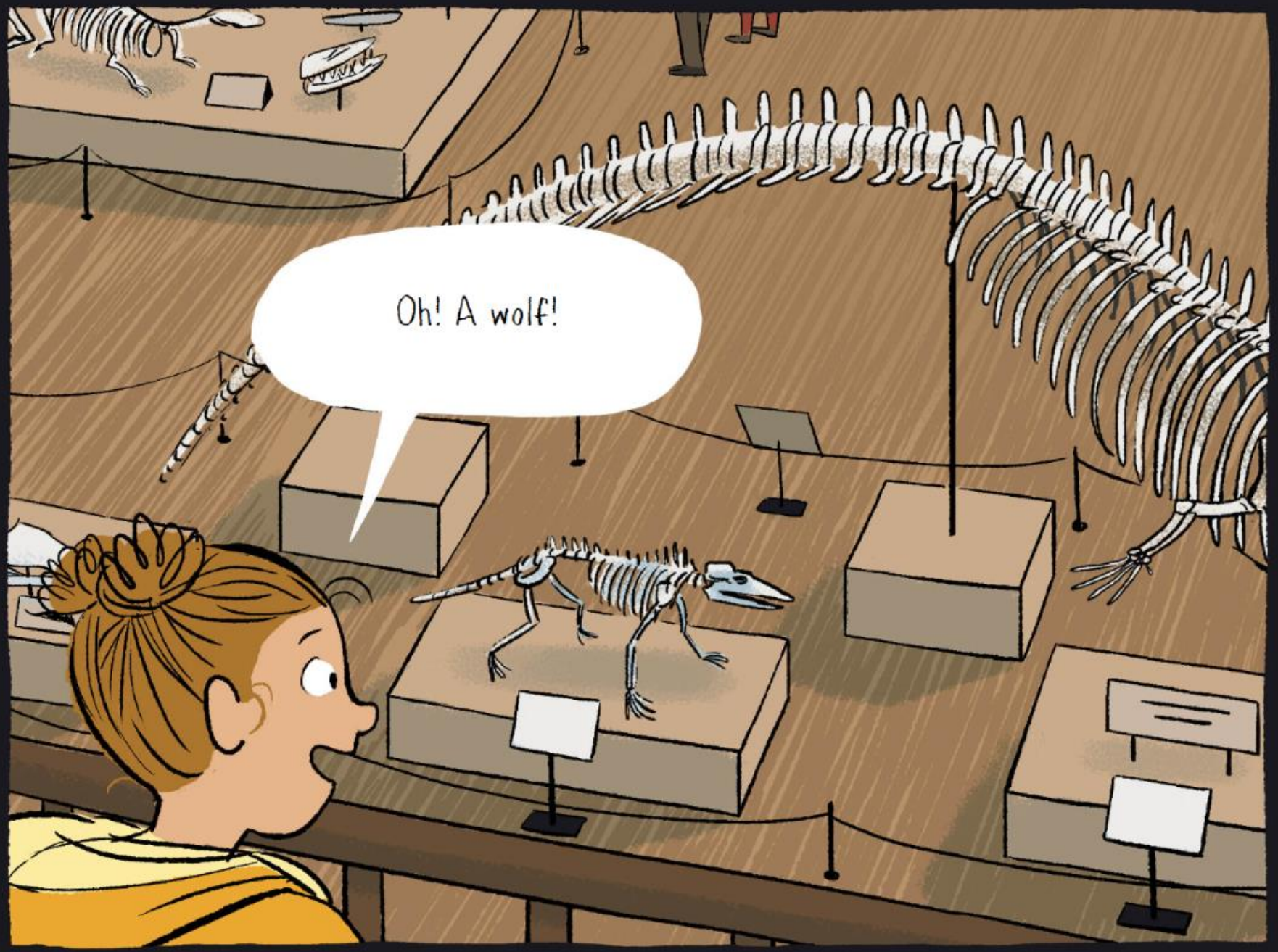

Alice in Whaleland!

You can use this opportunity to make connections with the concept of geological time cover during grade 10.


Look at those cetacean ancestors over there!

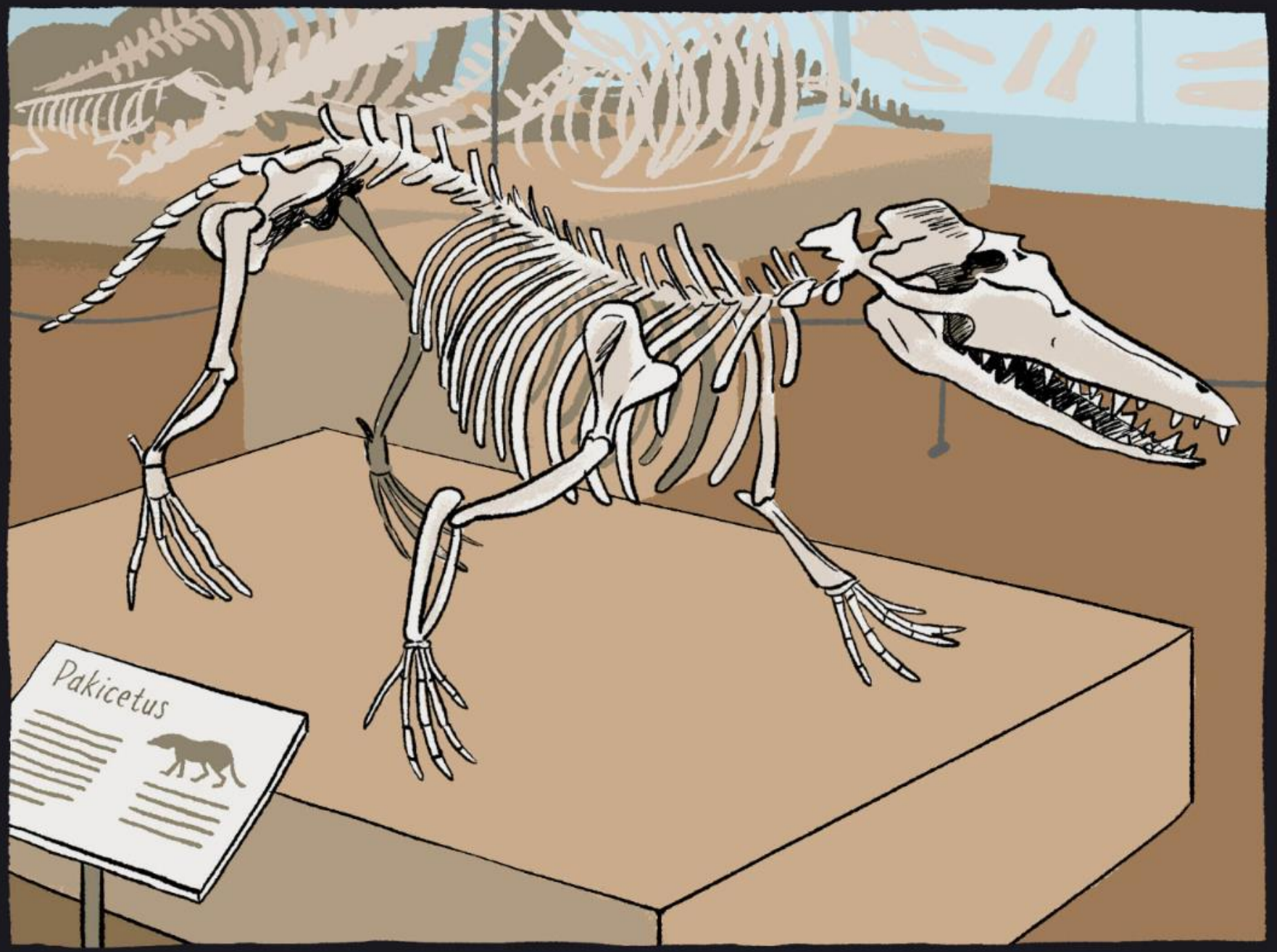


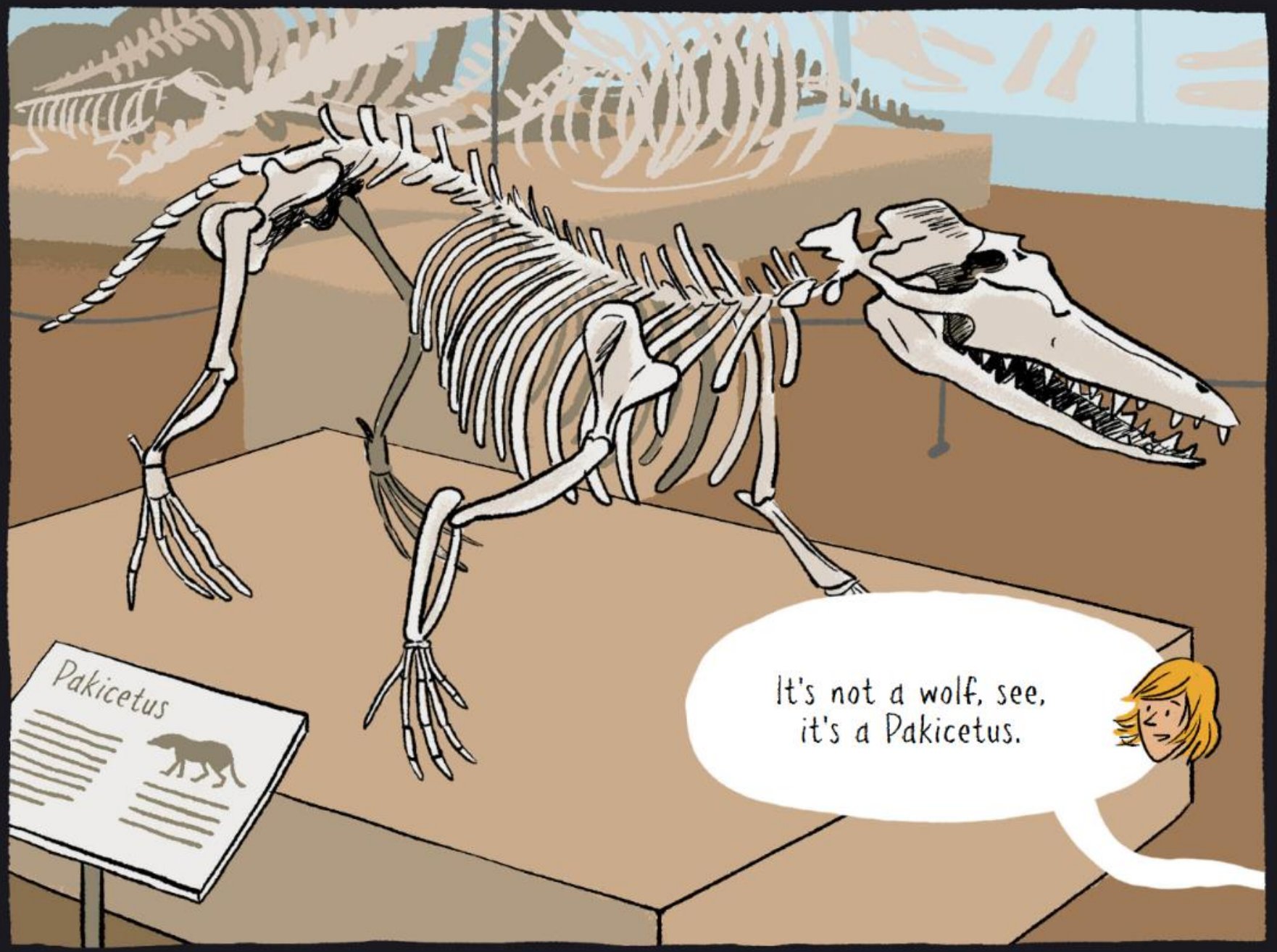



Oh! A wolf!


A wolf skeleton among the whales? Let's go and see!

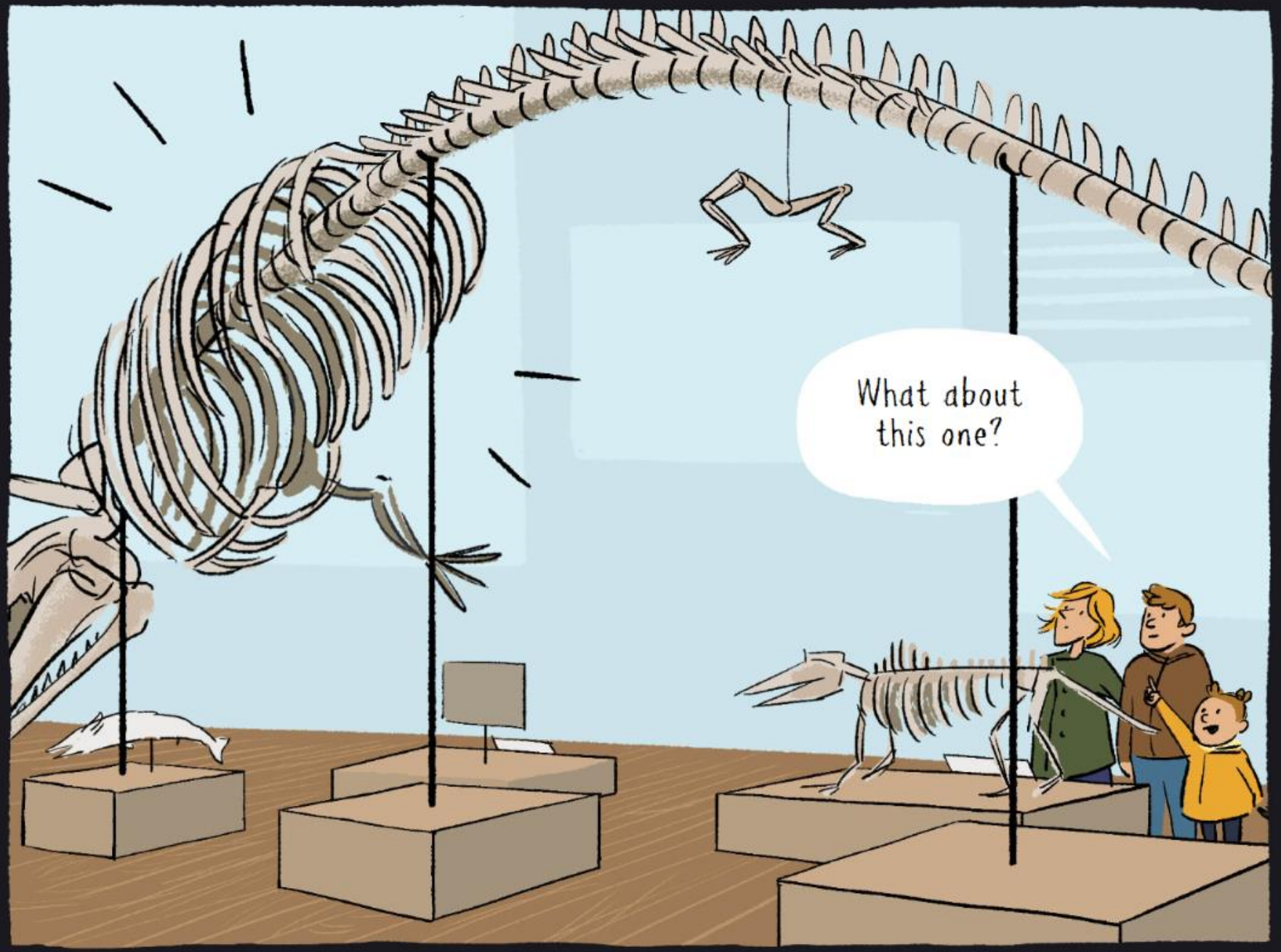

I thought vertebrates had evolved from water to land...
Yes, it wasn't the other way around. They must have made a mistake!

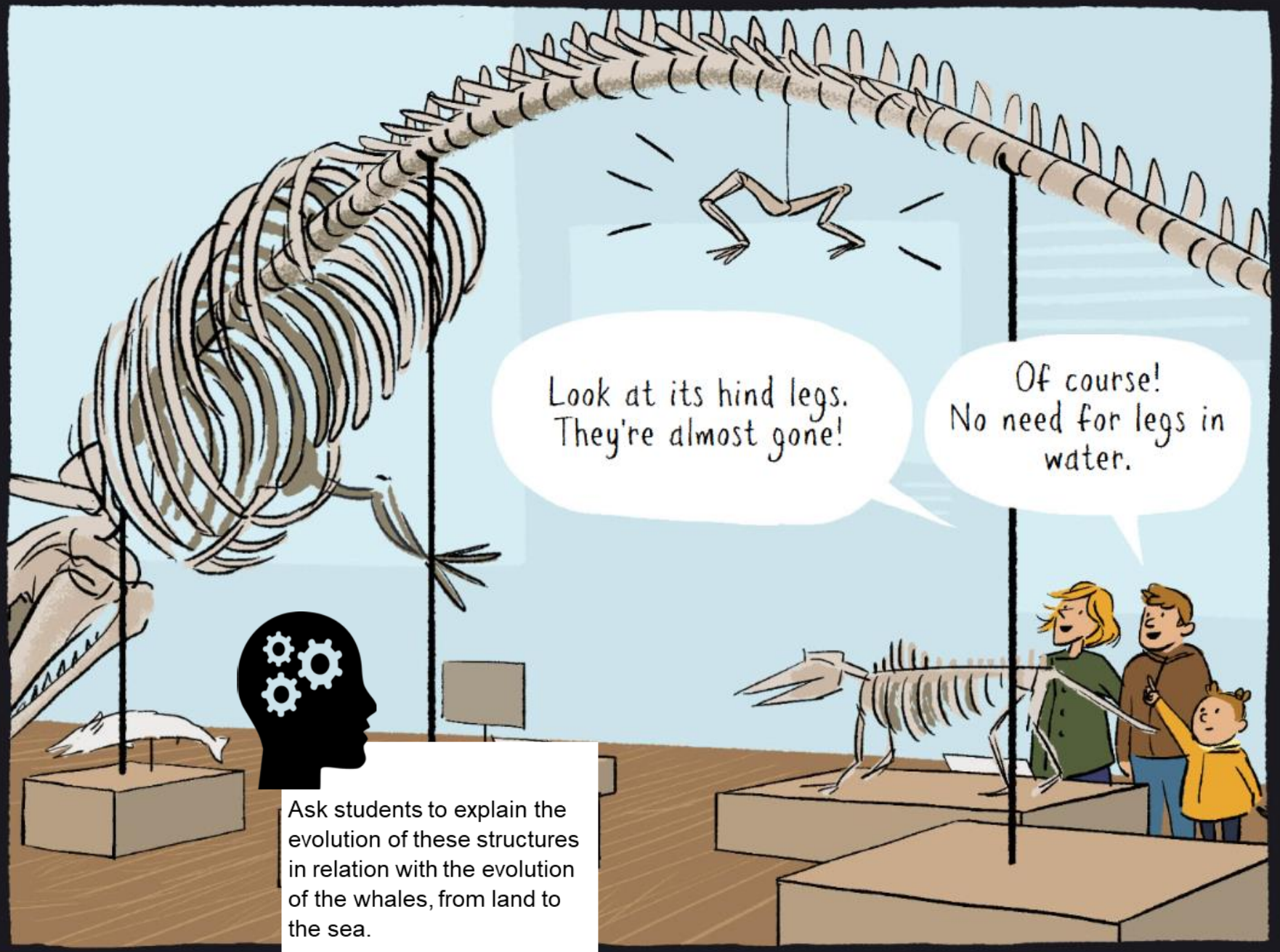

Pakicetus


Pakicetus
It's not a wolf, see, it's a Pakicetus.

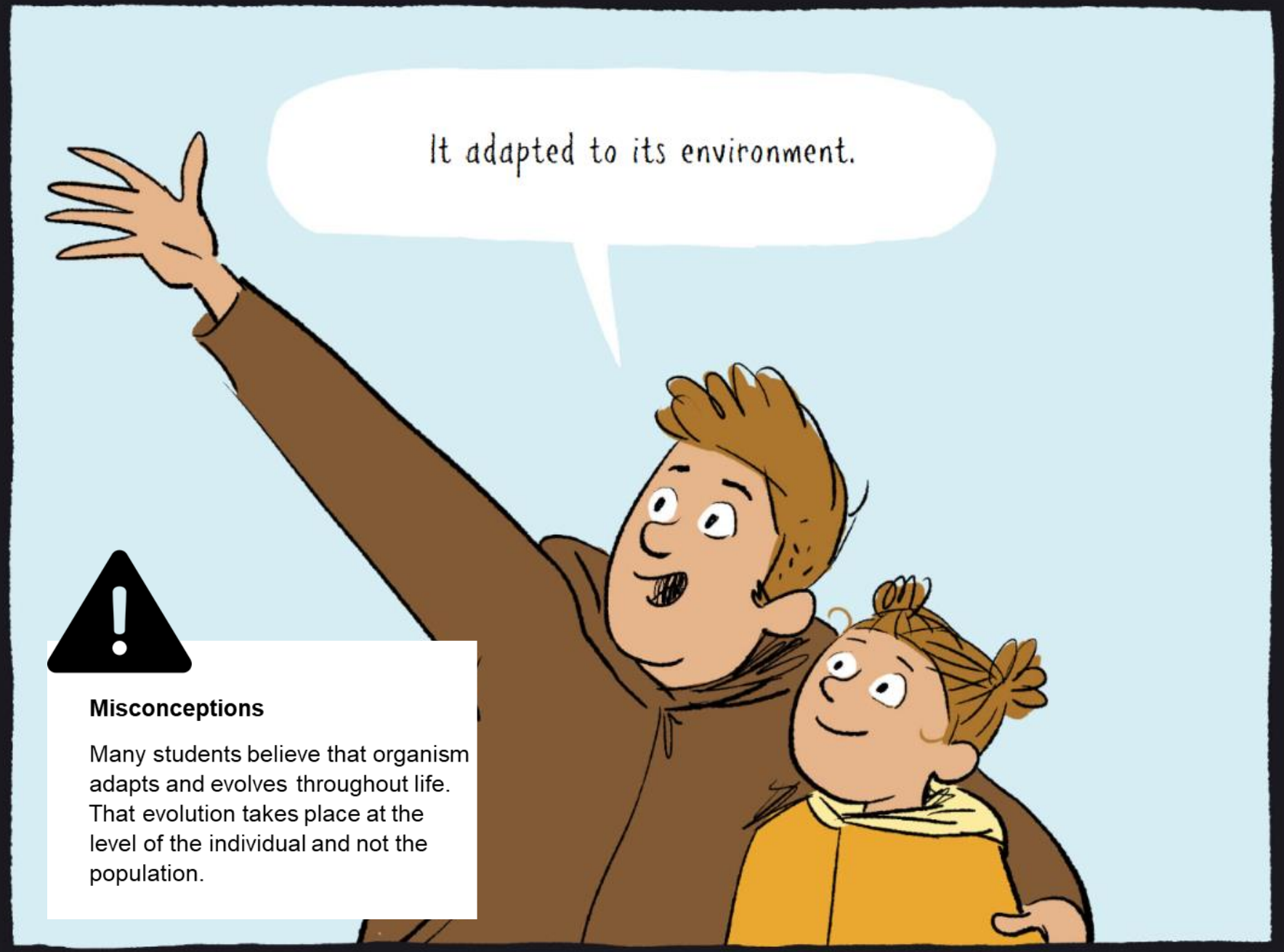
Based on the video about the discovery of the Pakicetus fossil, you can ask students to imagine how this fossil could have arrived at the Museum. Students can create a new comic about this discovery.

Suggestion: the comic can be made digitally using software such as StoryBoardThat, Canva, and StripCreator, among others. See some guidelines on creating webcomics.


What about this one?

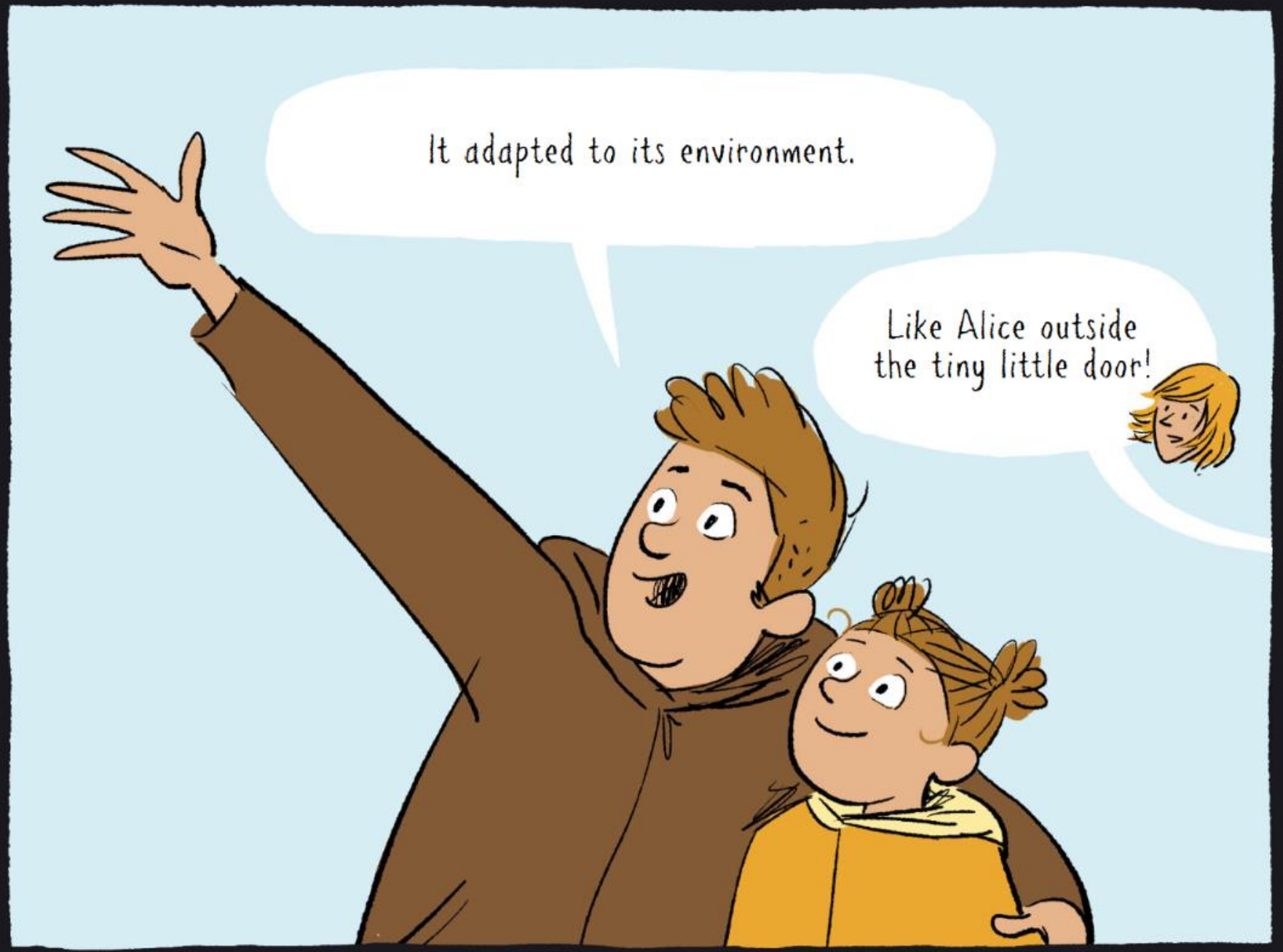


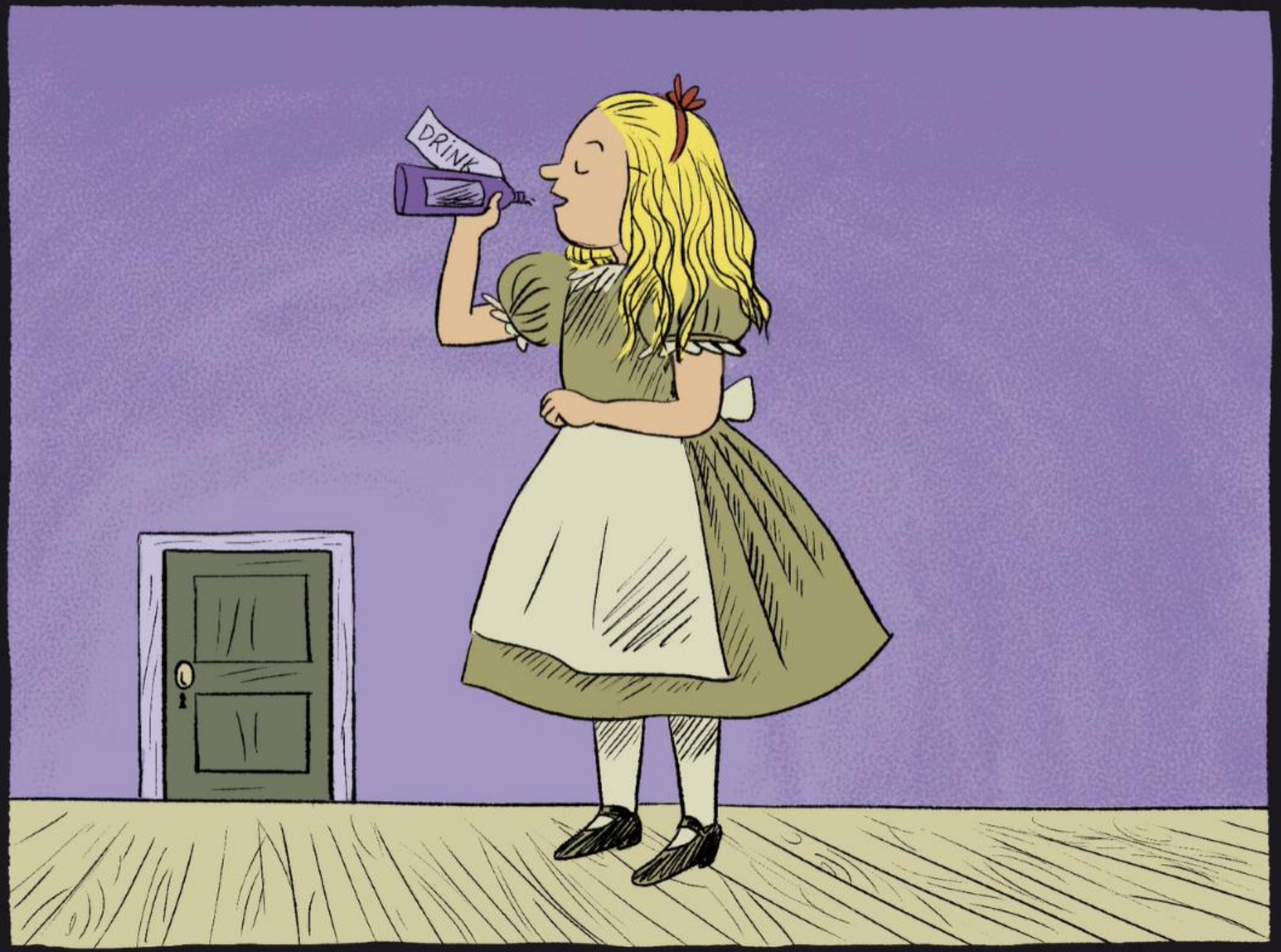
Ask students to explain the evolution of these structures in relation with the evolution of the whales, from land to the sea.

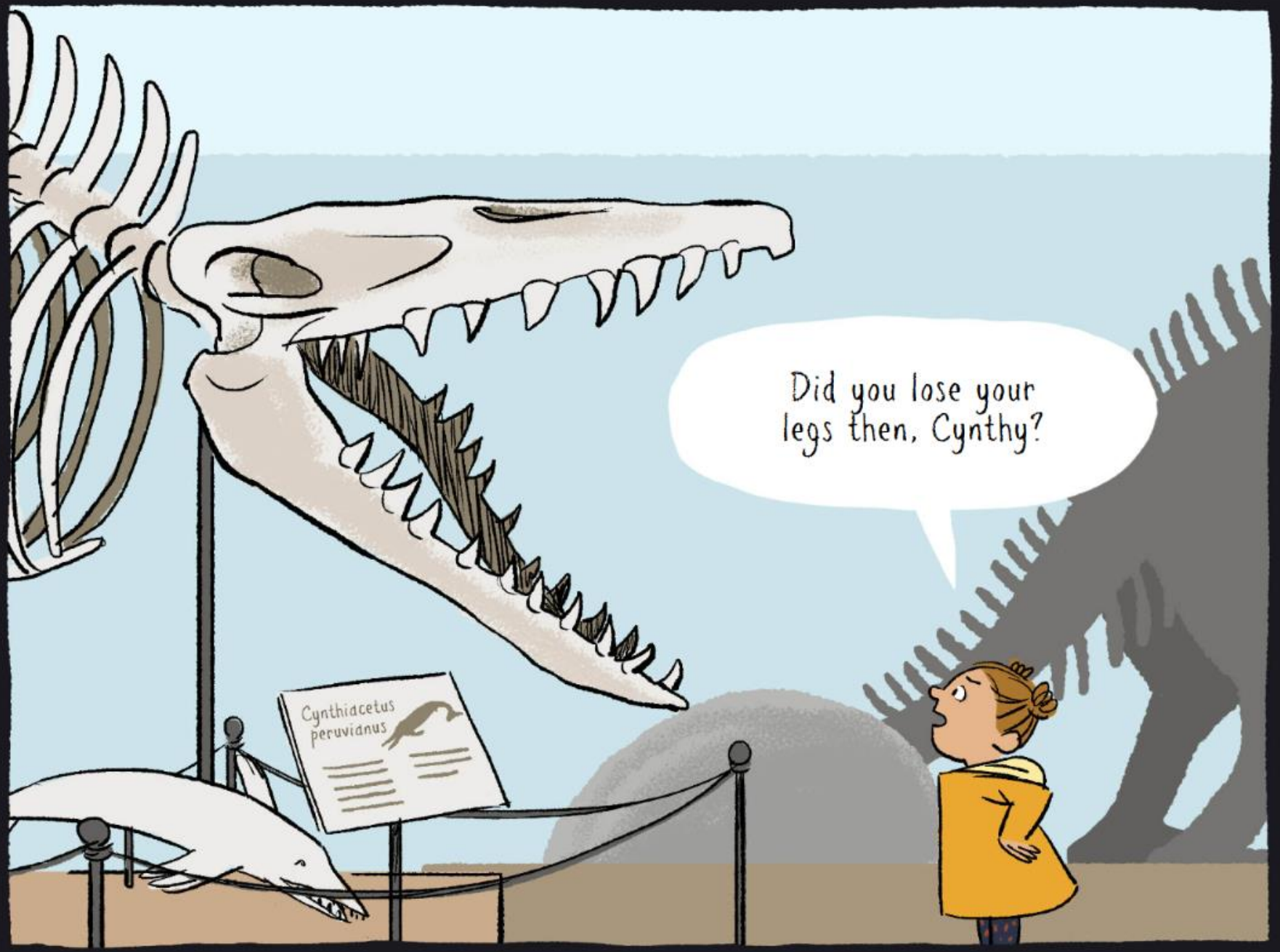


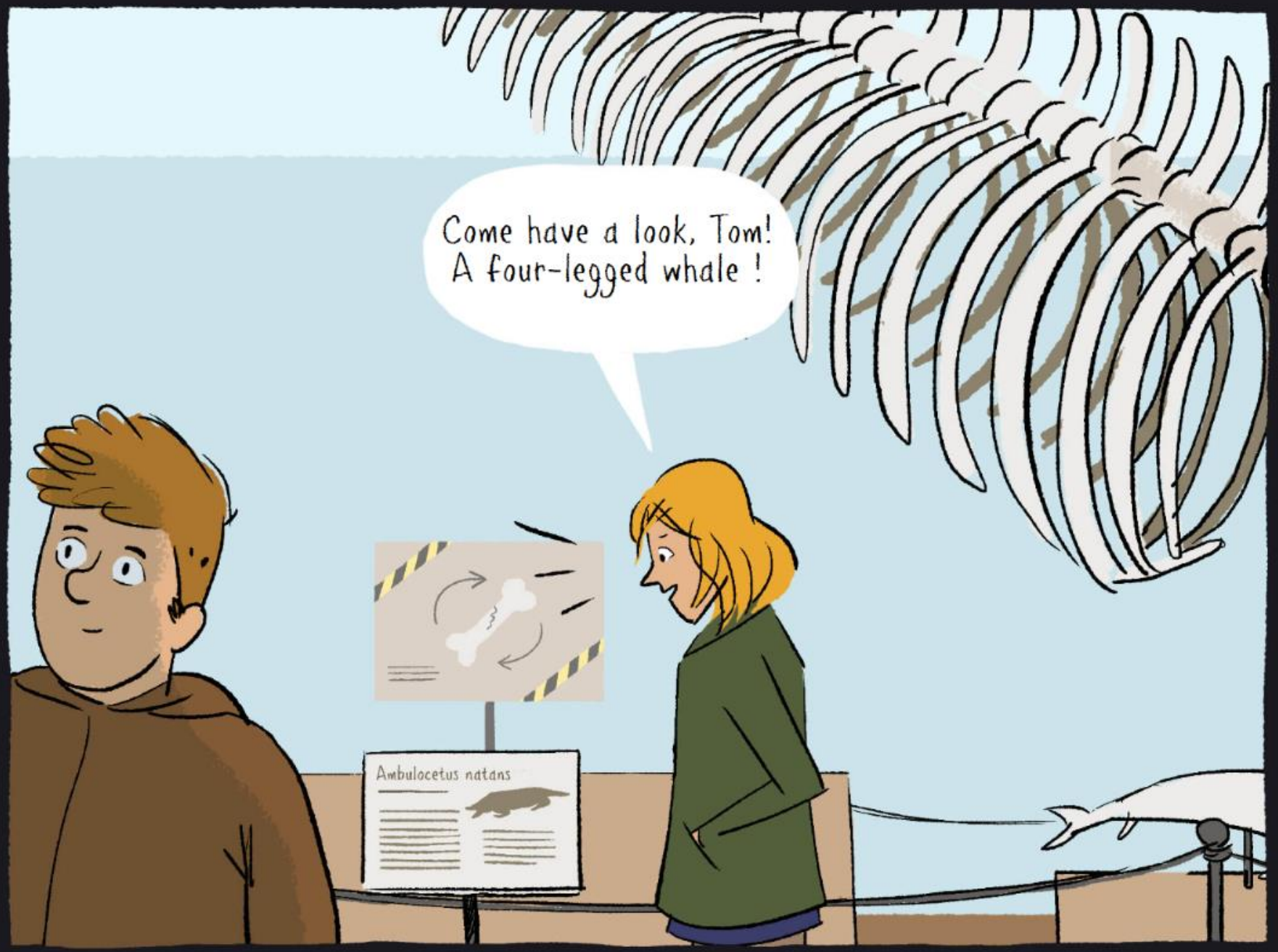
Misconceptions

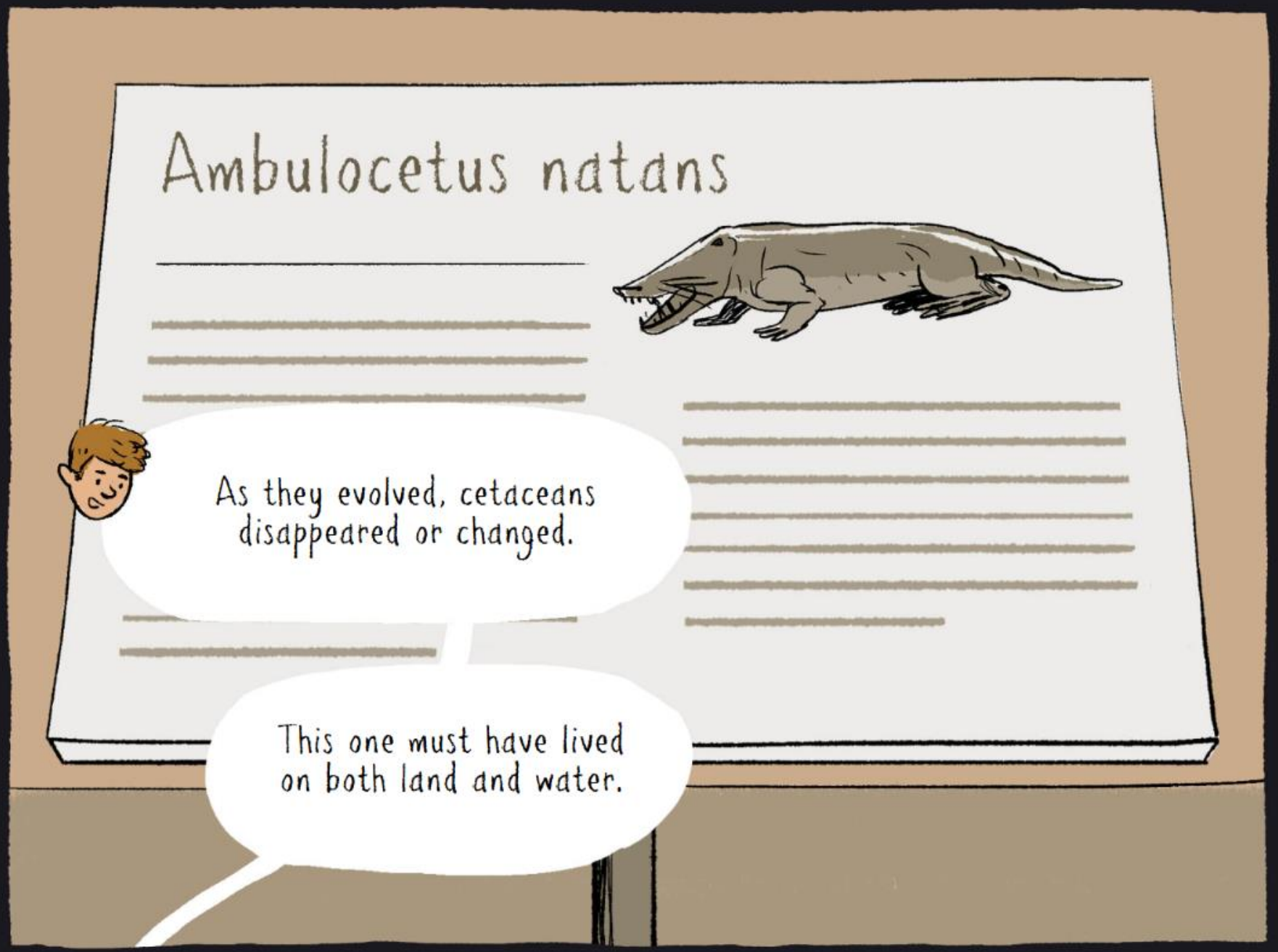
Many students believe that organism adapts and evolves throughout life. That evolution takes place at the level of the individual and not the population.

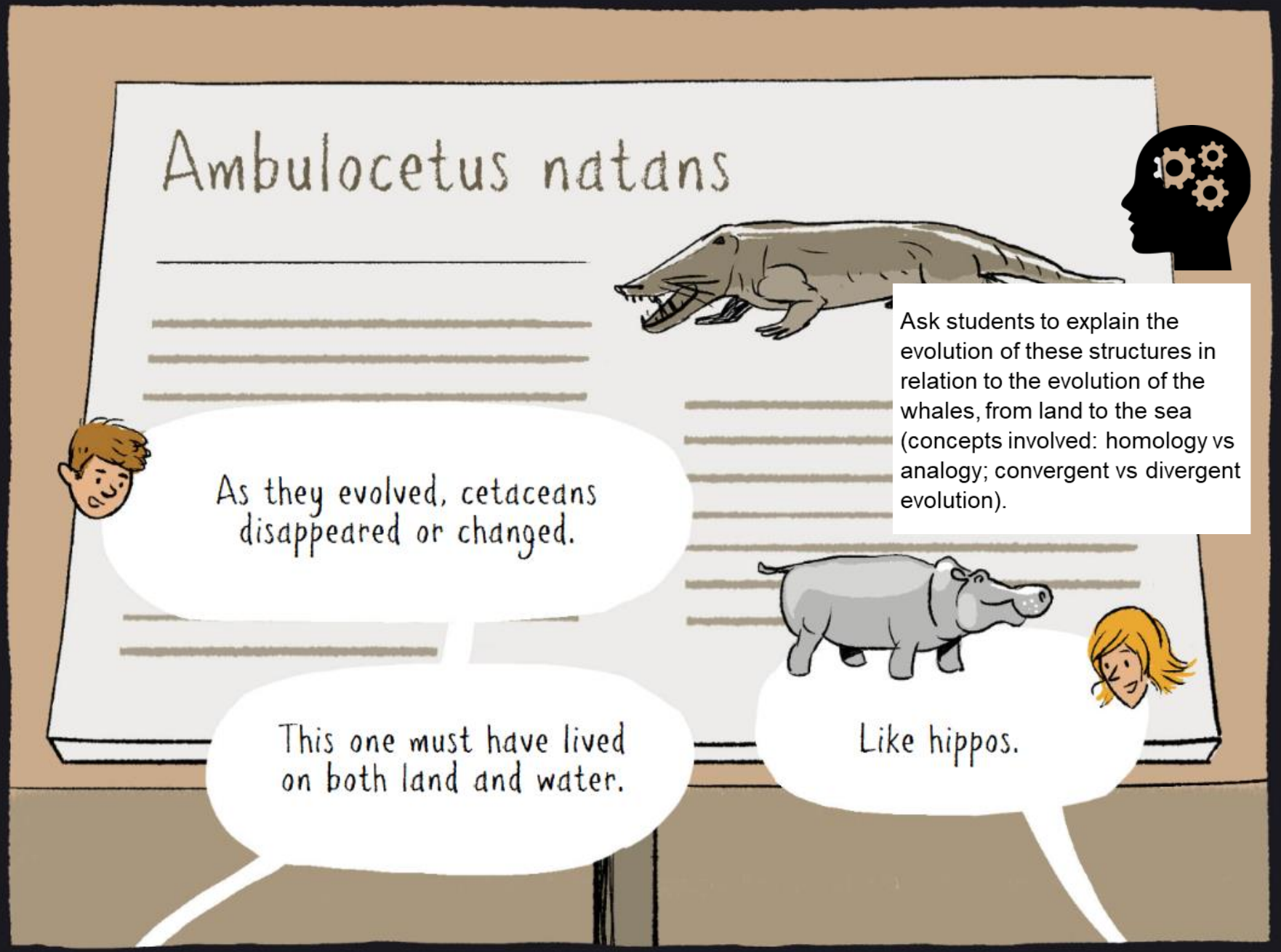

It adapted to its environment.
Like Alice outside the tiny little door!


DRINK

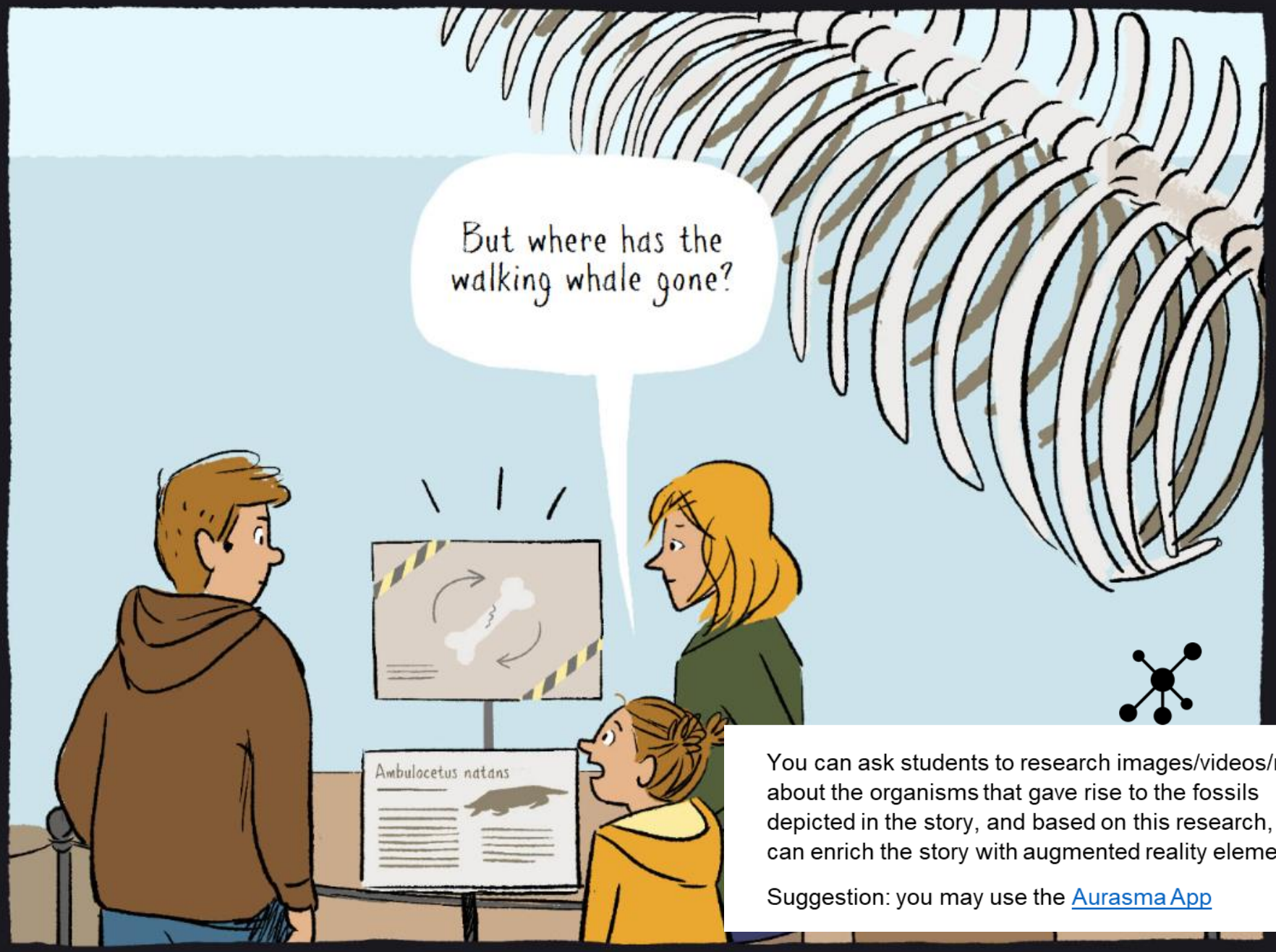

Did you lose your legs then, Cynthy?
Cynthiacetus peruvianus


Come have a look, Tom!
A four-legged whale !
Ambulocetus natans


Ambulocetus natans
As they evolved, cetaceans disappeared or changed.
This one must have lived on both land and water.

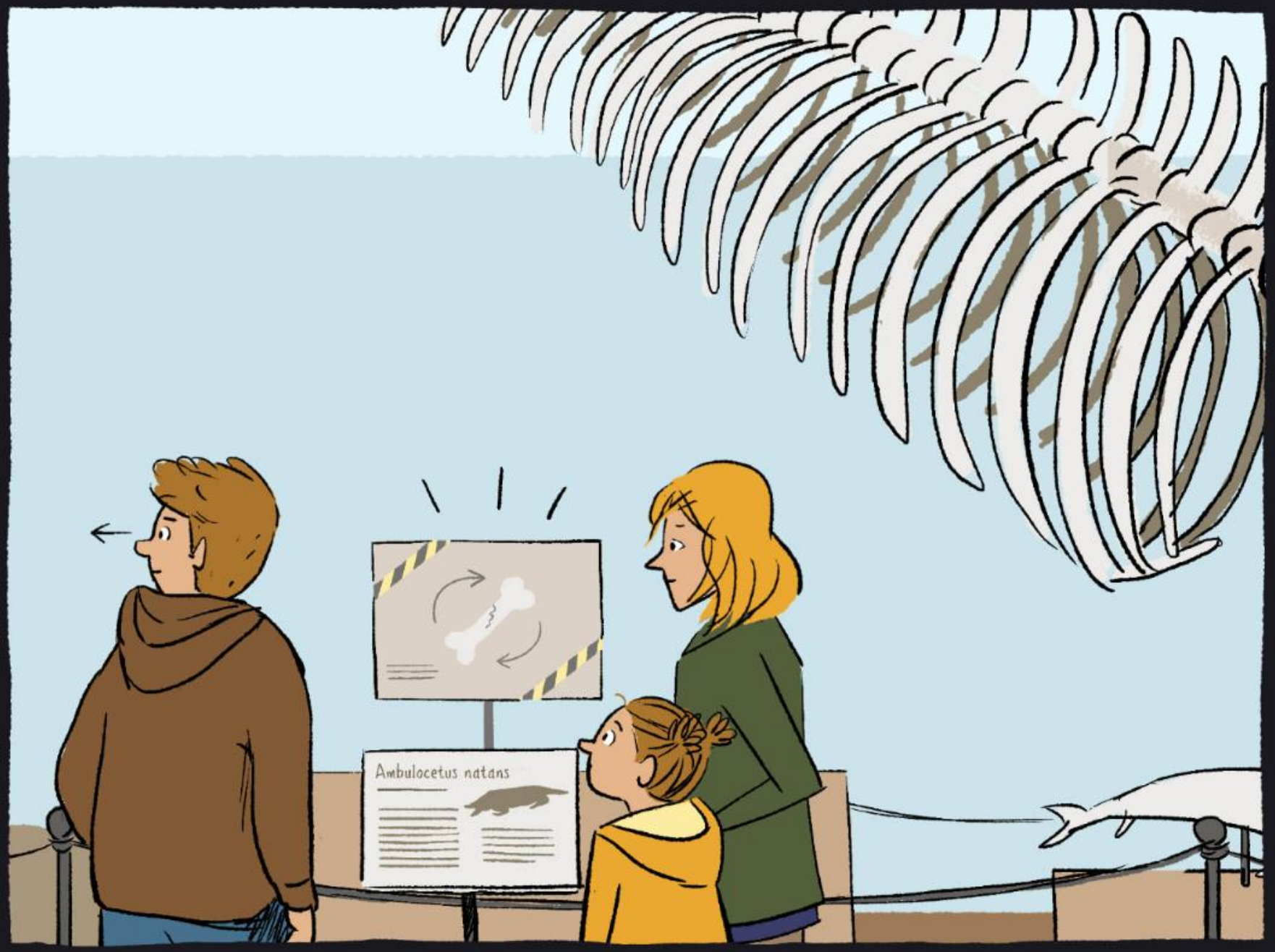


Ask students to explain the evolution of these structures in relation to the evolution of the whales, from land to the sea (concepts involved: homology vs analogy; convergent vs divergent evolution).



You can ask students to research images/videos/news about the organisms that gave rise to the fossils depicted in the story, and based on this research, they can enrich the story with augmented reality elements.

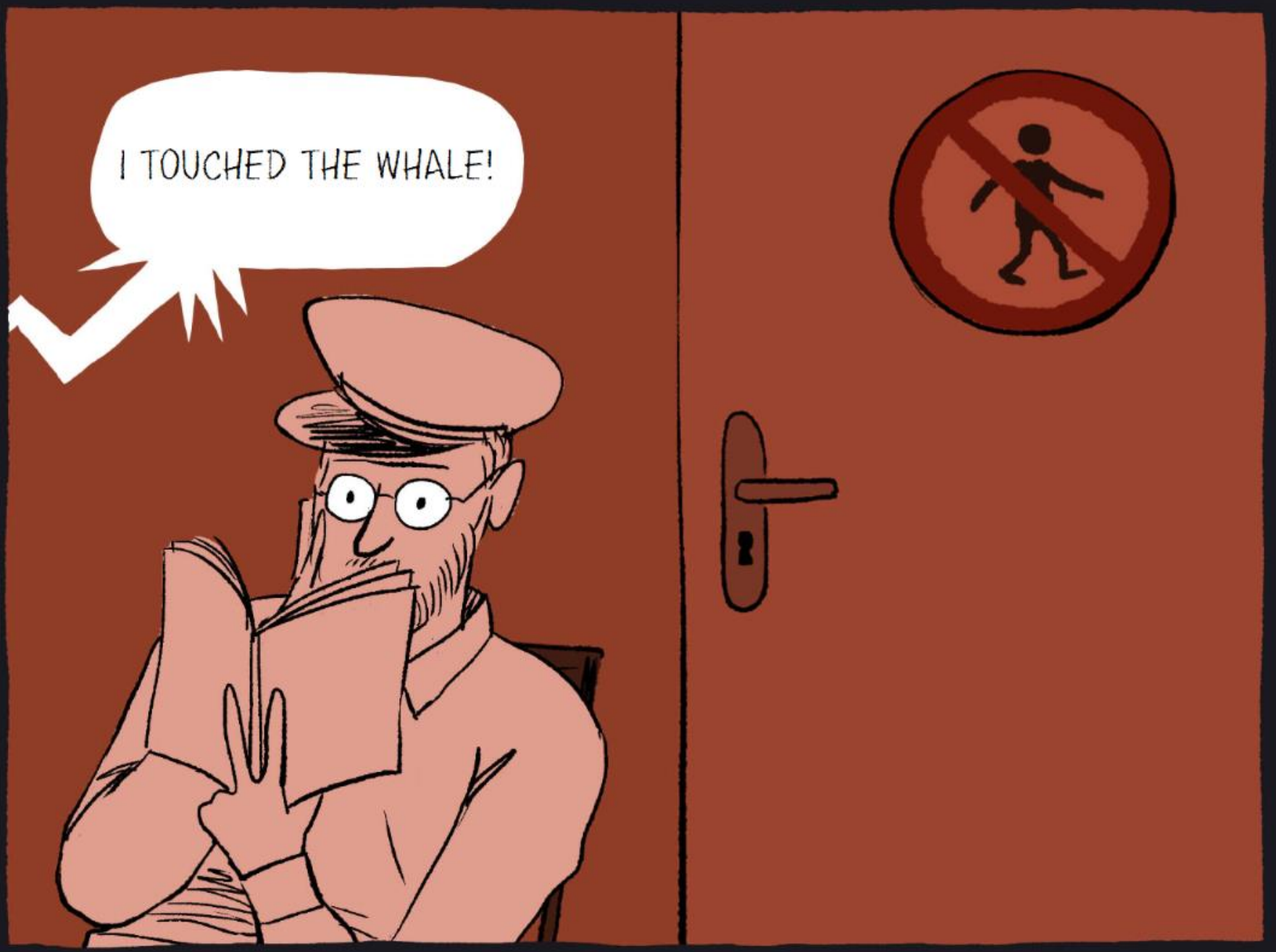
Suggestion: you may use the Aurasma App


Ambulocetus natans


Let's look for that walking whale!


Here's what we'll do...


No entry

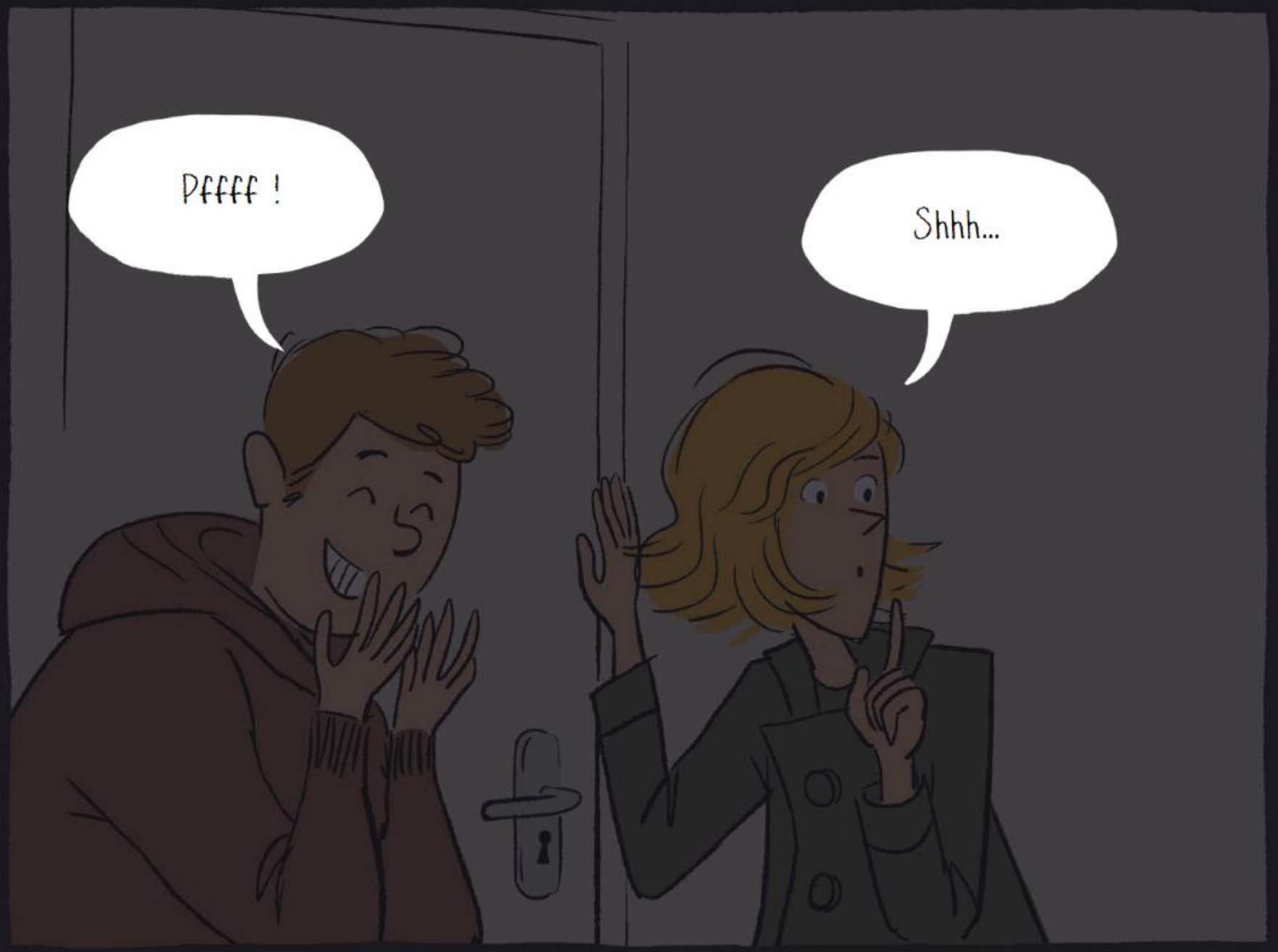

I TOUCHED THE WHALE!


No no no!
Don't touch the skeletons, child!

Chapter 2

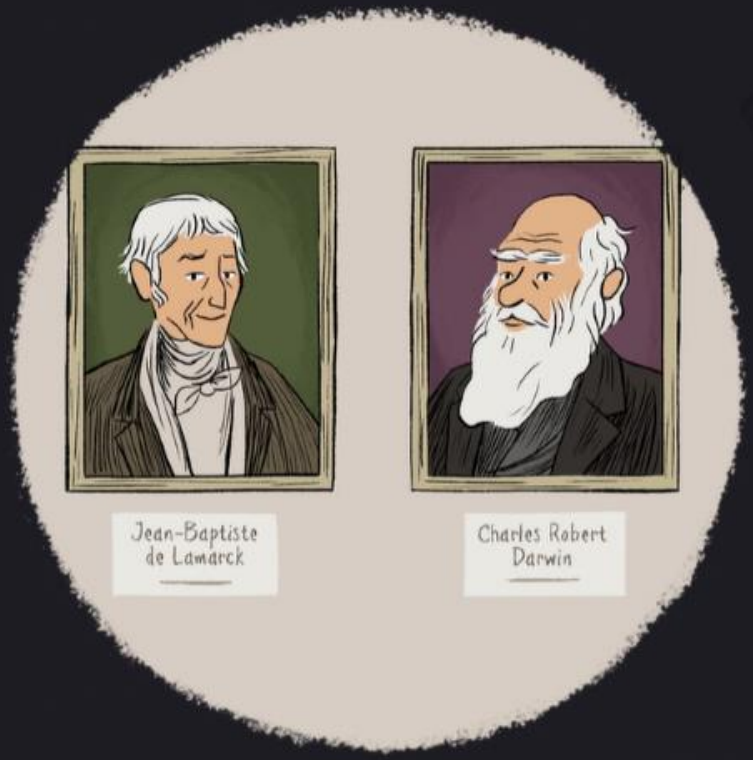
Start reading

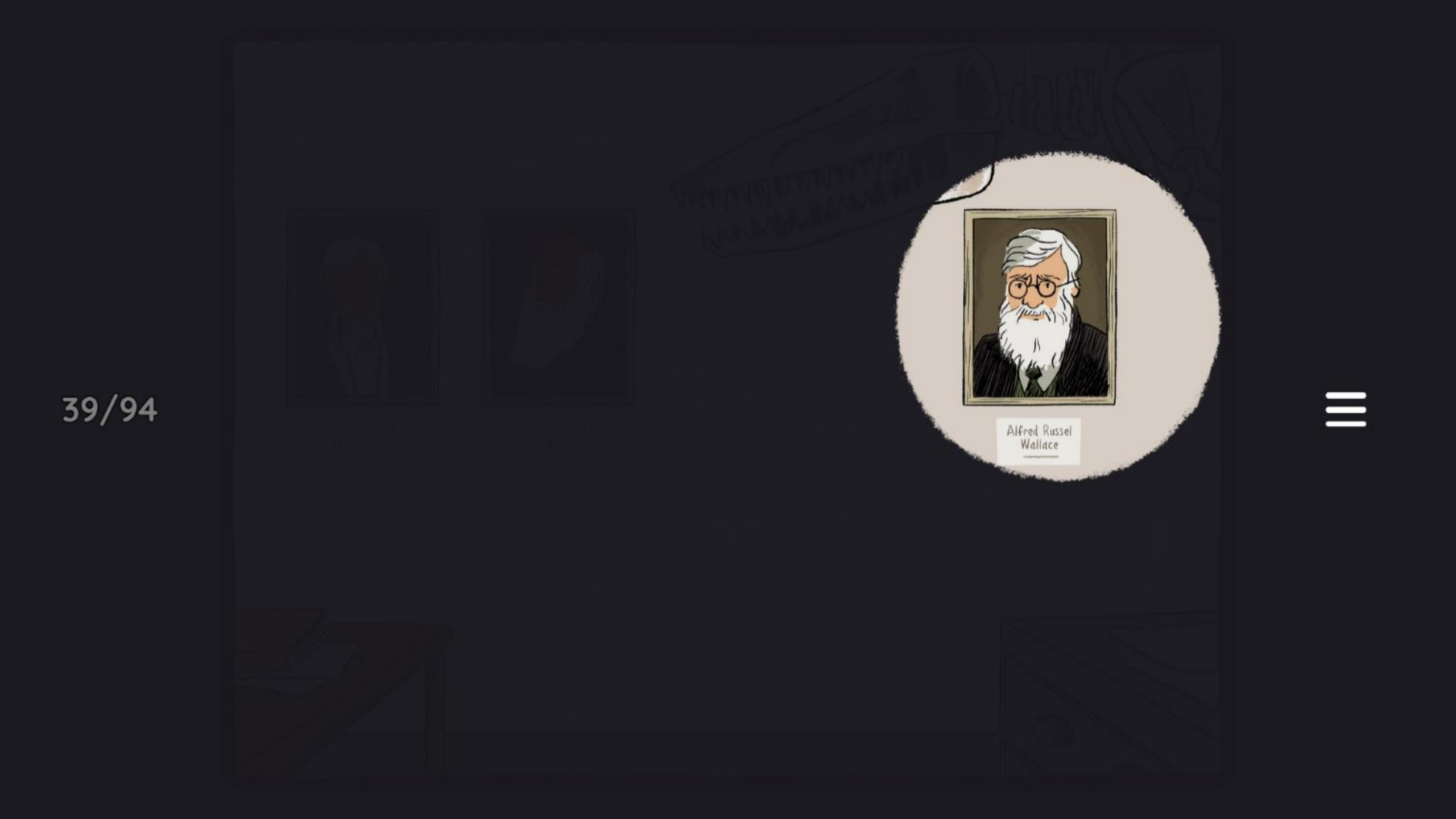
Menu

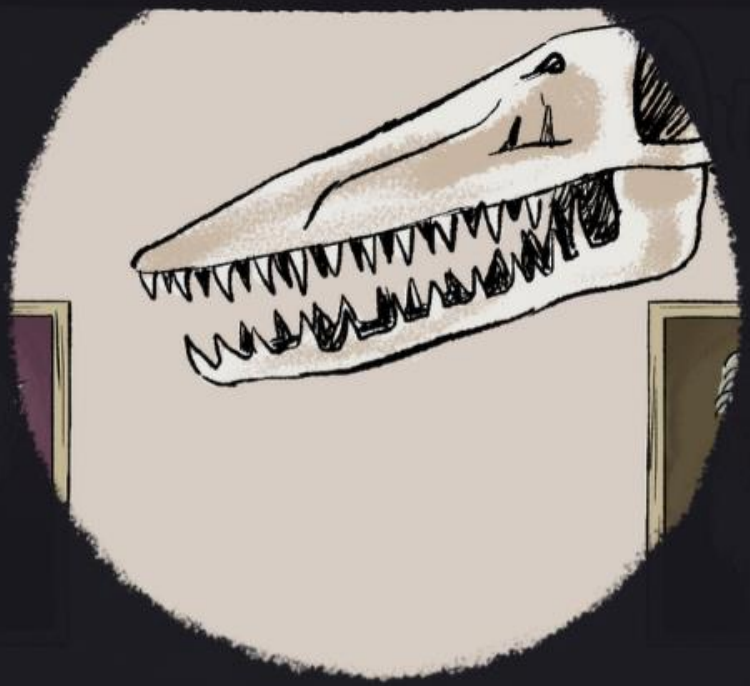

Pfffff !
Shhh...

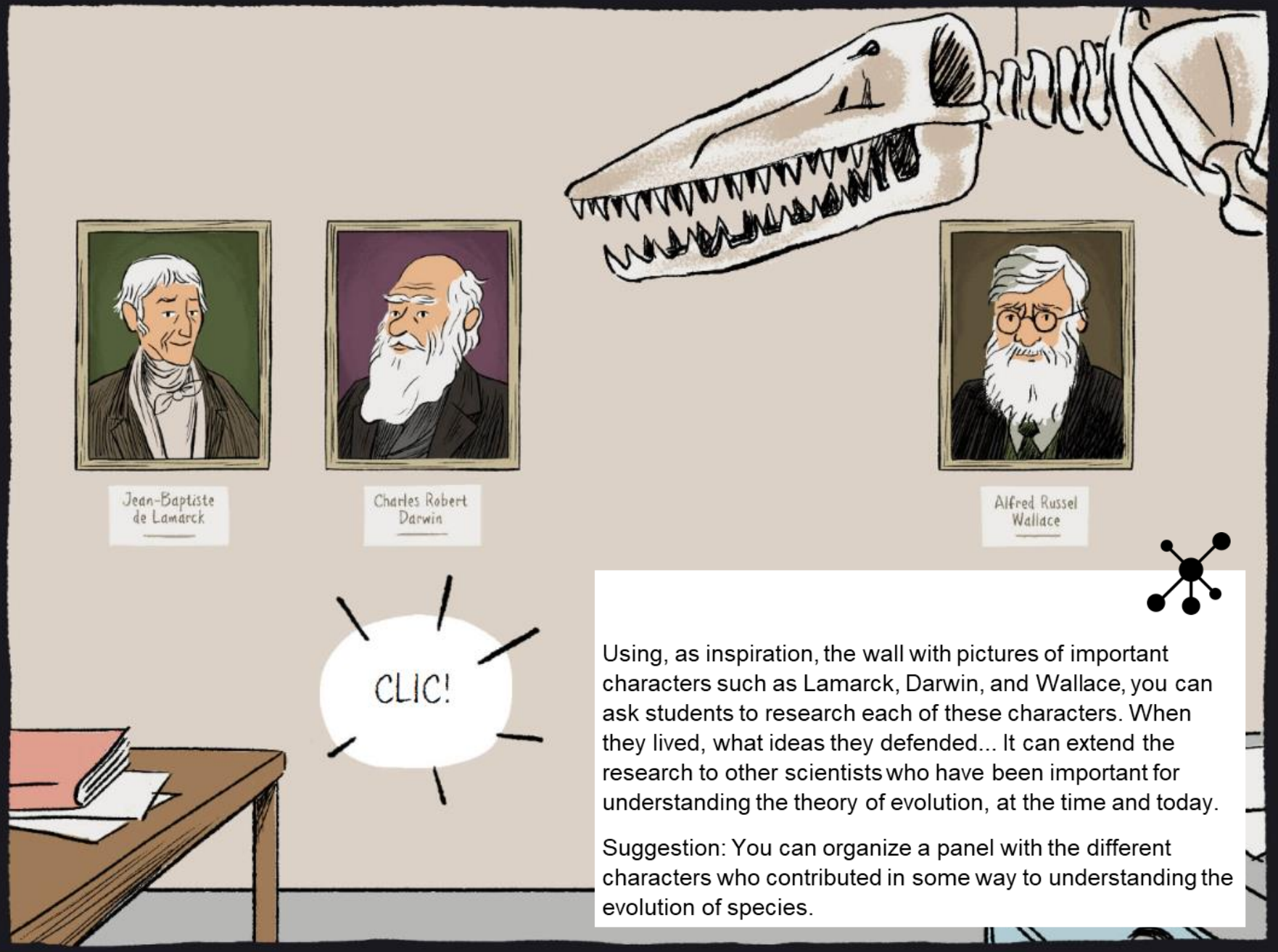
Using, as inspiration, the wall with pictures of important characters such as Lamarck, Darwin, and Wallace, you can ask students to research each of these characters. When they lived, what ideas they defended... It can extend the research to other scientists who have been important for understanding the theory of evolution, at the time and today.

Suggestion: You can organize a panel with the different characters who contributed in some way to understanding the evolution of species.


Jean-Baptiste de Lamarck
Charles Robert Darwin


Alfred Russel
Wallace





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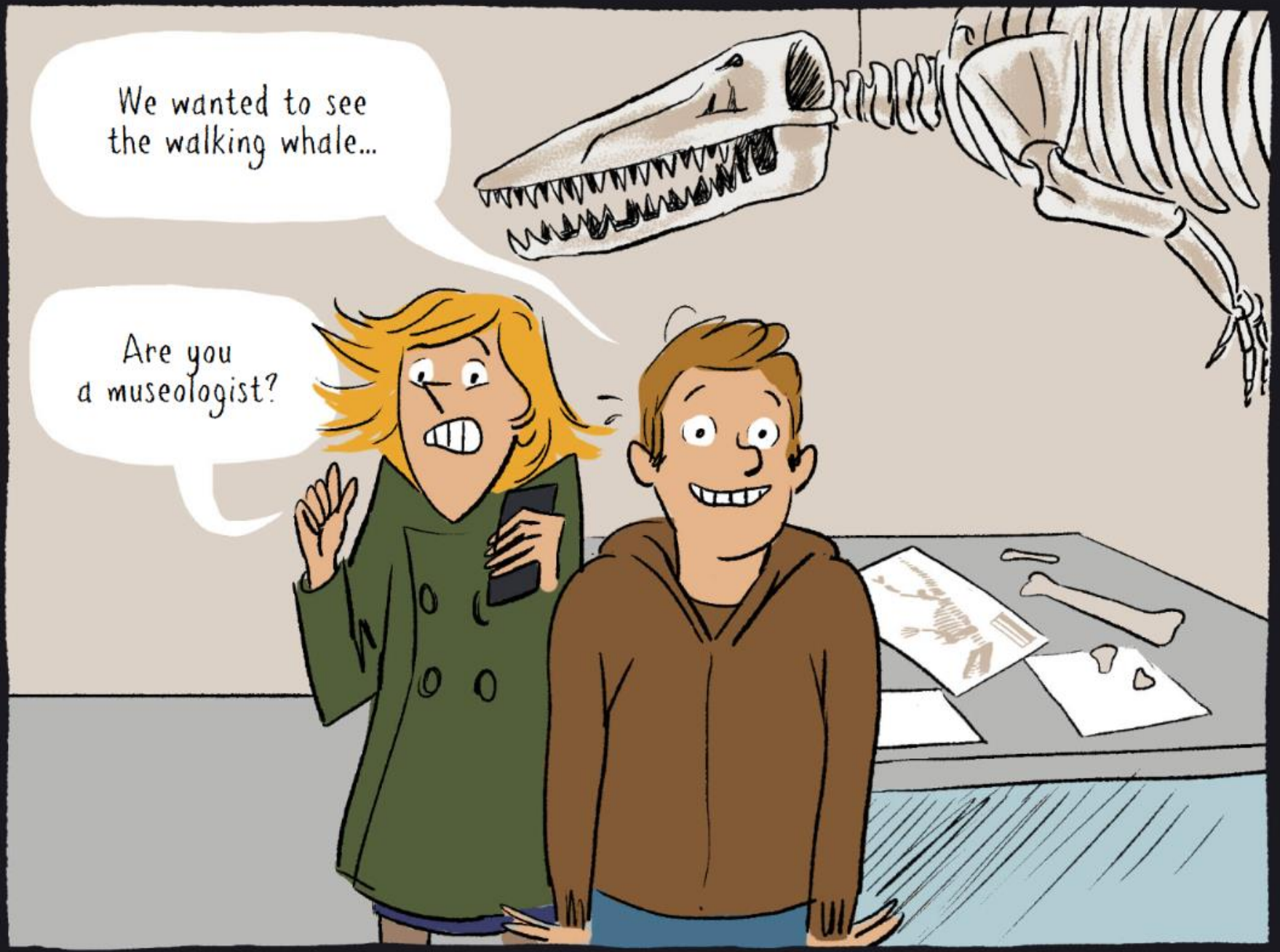
Suggestion: You can organize a panel with the different characters who contributed in some way to understanding the evolution of species.


Well well well.
Two 21st century human specimens!


We wanted to see the walking whale...
Are you a museologist?

The American researcher in the story is called Analissa Berta and she is a paleontologist. You could ask students to do a little research about this scientist's work.

Link: https://www.youtube.com/watch?v=Vgu21M0Anto (Analissa Berta, women paleontologists)

Or you can ask them to research on your own paleontologists.


Ambulocetus was an amphibian vertebrate. It certainly was a good terrestrial predator on land. But it could also swim like an otter to hunt its prey.

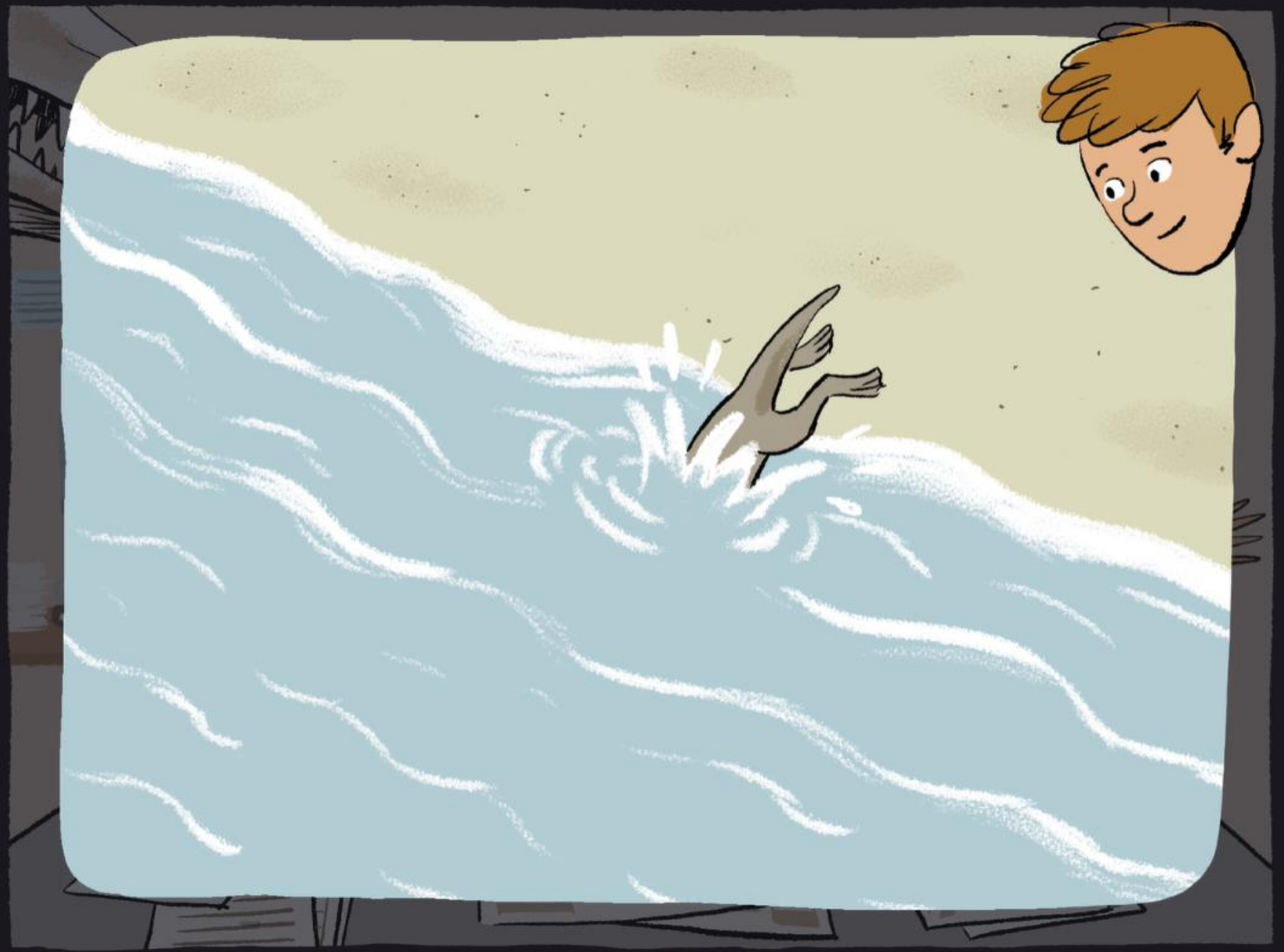

Its hind limbs look like flipper legs.

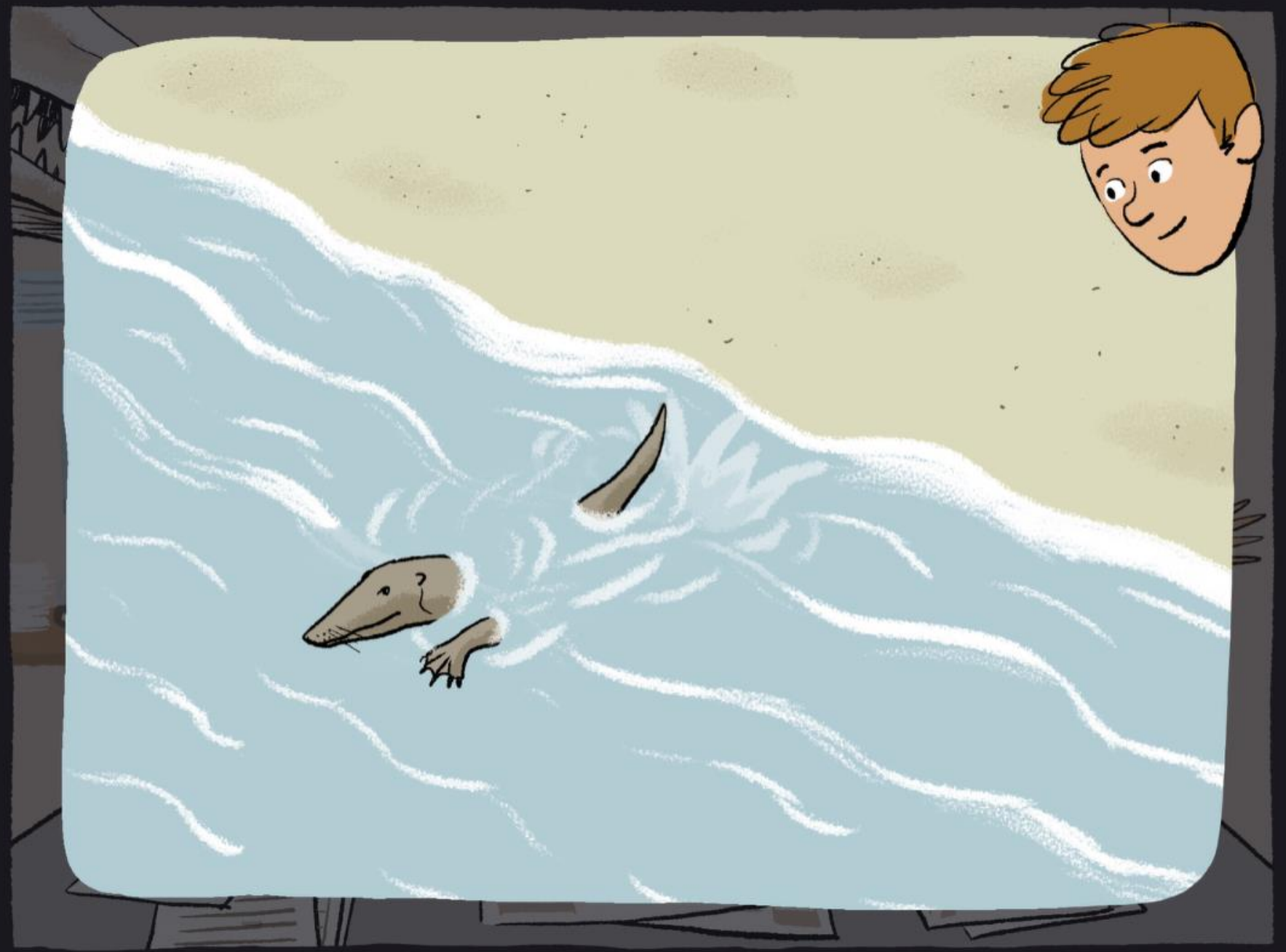
Ask students to explain the evolution of these structures in relation with the evolution of the whales, from land to the sea (concepts involved: homology vs analogy; convergent vs divergent evolution).


And to escape predators on land!

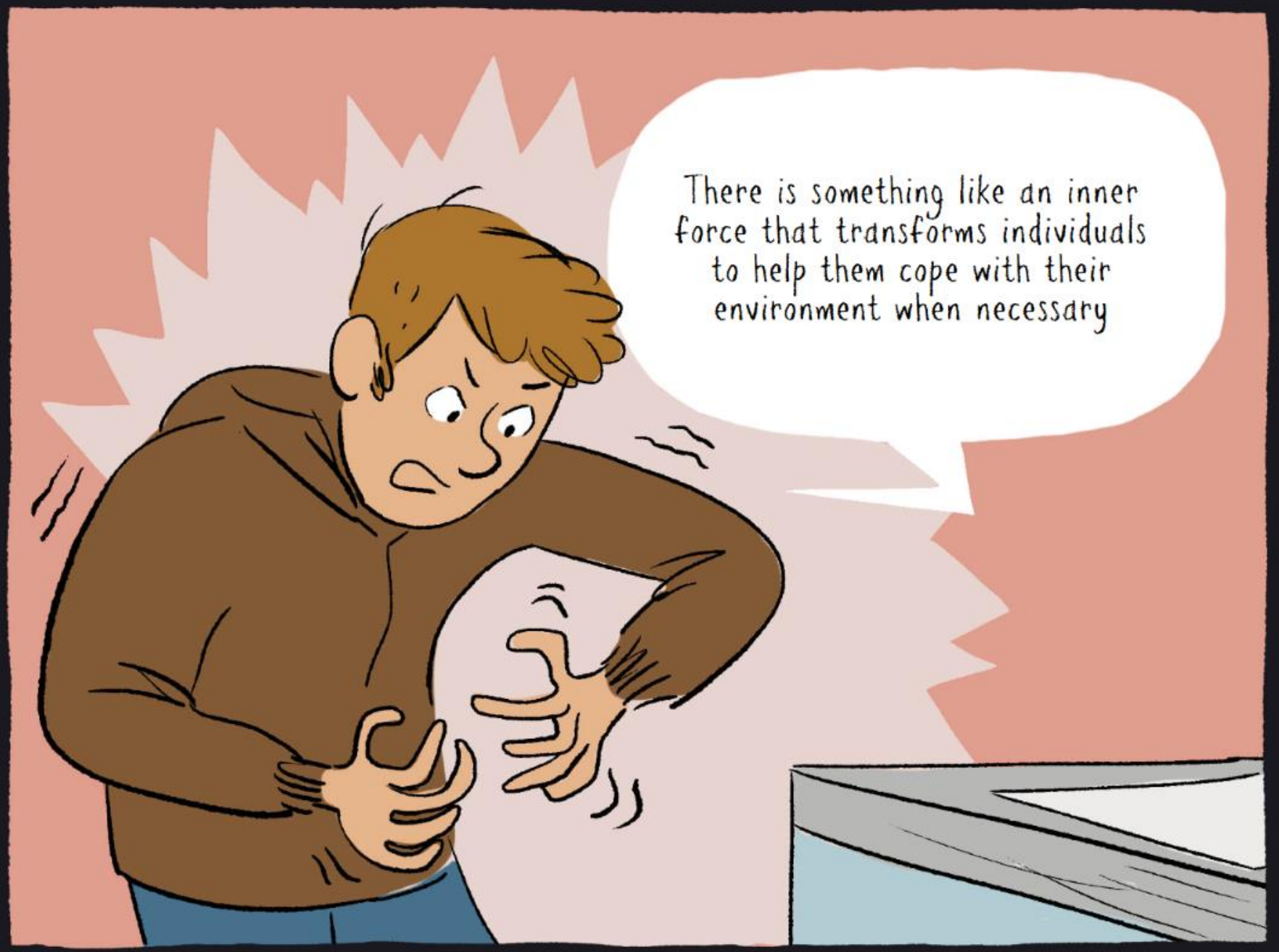

How do you think this adaptation happened?


How do you think this adaptation happened?
If there was more water in their environment, these animals must have developed sorts of flippers to cope with living in water.

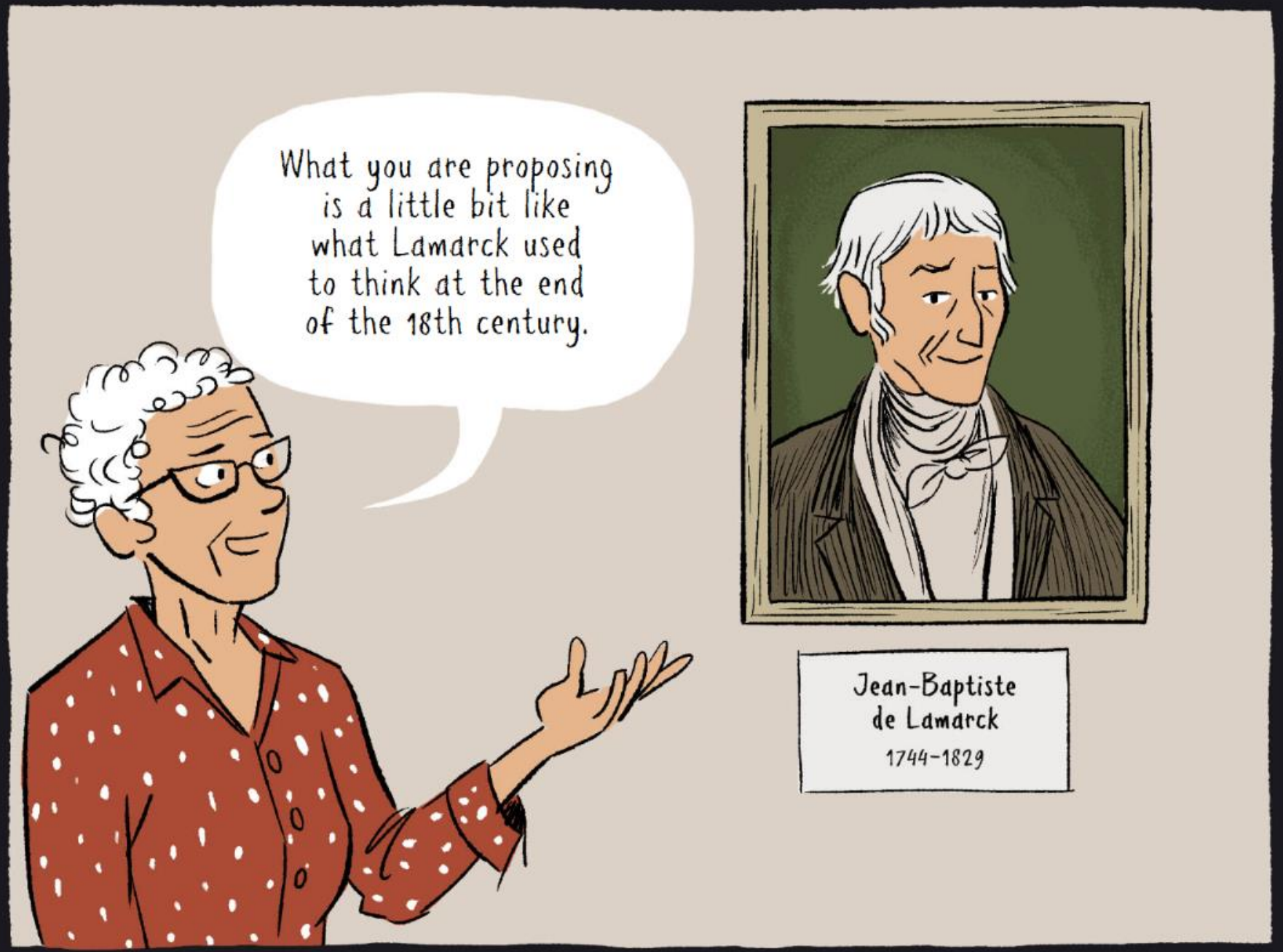


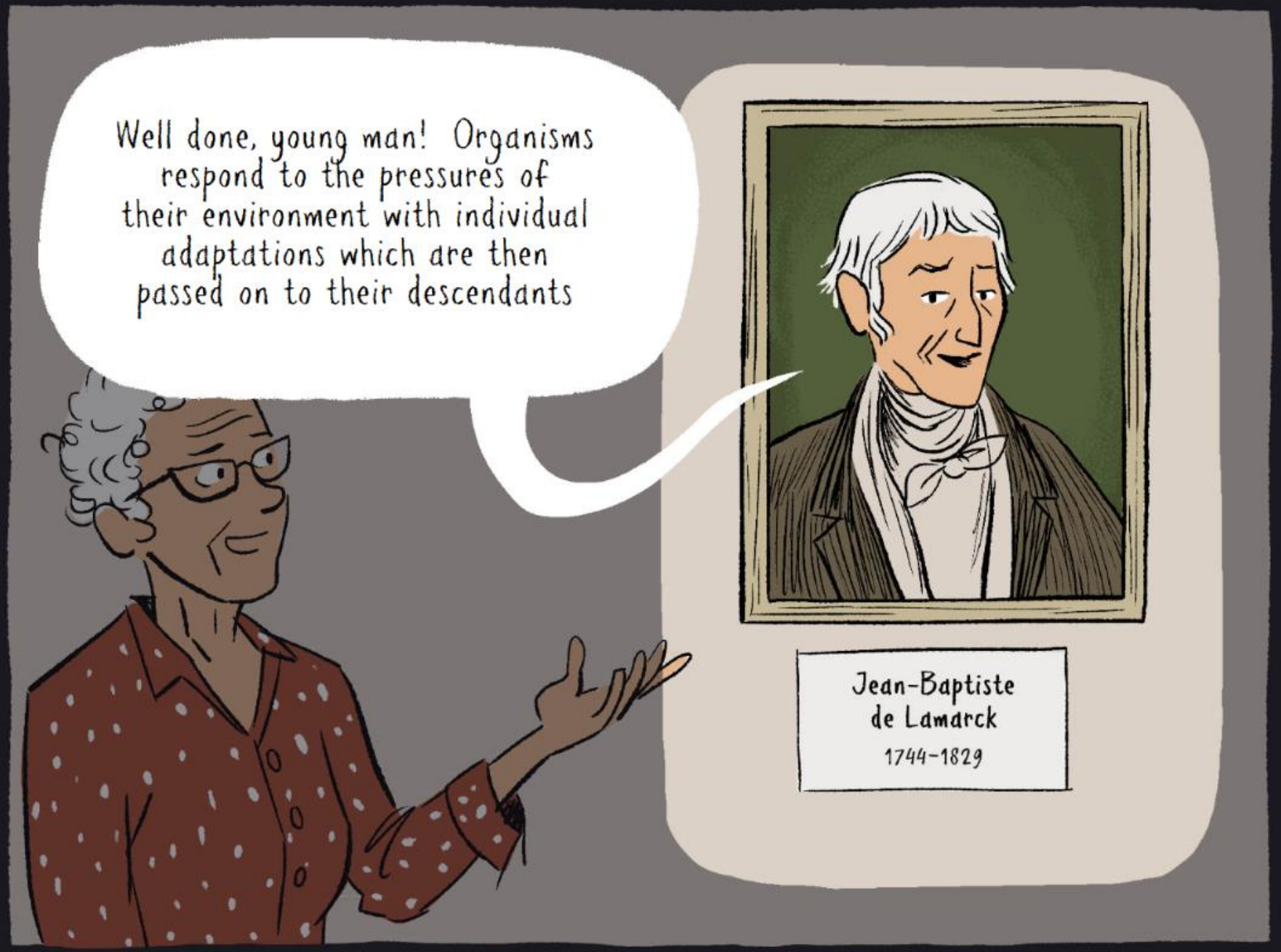


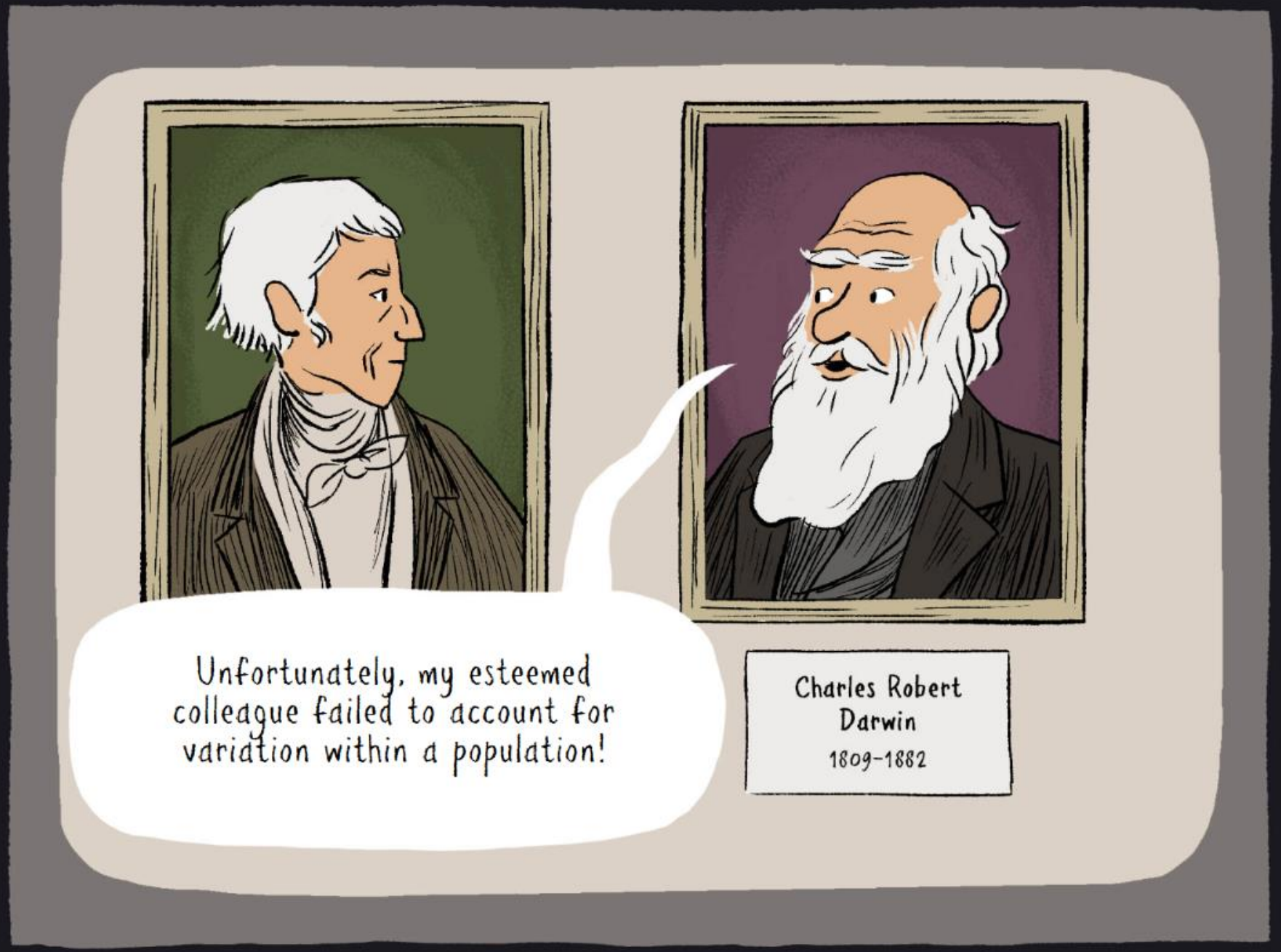

This doesn't explain how it happened.

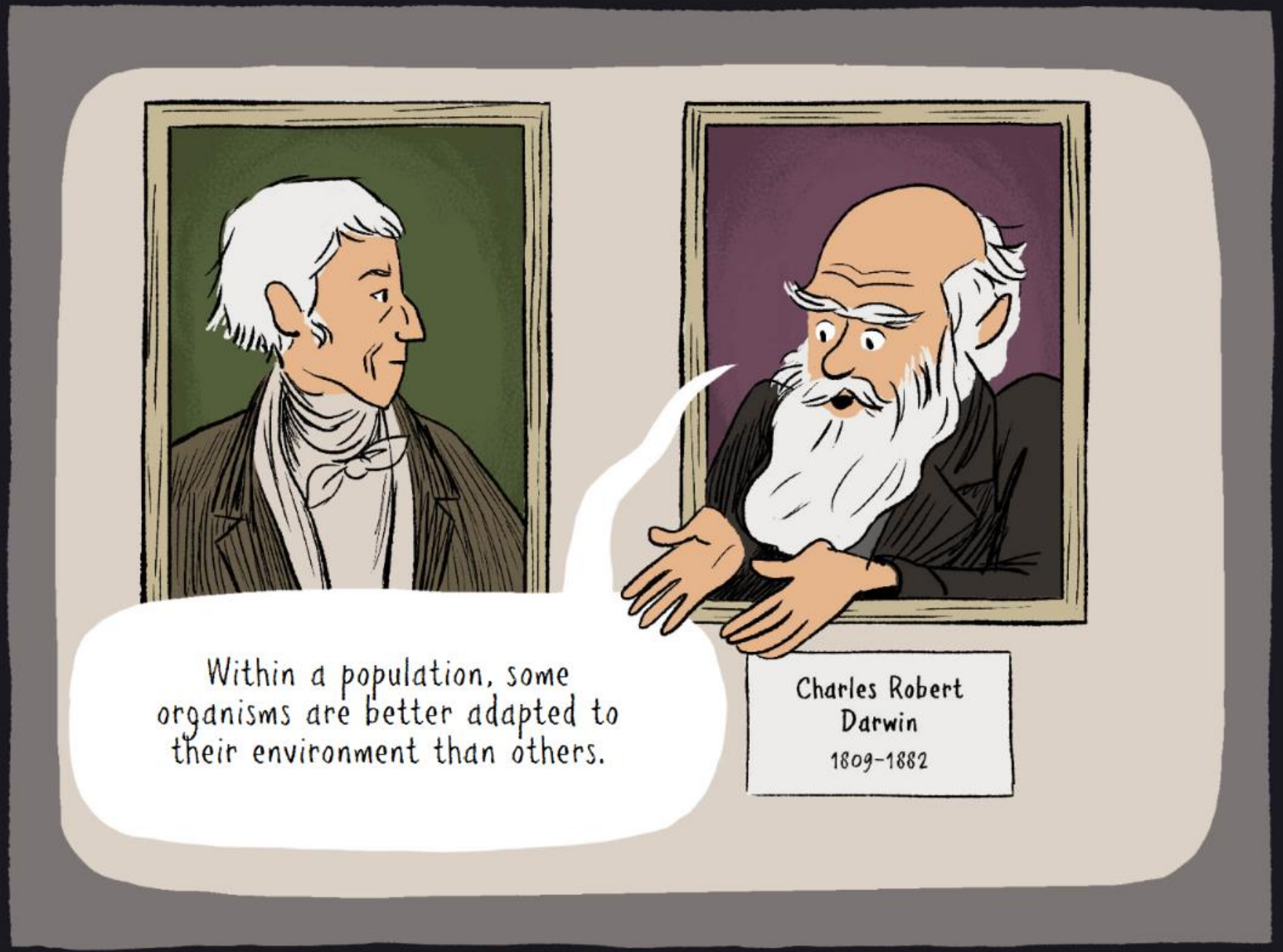

There is something like an inner force that transforms individuals to help them cope with their environment when necessary

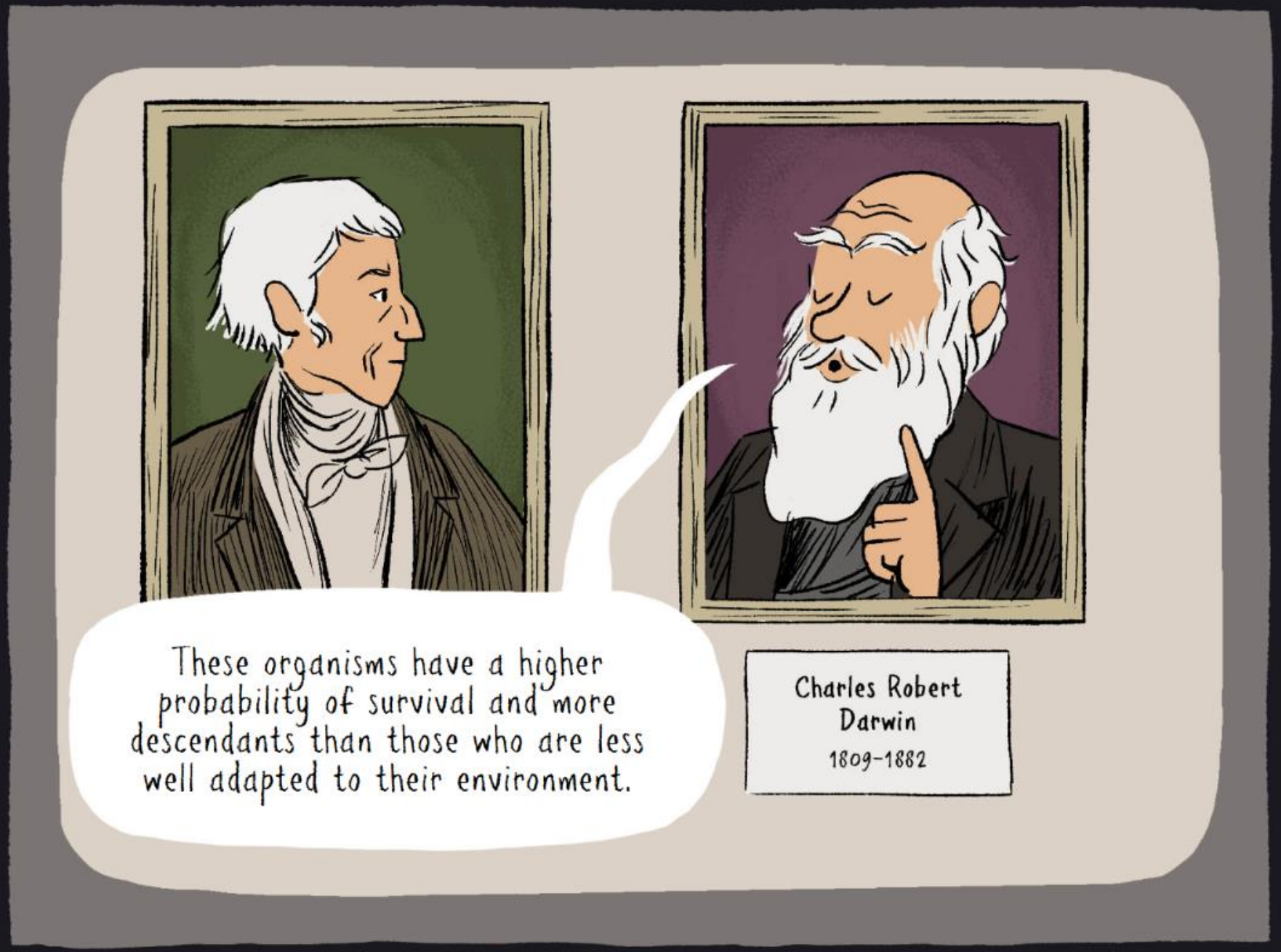

...
Misconceptions
Many students believe that organisms struggle and try to adapt.


What you are proposing is a little bit like what Lamarck used to think at the end of the 18th century.
Jean-Baptiste de Lamarck
1744-1829

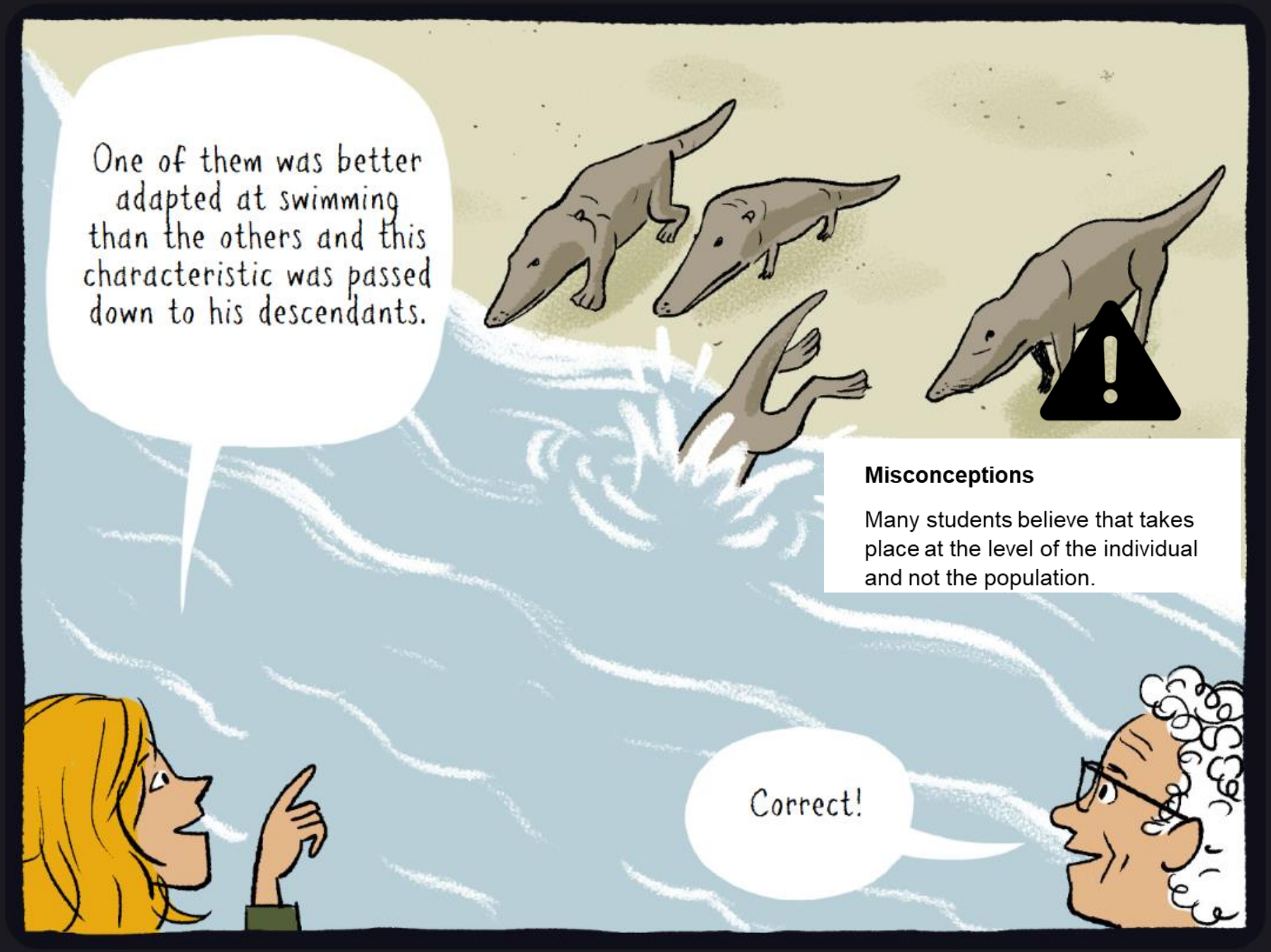

Well done, young man! Organisms respond to the pressures of their environment with individual adaptations which are then passed on to their descendants
Jean-Baptiste de Lamarck
1744-1829


Unfortunately, my esteemed colleague failed to account for variation within a population!
Charles Robert Darwin
1809-1882


Within a population, some organisms are better adapted to their environment than others.
Charles Robert Darwin
1809-1882

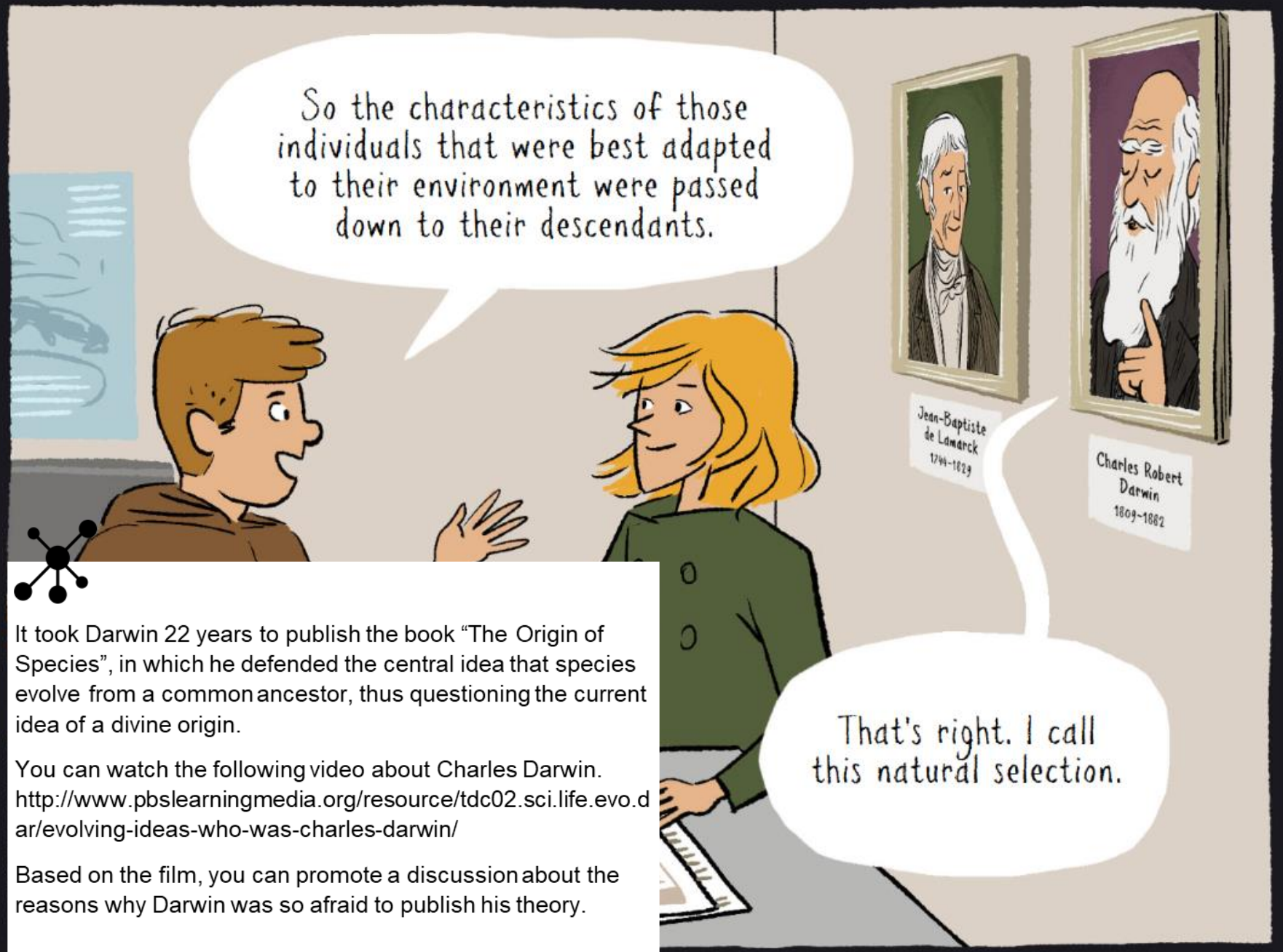

These organisms have a higher probability of survival and more descendants than those who are less well adapted to their environment.
Charles Robert Darwin
1809-1882


Of course there were lots of Ambulocetus at the time, not just one!
And Darwin helped us to understand that this Ambulocetus population was made up of individuals with a few differences from each other.



Misconceptions

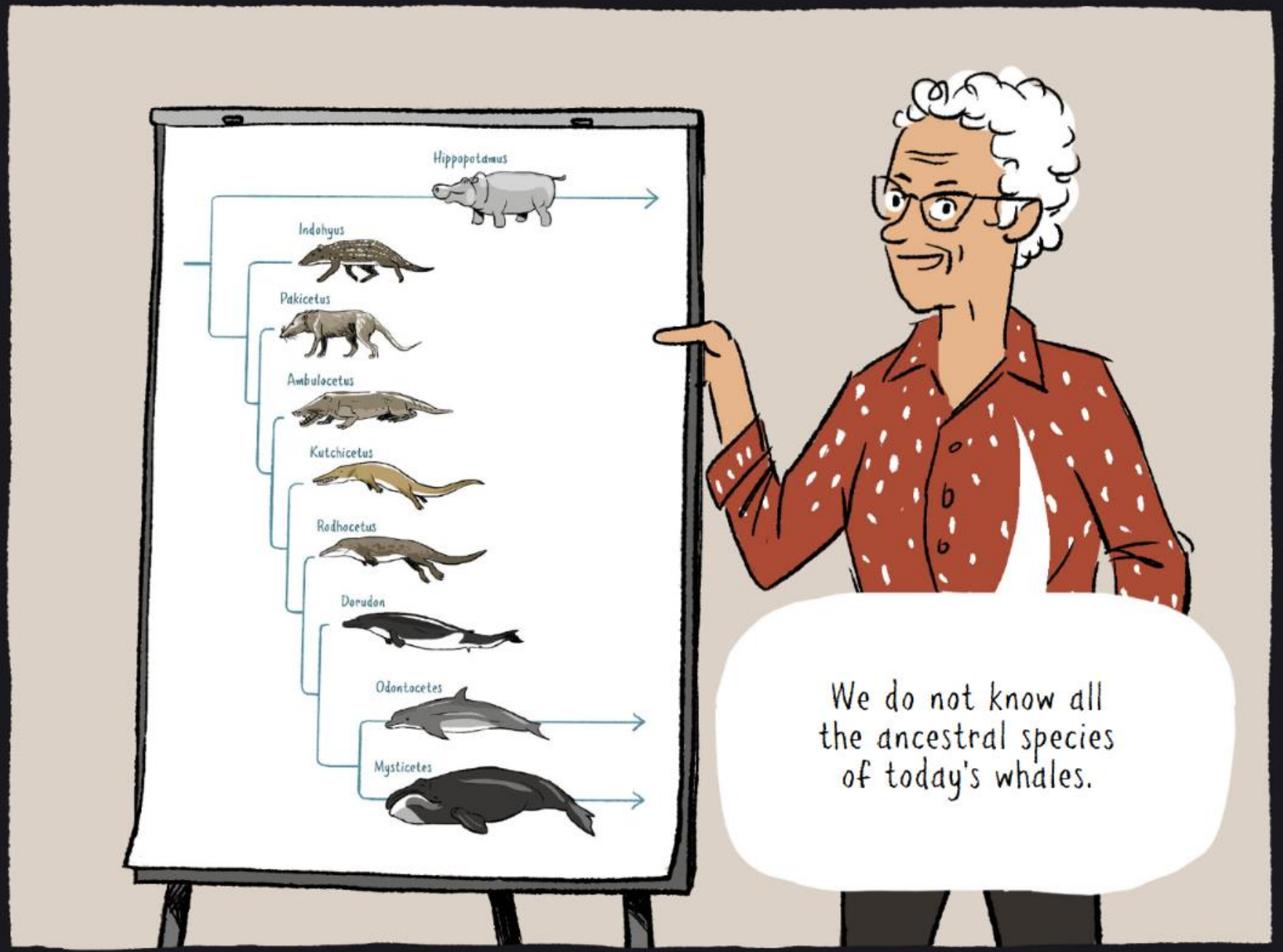
Many students believe that takes place at the level of the individual and not the population.

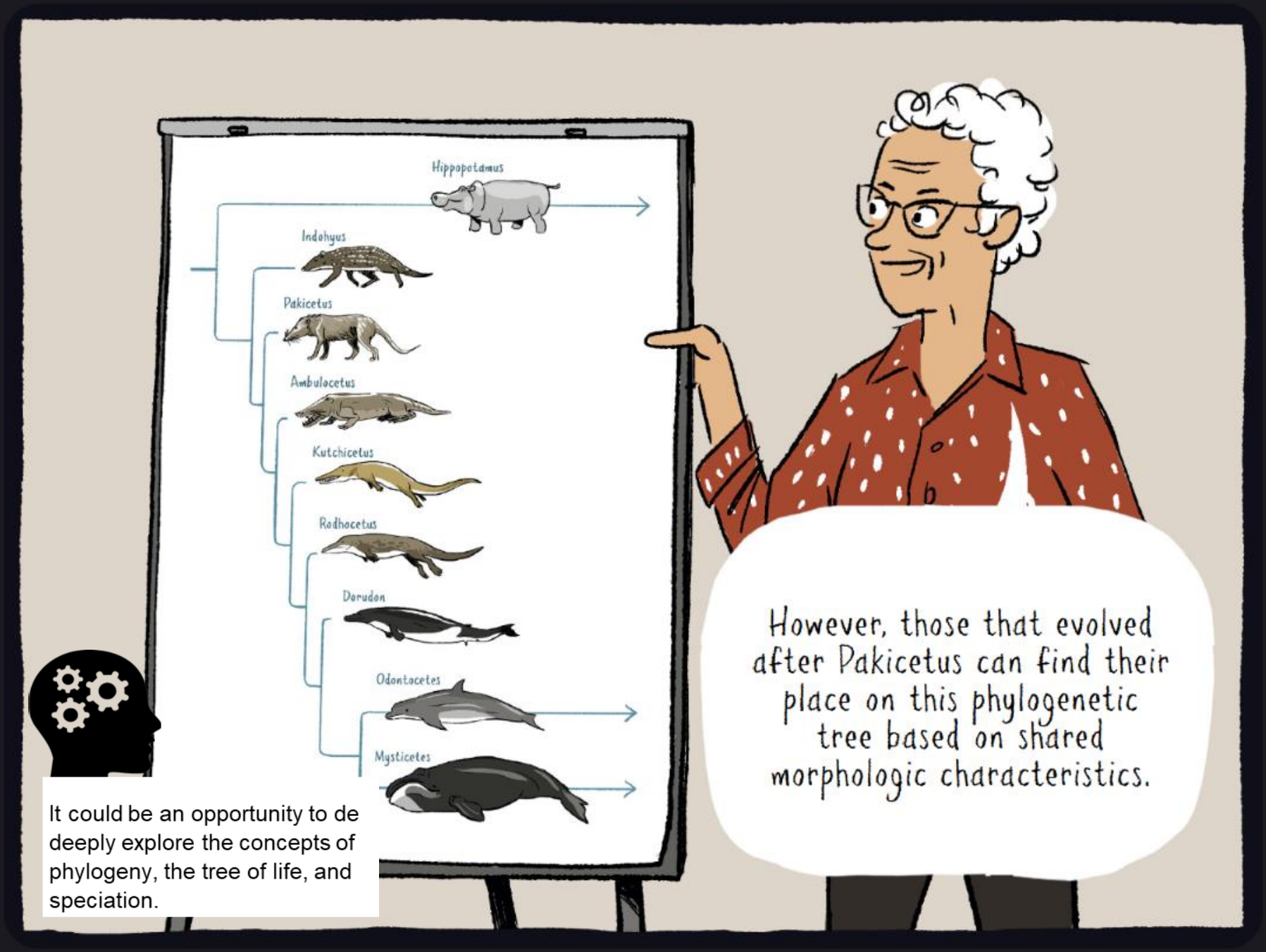


It took Darwin 22 years to publish the book “The Origin of Species”, in which he defended the central idea that species evolve from a common ancestor, thus questioning the current idea of a divine origin.

You can watch the following video about Charles Darwin. http://www.pbslearningmedia.org/resource/tdc02.sci.life.evo.dar/evolving-ideas-who-was-charles-darwin/

Based on the film, you can promote a discussion about the reasons why Darwin was so afraid to publish his theory.

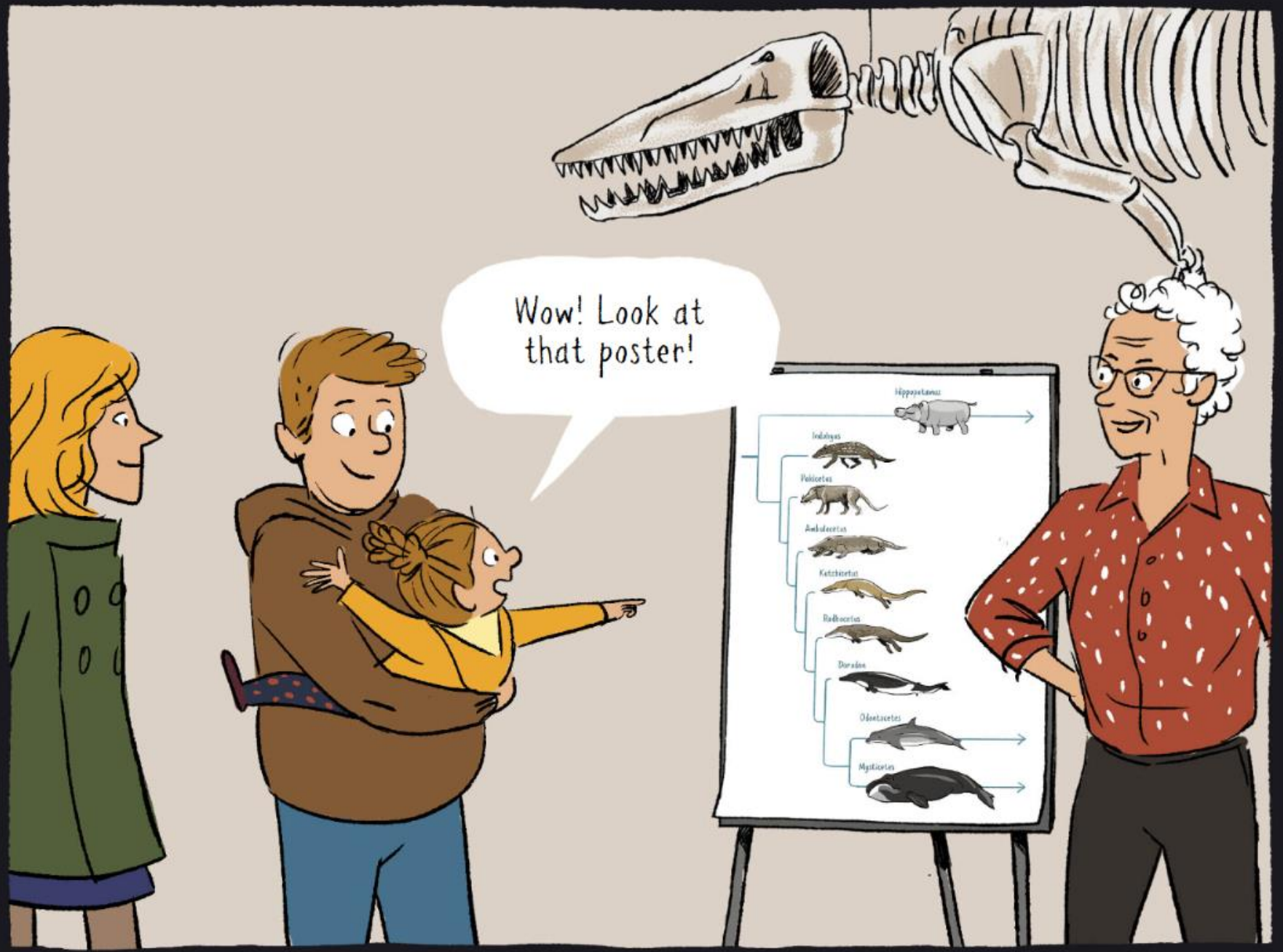

Hippopotamus
Indohyus
Pakicetus
Ambulocetus
Kutchicetus
Rodhocetus
Dorudon
Odontocetes
Mysticetes
We do not know all the ancestral species of today's whales.



It could be an opportunity to de deeply explore the concepts of phylogeny, the tree of life, and speciation.


I think you lost something in the palaeontology gallery...


We found the walking whale!

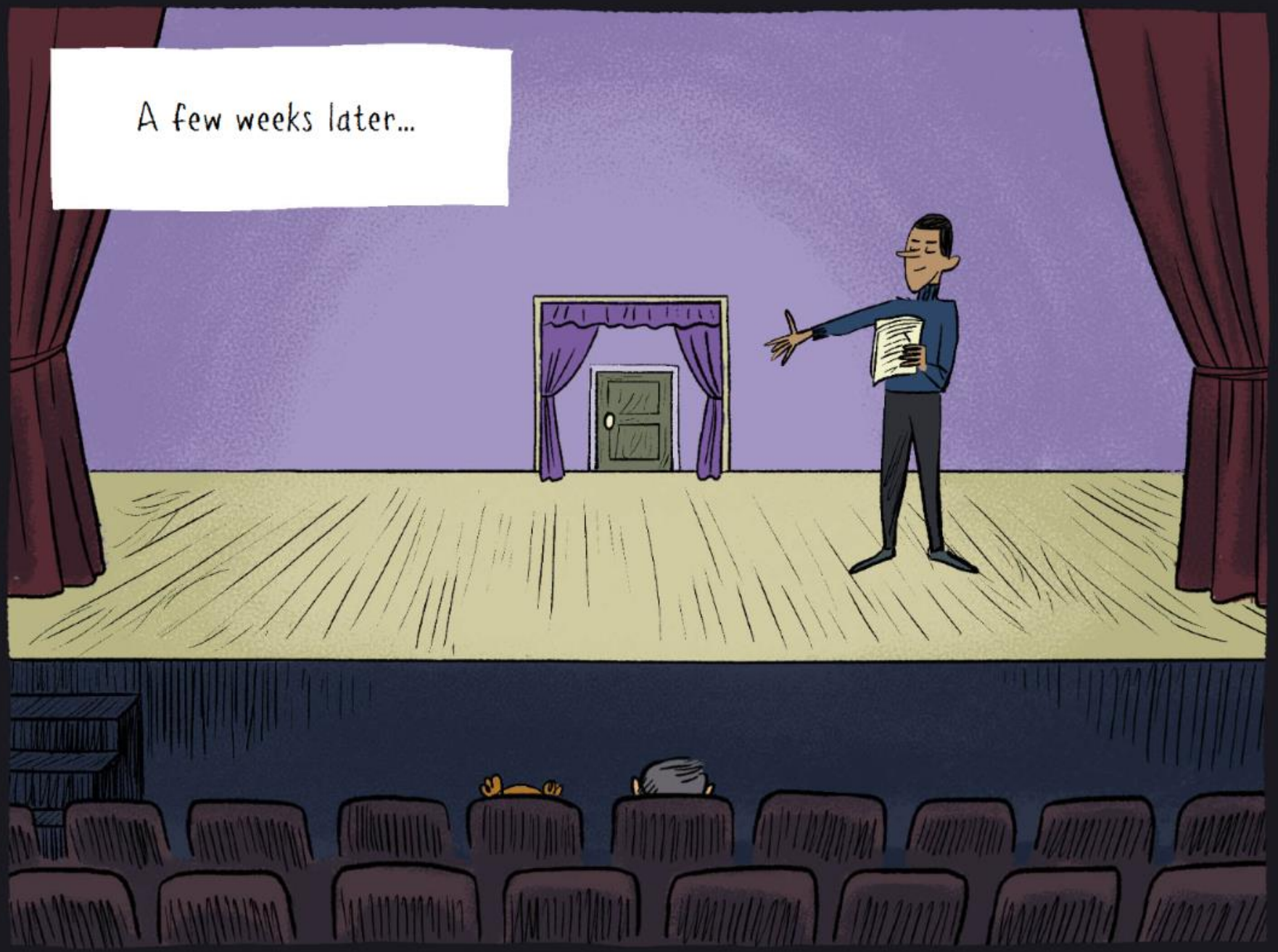

Wow! Look at that poster!
Hippopotamus
Indohyus
Pakicetus
Ambulocetus
Ketchicetus
Rodhocetus
Dorudon
Odontocetes
Mysticetes


You can have it if you like it!
Hippopotamus
Indohyus
Pakicetus
Ambulocetus
Ketchicetus
Rodhocetus
Dorudon
Odontocetes
Mysticetes

Chapter 3

Start reading

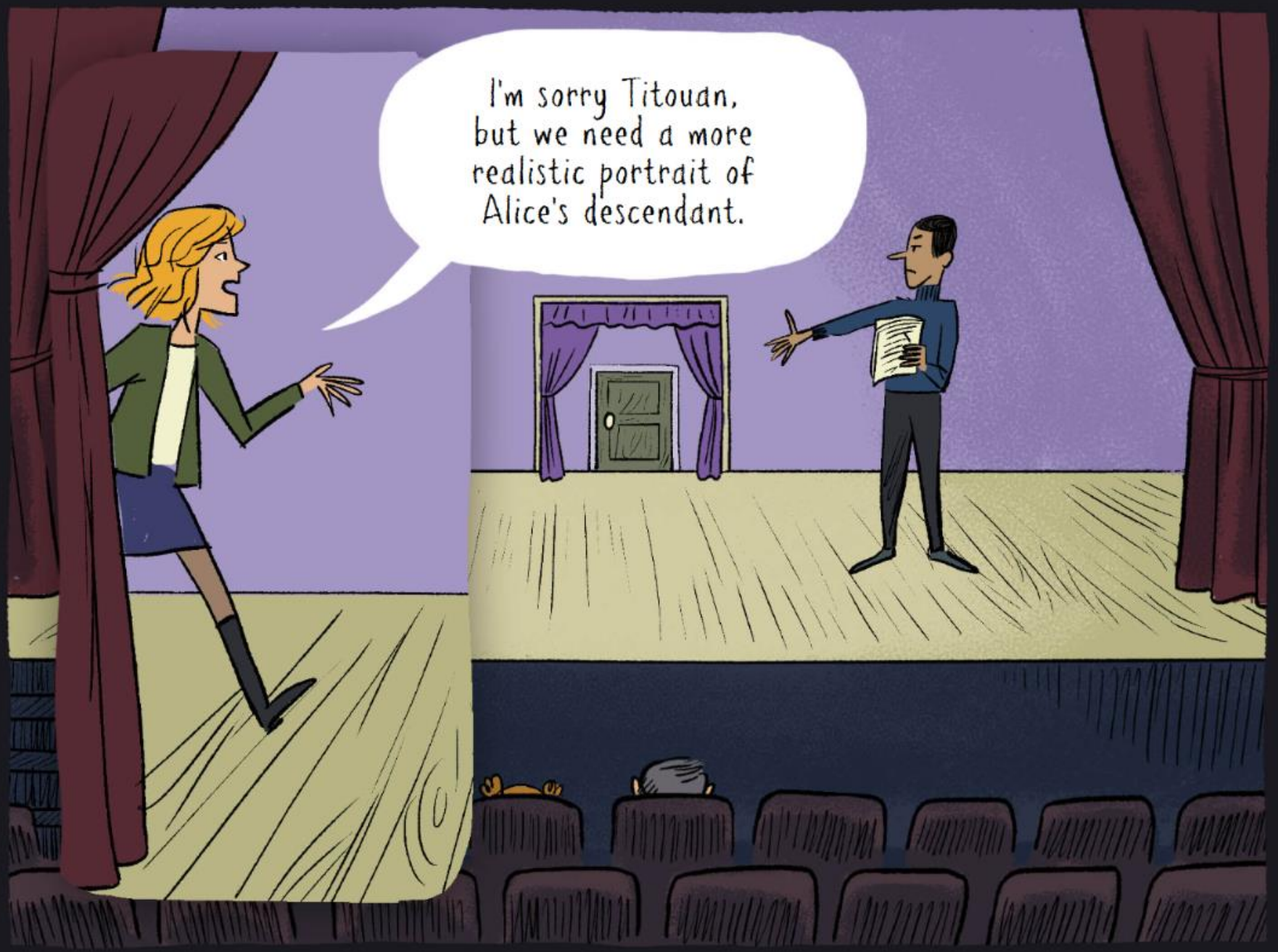
Menu


A few weeks later...

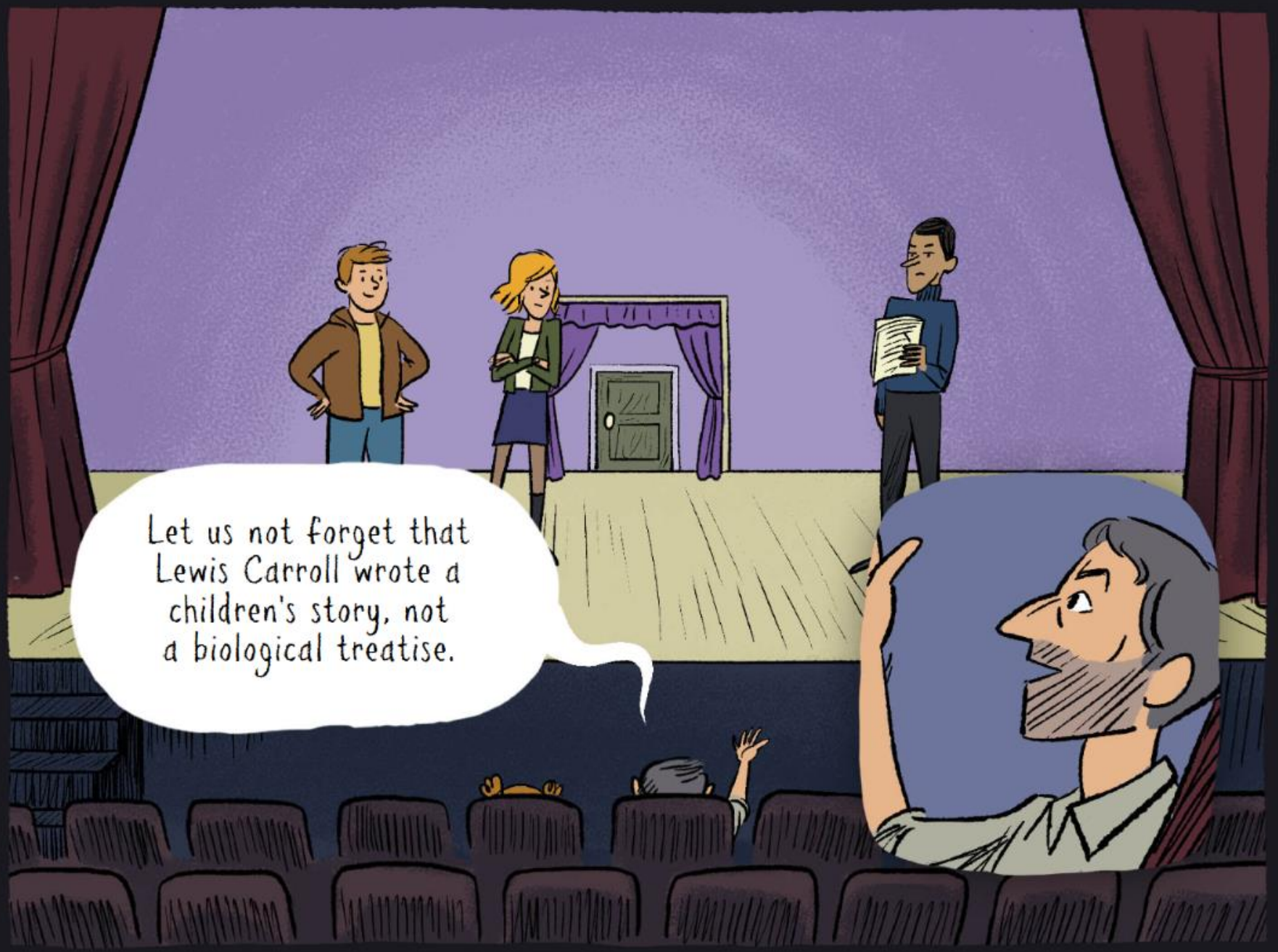
Misconceptions

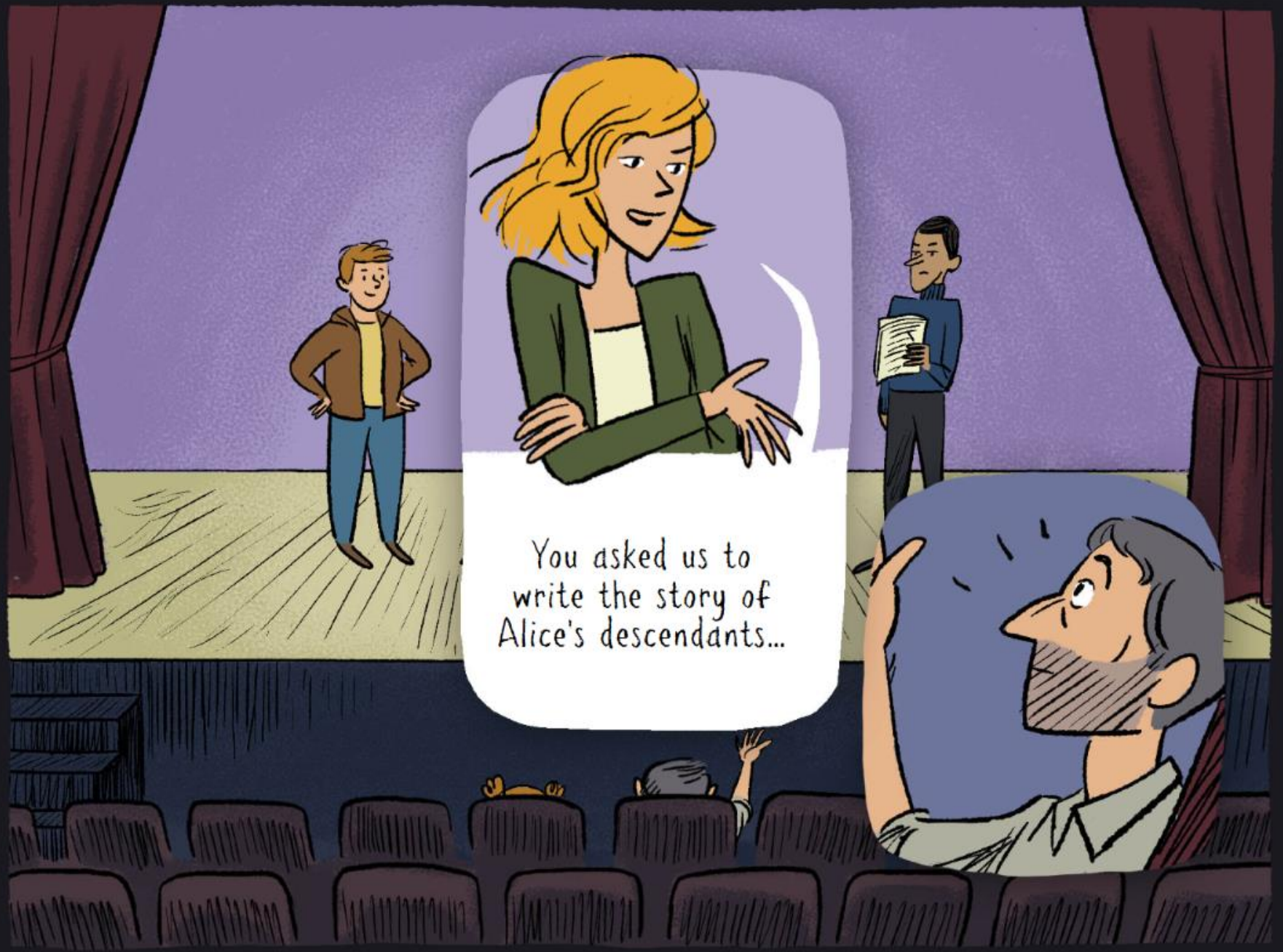
Many students believe that organisms struggle and try to adapt, and that the organism adapts and evolves throughout life (that evolution takes place at the level of the individual and not of the population)

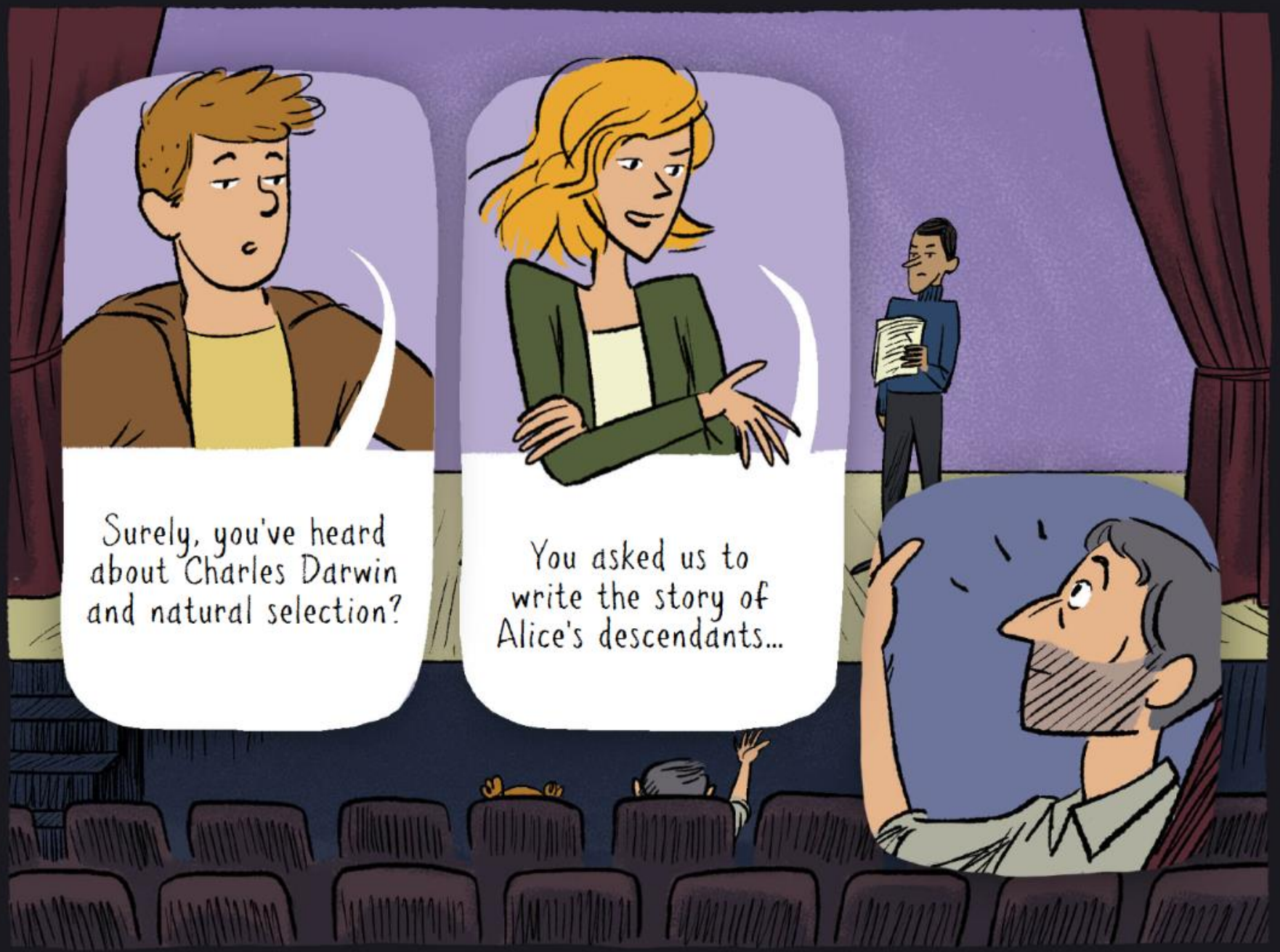

...and will no longer need
her magic 'drink me' bottle...

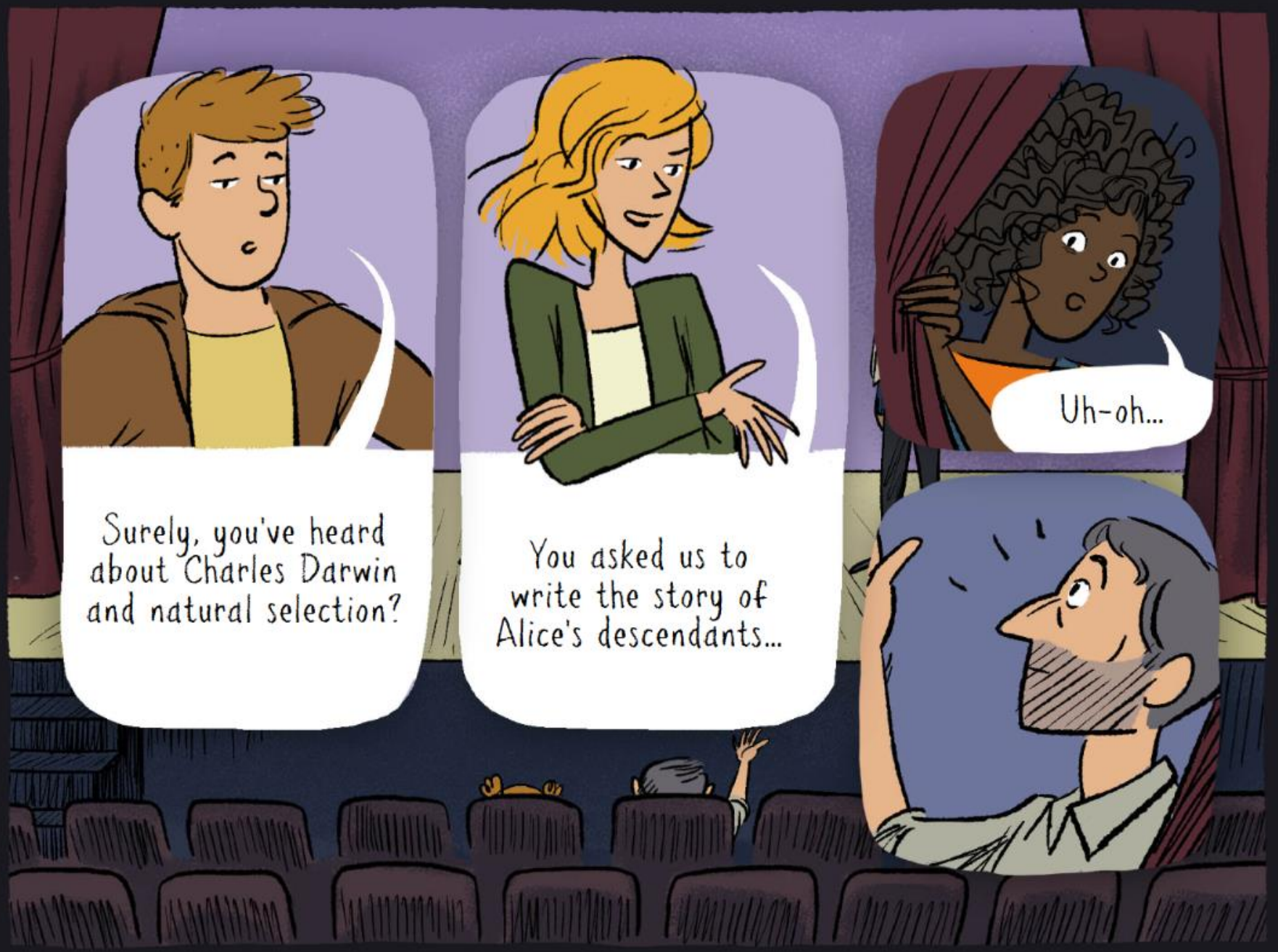

I'm sorry Titouan, but we need a more realistic portrait of Alice's descendant.

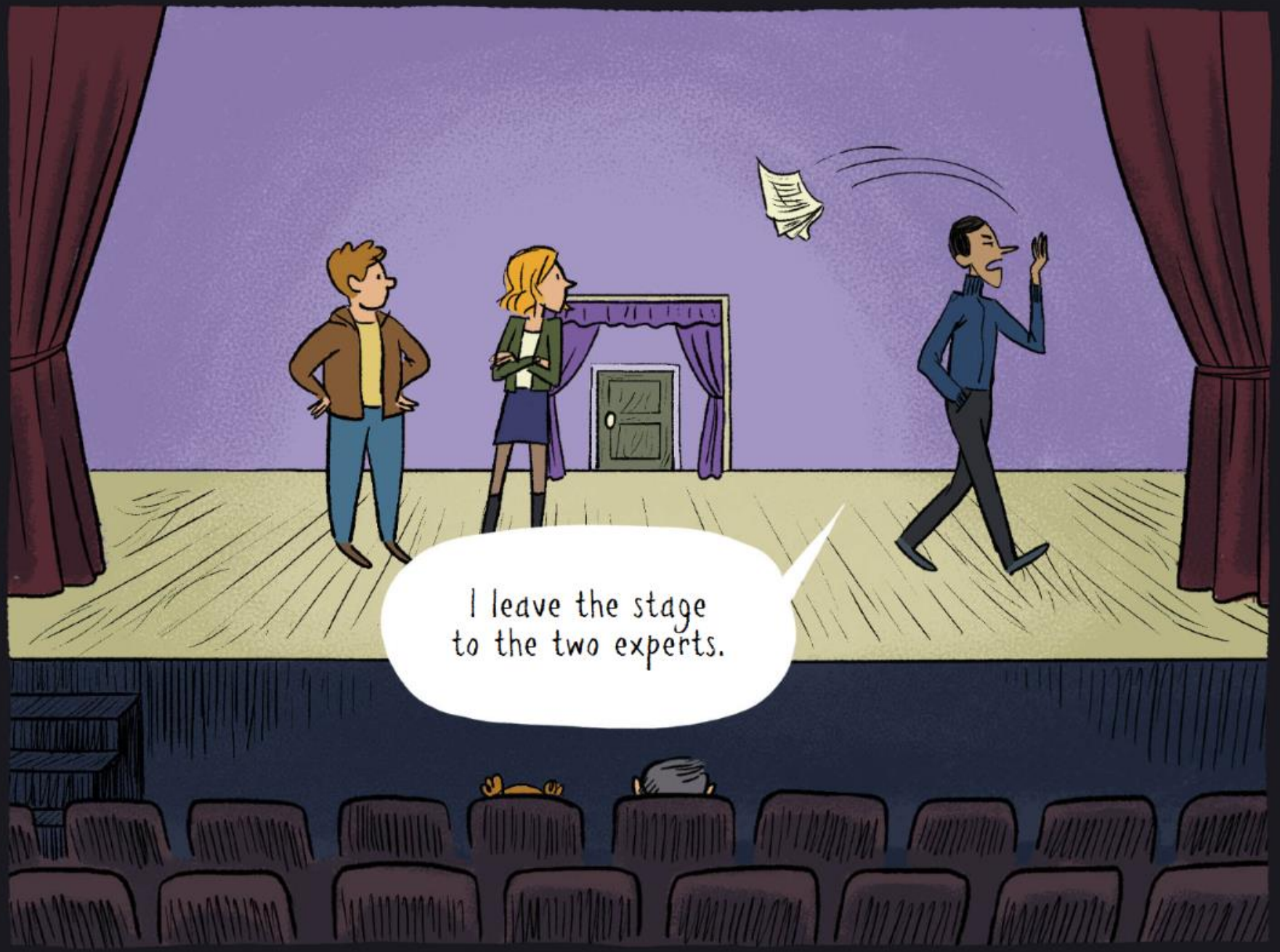

Changes like Alice's shifting size in Lewis Carroll's 19th century story do not happen in a few minutes within an individual's lifetime or because she's decided that it suits her needs to evolve!


Let us not forget that Lewis Carroll wrote a children's story, not a biological treatise.


You asked us to write the story of Alice's descendants...

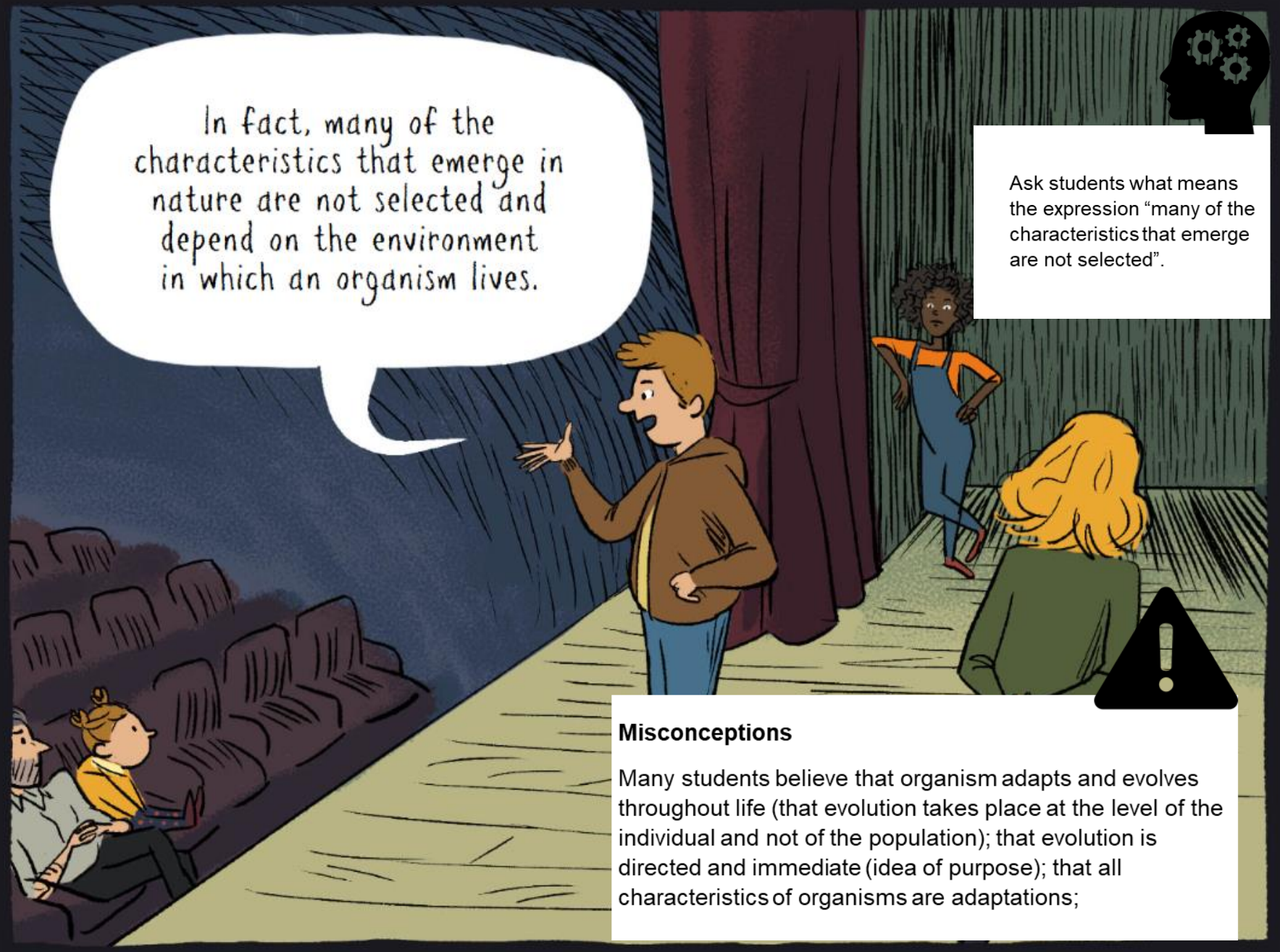

Surely, you've heard about Charles Darwin and natural selection?
You asked us to write the story of Alice's descendants...


Surely, you've heard about Charles Darwin and natural selection?
You asked us to write the story of Alice's descendants...
Uh-oh...


I leave the stage
to the two experts.


We started with a 19th century child who changed size after drinking a magic potion that tasted like roast turkey.


But species don't just magically or immediately adapt to the constraints of their environment!



Ask students what means the expression “many of the characteristics that emerge are not selected”.

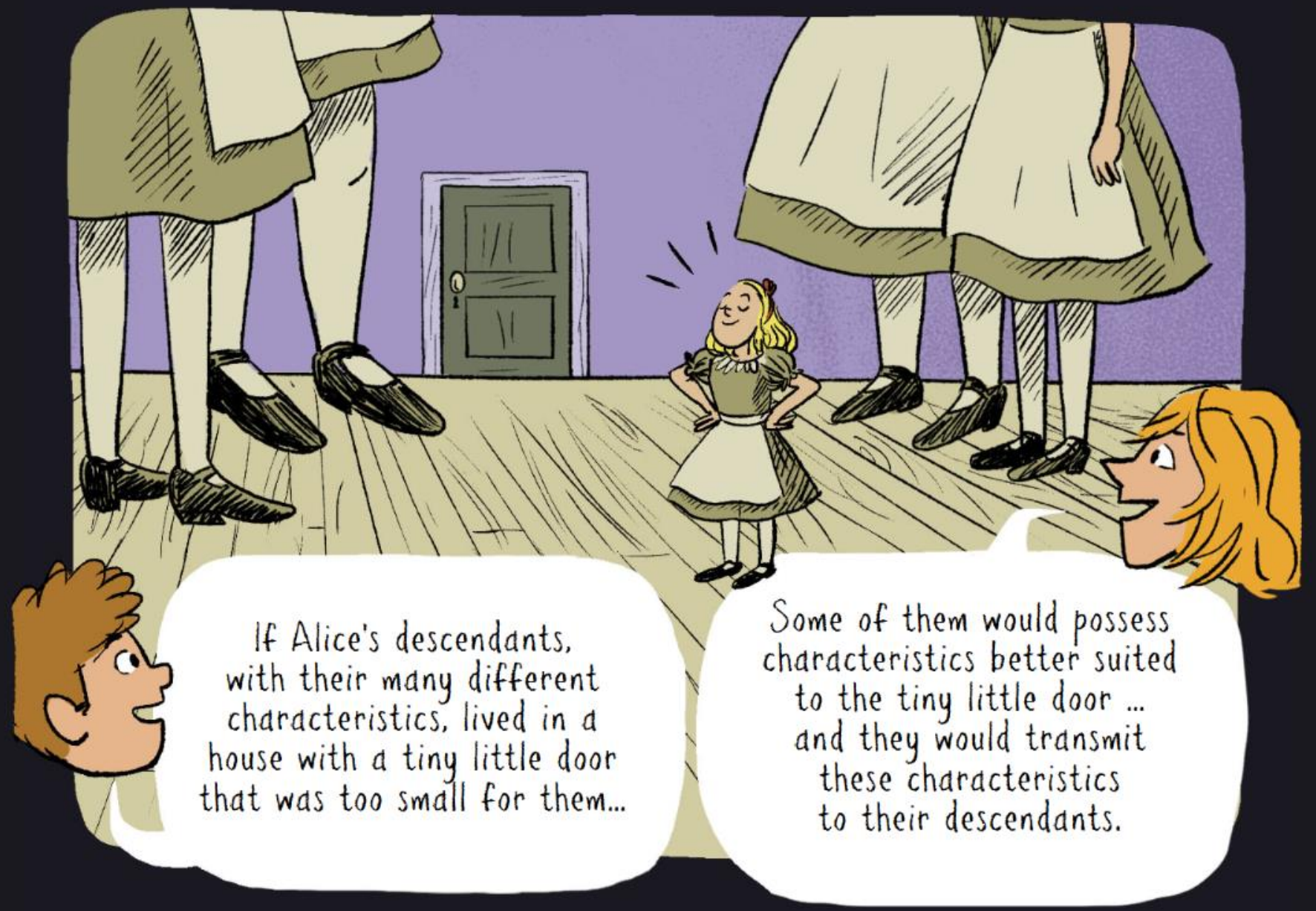
Misconceptions

Many students believe that organism adapts and evolves throughout life (that evolution takes place at the level of the individual and not of the population); that evolution is directed and immediate (idea of purpose); that all characteristics of organisms are adaptations;


What a great mind!

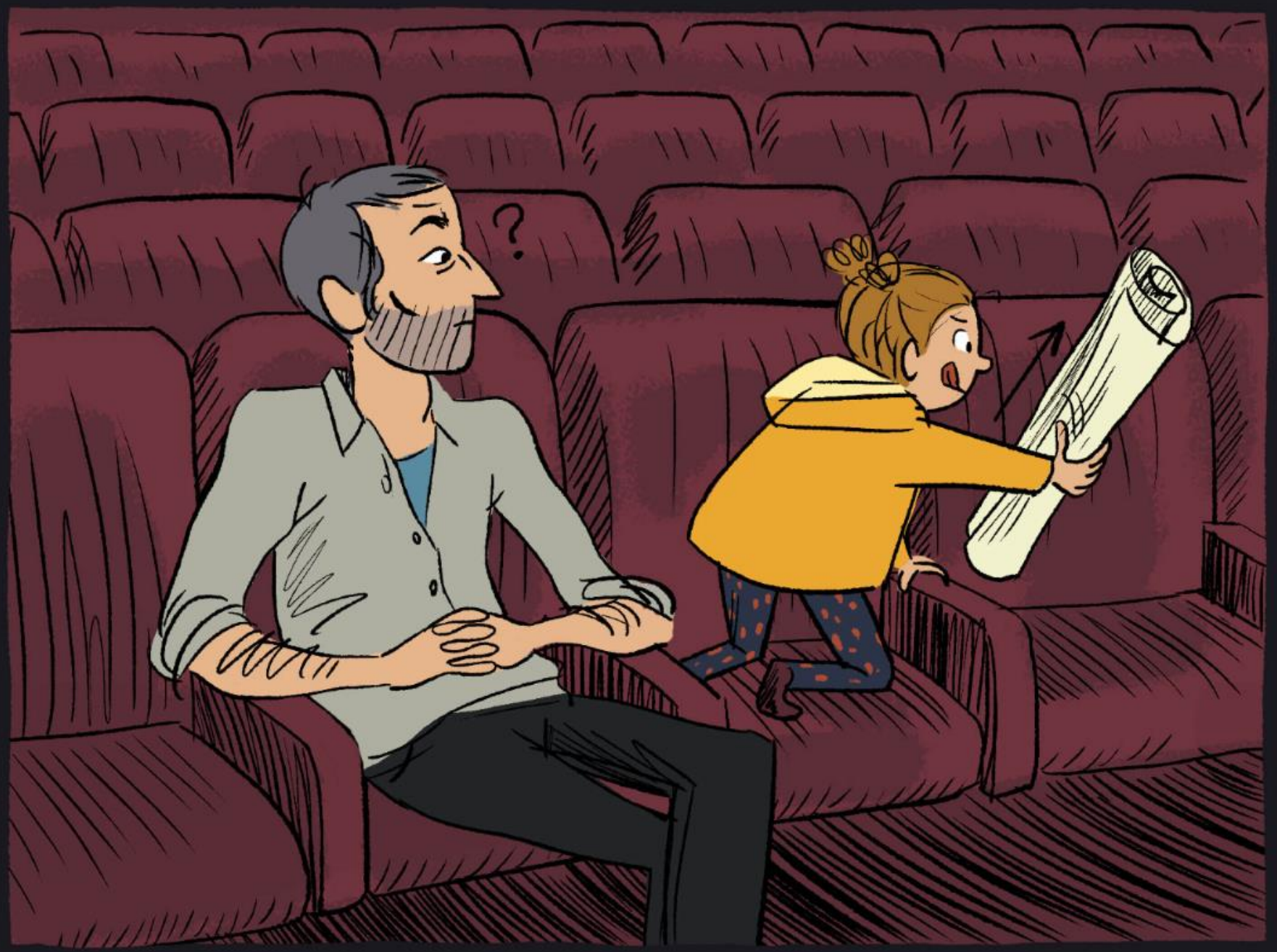

A real genius!
What a great mind!

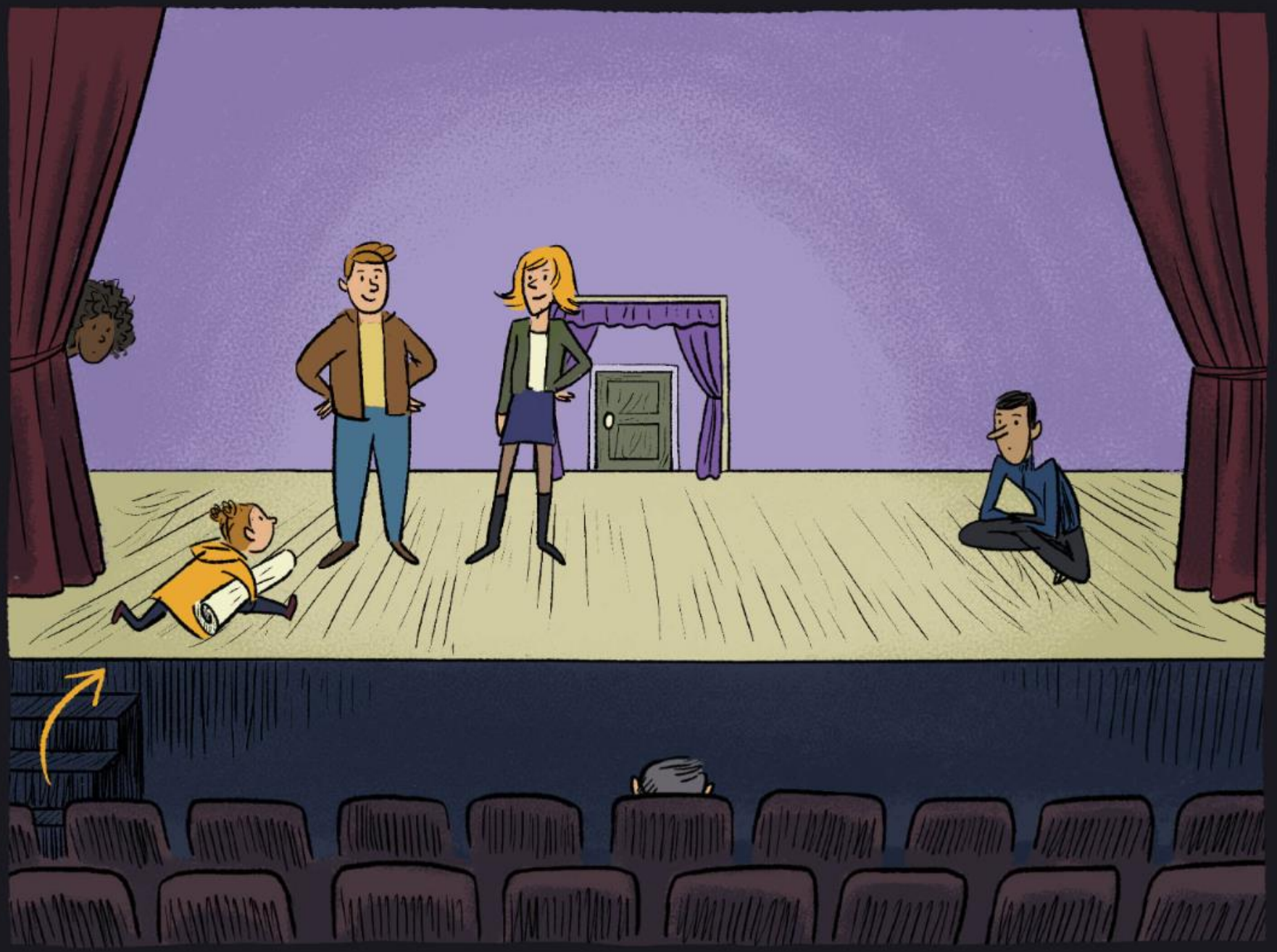

If Alice's descendants, with their many different characteristics, lived in a house with a tiny little door that was too small for them...

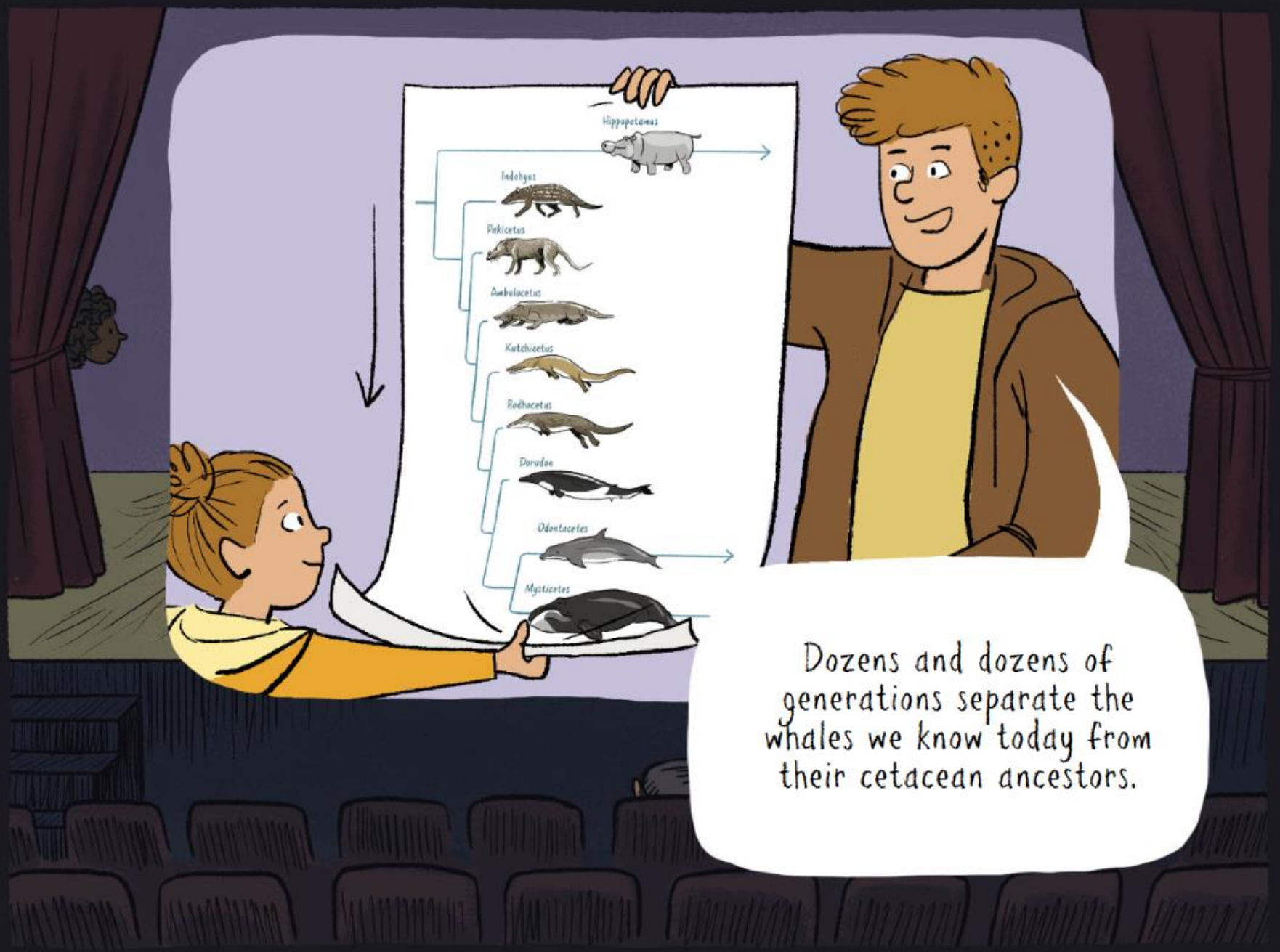

If Alice's descendants, with their many different characteristics, lived in a house with a tiny little door that was too small for them...
Some of them would possess characteristics better suited to the tiny little door ... and they would transmit these characteristics to their descendants.


And this process would take place over thousands and thousands of years. Like for the cetaceans!

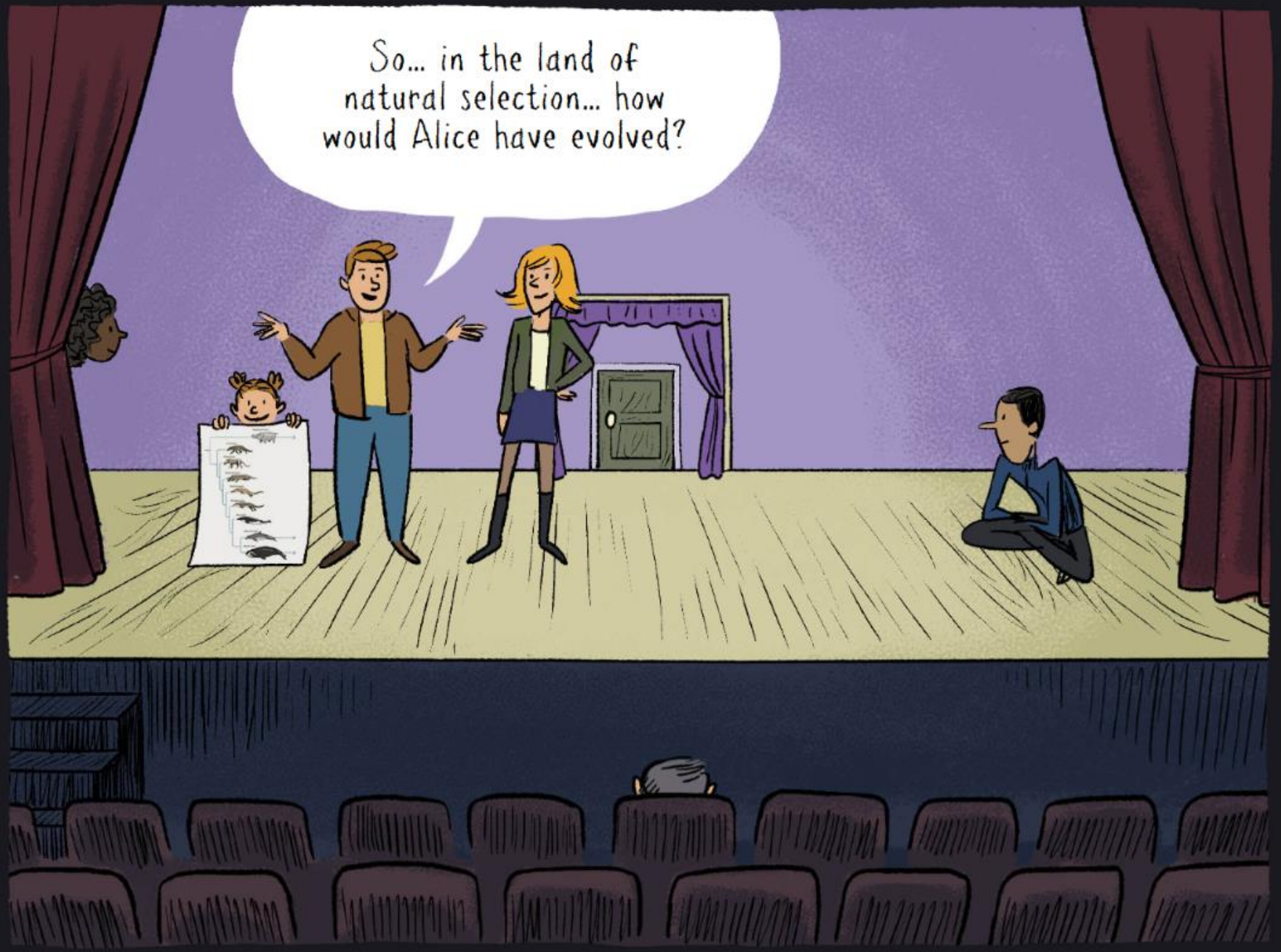

Did Lewis Carroll expect that his story would suddenly turn two of its young readers into specialists of evolution?






Hippopotamus
Indohyus
Pakicetus
Ambulocetus
Kutchicetus
Rodhocetus
Dorudon
Odontocetes
Mysticetes
Dozens and dozens of generations separate the whales we know today from their cetacean ancestors.


Hippopotamus
Indohyus
Pakicetus
Ambulocetus
Kutchicetus
Rodhocetus
Dorudon
Odontocetes
Mysticetes
And evolving from the one to the other was a slow, mechanical and involuntary process.


So... in the land of natural selection... how would Alice have evolved?

Ask students to explain what the word “involuntary” means

The End

Script

Lau Bergey

Scriptdoctoring

Edith de Cornulier

Storyboard

Barbara Govin

Drawing

Aline Rollin

Start this chapter

Menu