

# How we know vs. what we know

Learning Goal: I can distinguish between first and second-order knowledge

A Hero's  
Journey

Environment  
& Setting

Hero  
Archetypes

Character  
Archetypes

# Starter

What's the difference between the reflection in your learning journal, and what you study during daily lessons?

Clue - consider the lesson title.

# **First Order Questions**



First-order questions are about knowledge.

First-order questions are about absolute and concrete matters. (e.g. what should we do?)

**WHAT do you know?**

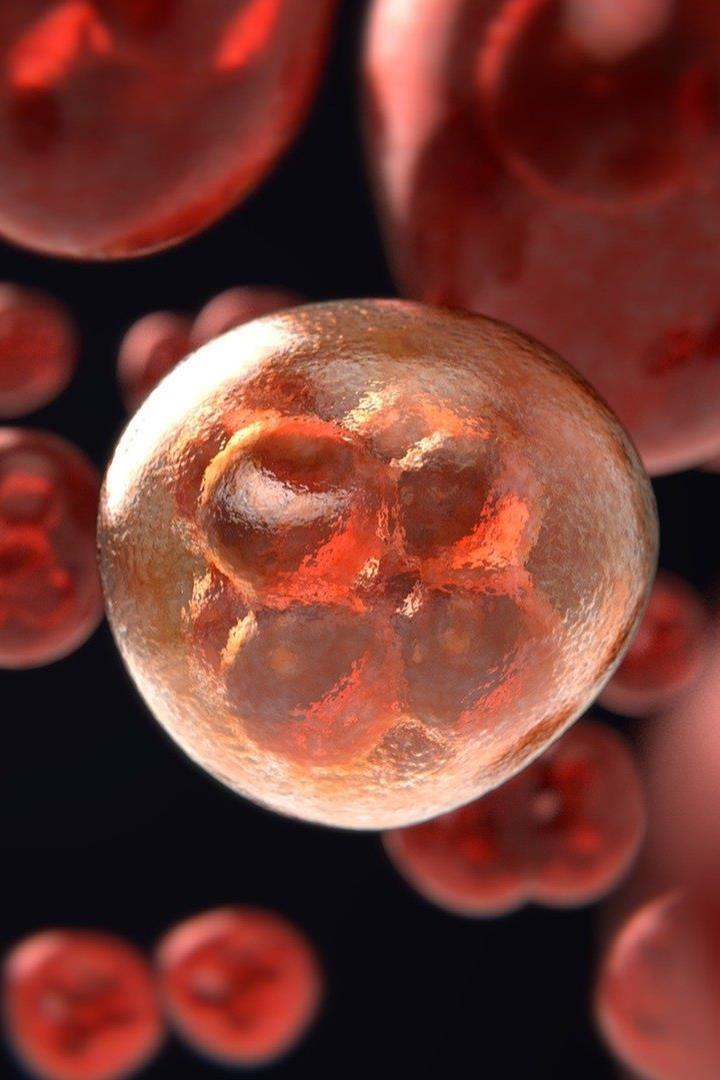
# **Second Order Questions**



Second-order questions are about abstract matters (e.g. why should we do it?).

Second-order questions are questions about first-order questions and their answers.

**HOW do you know?**



Here are some questions related red blood cells. Which of them are about **what** we know in science, and which ones are about **how** we know in science?

1. What are T-Cells?
2. What role does chance play in making discoveries?
3. How does the body fight cancer?
4. What treatments are used to treat cancer?
5. Why and how does knowledge change over time?

The social issue we explored was the limited accessibility of spacecraft. In the Star Wars unit, we redesigned the Millennium Falcon to allow for different passenger types. We changed labelling to include pictures for ELL learners, or even intergalactic aliens. As well, by increasing the contrast between the wall colours and writing, we helped low-vision passengers.

Great. Now let's add some analysis.

So, what's a 2<sup>nd</sup> order question you can apply?

What is the most important aspect of social justice?

The social issue we explored was the limited accessibility of spacecraft. In the Star Wars unit, we redesigned the Millennium Falcon to allow for different passenger types. We changed labelling to include pictures for ELL learners, or even intergalactic aliens. As well, by increasing the contrast between the wall colours and writing, we helped low-vision passengers. **This made us realize that a fundamental aspect of social justice is creating spaces that allow diversity.** To do this, you should design spaces using the widest variety of users that you can brainstorm. This practice may have hidden benefits for groups that you didn't even consider. For example, our wheelchair lift also helped everyone from people with canes, to people who have heavy loads of supplies, to baby Yoda strollers, to BB8 droids, to non-humans with different appendages.

– 161 words

What is the key to being a good hero?

Can ideas ever be produced in isolation?

# What is the key to being a good hero? Can ideas ever be produced in isolation?

A hero's success  
is dependent on  
their creativity.

A hero's success  
depends on the  
quality of their  
journey.

A hero's success is  
dependent on the  
relationships they  
build.

Great ideas can never be  
produced in isolation  
because multiple  
perspectives are critical to  
problem solving.

How can a study of the future help us to make sense of events in society?

# How can a study of the future help us to make sense of events in society?

The shortsighted actions of humanity will cripple our environment to the point of destruction, leaving only the pale facsimile of a virtual reality.

To what extent can our virtual selves represent our real selves?

# To what extent can our virtual selves represent our real selves?

Within the virtual world, our avatar can never be more than a reflection of our worst self.

Within the virtual world, our avatar can never be more than a reflection of our best self.

Masks are wonderfully paradoxical in this way: while they may hide the physical reality, they can show us how a person wants to be seen. - Joanna Scott

To what extent can recreations  
replace the original objects?

# To what extent can recreations replace the original objects?

Virtual reality pales  
in comparison to the  
world.

The medium is the  
message: OASIS teaches its  
uses that the real world  
isn't worth living.

What is the relation between theory and practice?

Is concrete knowledge better than theoretical knowledge?

## What is the relation between theory and practice?

The ability to implement theoretical knowledge in the real world is a powerful weapon.

## Is concrete knowledge better than theoretical knowledge?

Knowledge is information and wisdom is the application of it

Do you agree that in the internet age knowing where to find the answers is more important than knowing the answers?

Do you agree that in the internet age knowing where to find the answers is more important than knowing the answers?

Knowing is not knowledge; knowledge is understanding.

Anyone can find answers; but not everyone can understand them well enough to use them



# Review

**First-order knowledge** is directly about the world. It has a **narrow** scope, related to a **specific** aspect of an area of knowledge. First-order knowledge questions generally (but not always!) ask, ‘**What** do we know...?’ They are more descriptive and factual.

**Second-order knowledge** is about the **process of finding out** about the world. It has a **broad** scope, related to one or more **entire** areas of knowledge. Second-order knowledge questions generally (but not always!) ask, ‘**How** do we know...?’ They are more analytical and debatable.

Your **subjects** are mostly concerned with first-order knowledge. **Higher order analysis** can be gained using second-order knowledge.

## A selection of second order questions

1. What role does imagination play in creativity?
2. What qualities make a good student?
3. Is concrete knowledge better than theoretical knowledge?
4. What is the relation between reflection and creativity?
5. How does access to technology change the learning experience?
6. If you want to think seriously, do you need to disconnect from the internet?
7. What is the relationship between innovation and hard work?
8. How can students learn to learn?
9. How important is it that a piece of art or writing evoke a feeling of empathy in the reader?
10. How important is detailed planning in the building of a creative project?
11. What are the dangers of equating personal experience and knowledge?
12. Do new technologies affect the beliefs of a society?

Do the ever-improving tools of an area of knowledge always result in improved knowledge?

Does acquiring knowledge destroy our sense of wonder?

How can we reconcile the opposing demands for specialization and generalization in the production of knowledge?

Do we need  
custodians of  
knowledge?

For artists and natural scientists,  
which is more important: what  
can be explained or what cannot  
be explained?

Are we too quick to assume that the most recent  
evidence is inevitably the strongest?

To what extent do you agree with the directive to “measure  
what is measurable and make measurable what is not so”  
(Galileo Galilei)?

A close-up photograph of an 'EXIT' sign. The word 'EXIT' is written in large, bold, black capital letters on a light-colored, possibly yellow or cream, rectangular background. Above the sign, a circular, light-colored fixture, likely a light or a sensor, is visible against a dark, solid background.

Why do you think we  
are more interested in  
second-order than  
first-order knowledge  
in the final project?



A baby T-Rex  
would have weighed  
between 50 and 100  
pounds  
(22 to 45 kilograms)  
at hatching.



An adult T-Rex weighed around 5 to 7 tons (10,000 to 14,000 pounds or 4,500 to 6,350 kilograms)

# Research Question #1

To allow it to grow so large, did a T-Rex live longer than humans?



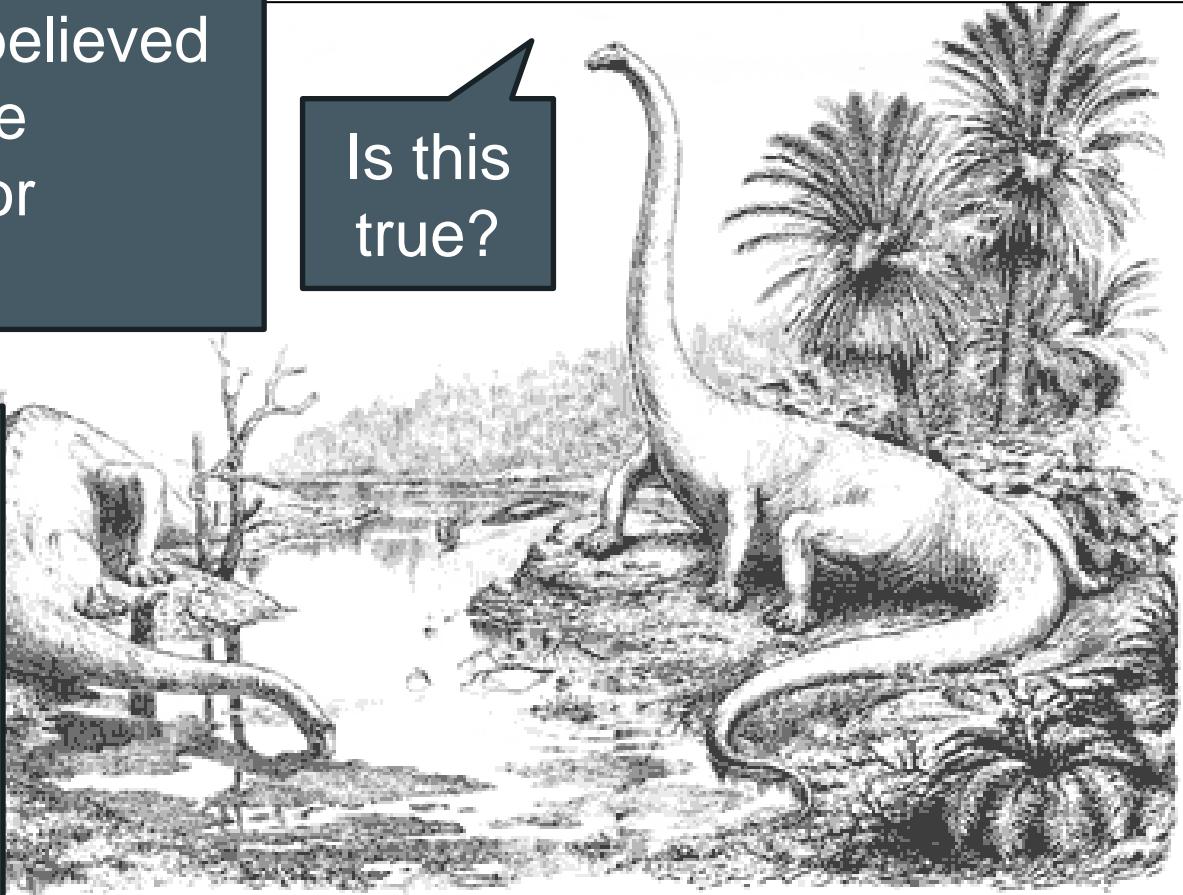
How long did it take a T-Rex to grow from 50 to 10,000 pounds?

It seems like that must have taken a while... did it?

Early Paleontologists believed that, to get so large, the dinosaurs had to live for hundreds of years.

Is this true?

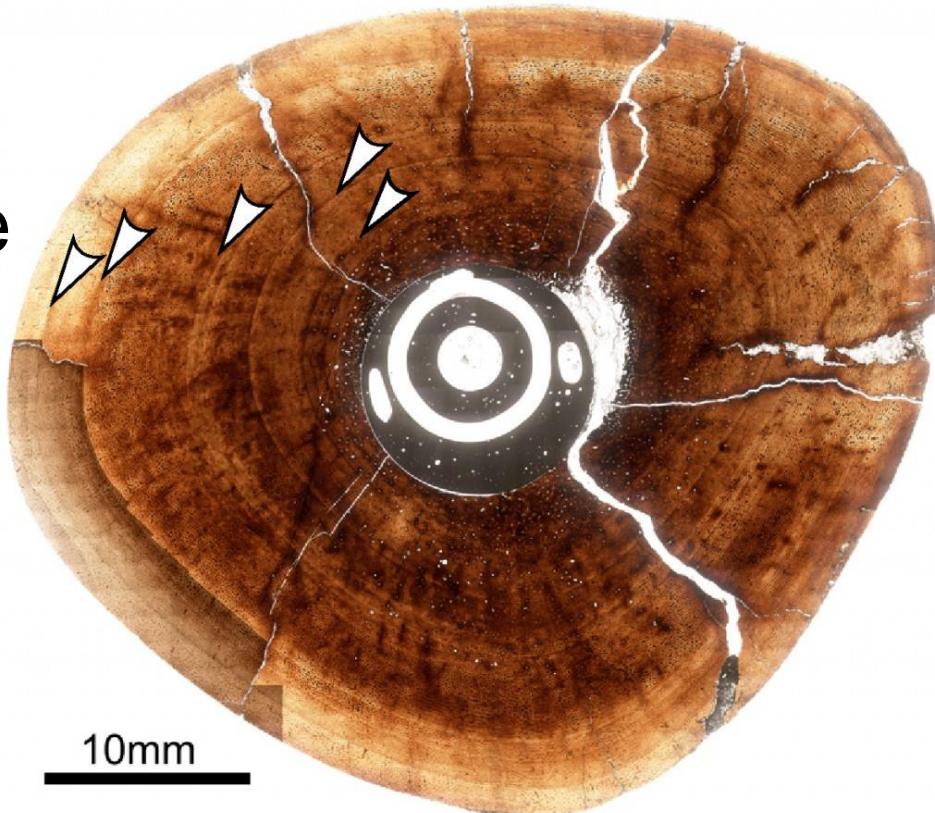
Did dinosaurs live for hundreds of years, or did they have more mammalian lifespans of years or decades?



THE FORM AND ATTITUDES OF DIPLODOCUS

Now, to estimate dinosaur age and growth, Paleontologists take dinosaur bones and slice them very, very finely.

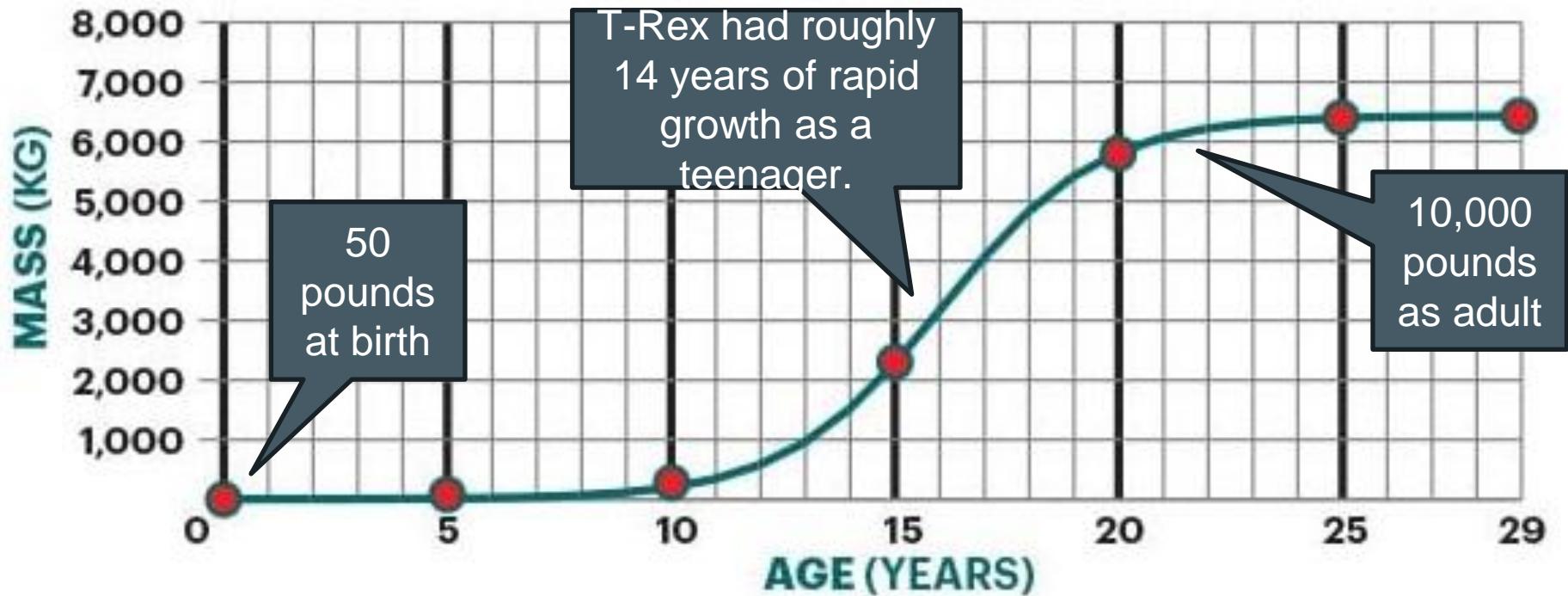
Then, they shine light through the slice and count the growth rings.





Paleontologists have discovered that the largest dinosaurs grew **VERY** quickly.

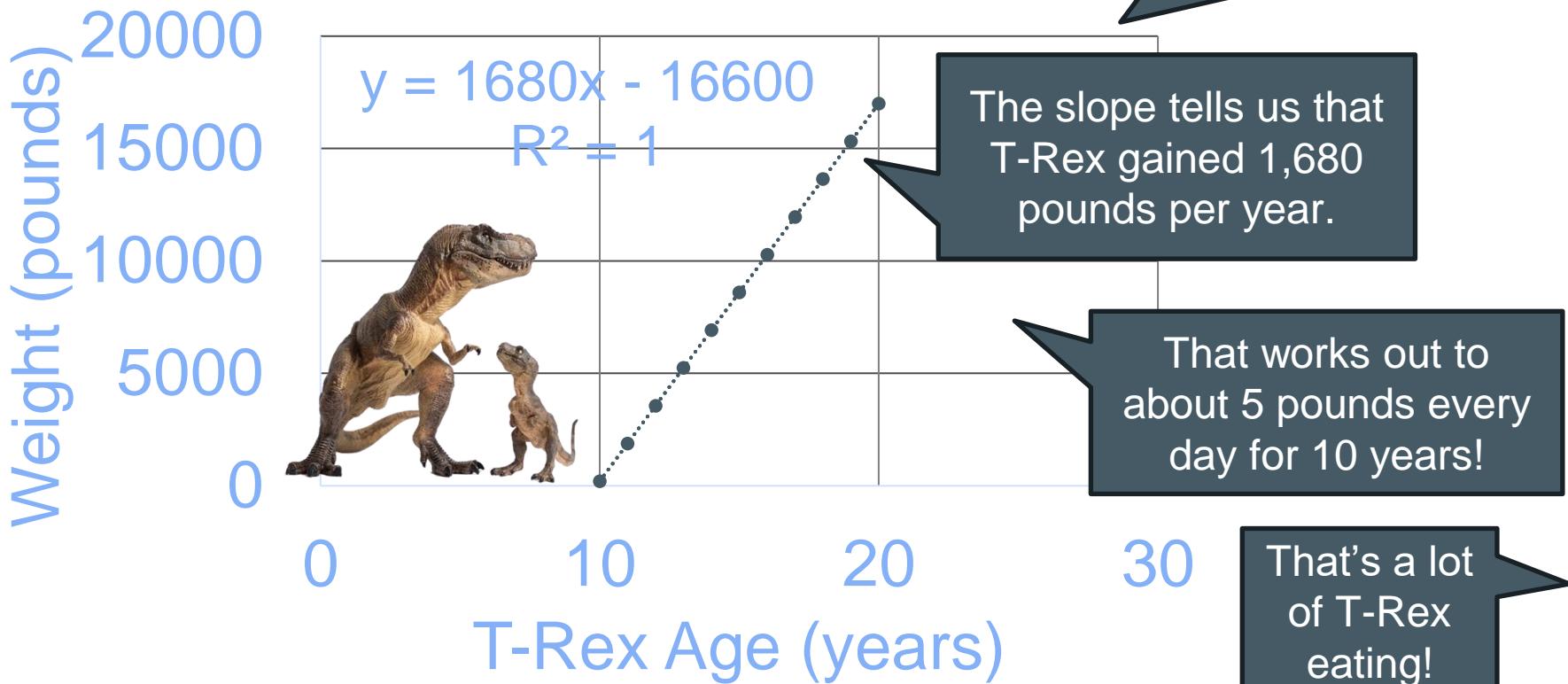
## GROWTH OF A T. REX



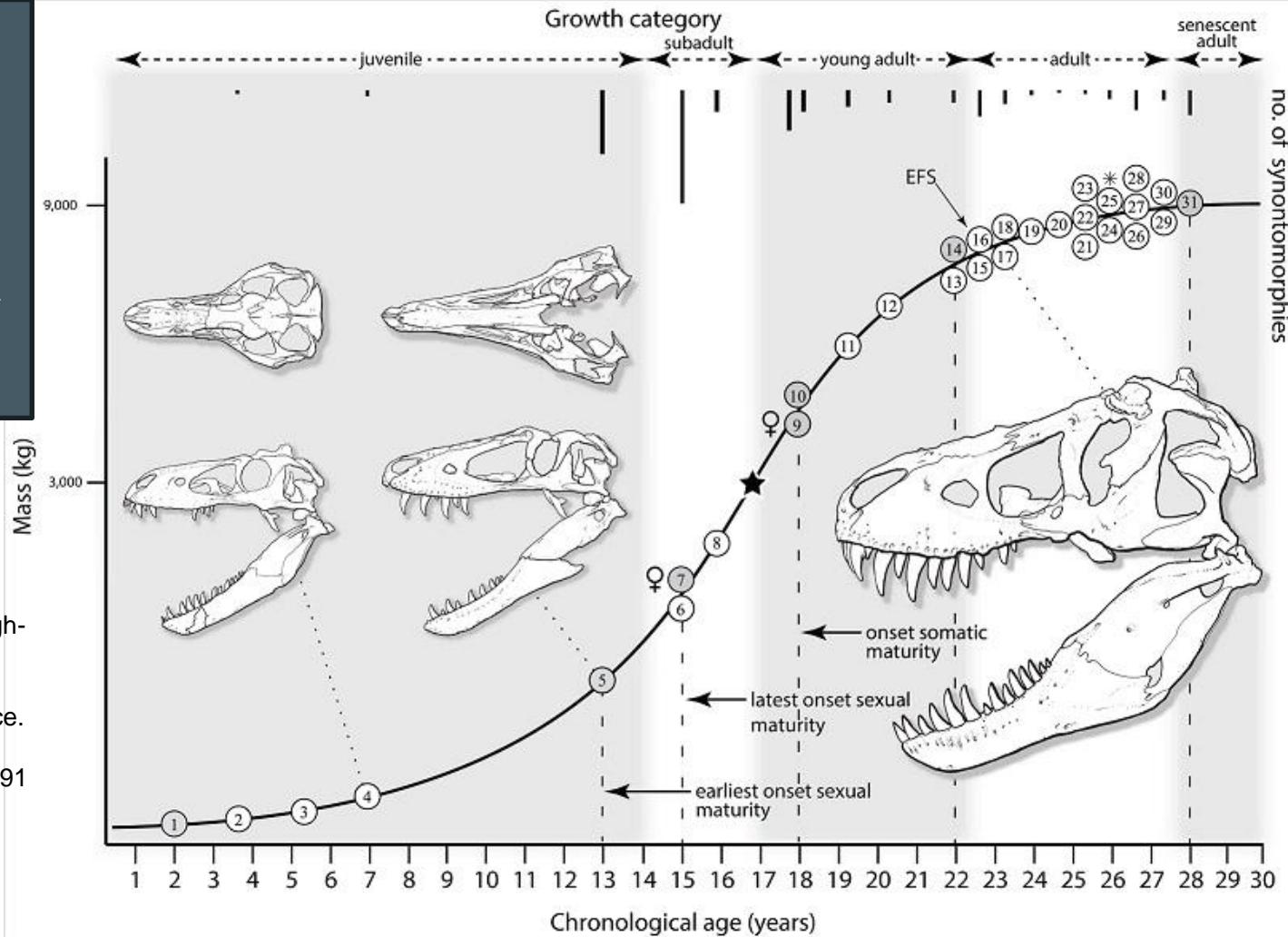
This graph shows the mass of a T-Rex throughout its life. Rapid growth happens between 10 and 20.

# T-Rex Growth Between Ages 10 and 20

This graph zooms in on the growth between ages 10-20.



This data has been verified for all 31 T-Rex skeletons.



# Research Question #1

To allow it to grow so large, did a T-Rex live longer than humans?



In fact, the T-Rex put on 10,000 pounds in about 10 years. It grew very fast.



The oldest T-Rex we have found is 29 years old. That's less than humans.

It's about as long as one of its descendants, the Puffin.

Many larger seabirds are long lived compared to other birds

Thus, if you want to understand a T-rex, a Puffin is a better model than an alligator.

First order  
question: How  
long did a T-Rex  
live?

First order  
question: How  
fast did a T-Rex  
grow?

Second order  
question: How did  
its growth effect a  
T-rex's life?

Large Seabird is a  
better model than a  
reptile or mammal.

University of Toronto St. George Campus  
Computer Science Supplementary Application Questions –  
2024

Question 1: (Required)\*

Describe a situation you witnessed, or were involved in, where someone was treated unfairly or discriminated against. As you describe the situation, please outline how you responded, and would you do anything differently if that situation occurred again? If you have never encountered a situation like this before, please outline what you would do if this happened to you or to a third party. (120 words max.)

## Question 2: (Required)\*

Briefly describe a personal goal you have set for yourself, and how long you have been working to achieve this goal. In your answer, please outline who you turned to for advice and/or help to achieve this goal, and what was their role? What did you learn about yourself? (120 words max.)

## Question 3: (Required)\*

Describe an example of a situation where you took on a leadership role. Some examples include (but are not limited to): helping to resolve a dispute or contributing to a group's goal. In your example, please outline what your contributions were including your role and responsibilities. What did you learn from this experience? Would you do anything differently if you were in the same situation again? (120 words max.)

## Question 4: (Required)\*

Describe a group, organization, or community you have been involved with. What did you do and how long have you been involved? Describe the impact of your involvement in this community, and what you learned from being a member. (120 words max.)

What is the  
difference  
between wisdom  
and knowledge?

Use second order  
questions to spark  
interesting responses  
to questions.

## Why do you want to go to university?

My grandfather stopped school in grade 8 to work on the family farm. When he was older, he registered for engineering at university. He solved the problem of missing high school by “simply” teaching it to himself as he attended classes.

My grandfather’s greatest insult was that someone “didn’t know how little they knew”. He firmly believed that seeing the holes in your knowledge was the true measure of wisdom.

I remember the first time I realized his saying applied to myself. My grandmother was discussing a friend researching ancient Chinese silk wall hangings. I couldn’t conceive how the history of weaving was so complex that you could get a PhD about it; that was when I realized how little I knew. I have come to see, as my grandfather did, that broadening your horizons through education is critical to understanding the world. While at university, learning from professors who have spent a lifetime studying, I hope to understand much more about how little I know.

165 words, 809 characters.

OR 2 - Explain using examples from your learning journal how you will incorporate big idea(s) for each unit in your daily life.

**Description**

Outline STEAM example

Introduce Observations from 2<sup>nd</sup> Order Question

Explain learning about 2<sup>nd</sup> Order question (specifically related to STEAM example)

Outline real life example

Explain learning about 2<sup>nd</sup> Order question (specifically related to real-life example)

Explain how learning about 2<sup>nd</sup> Order question will relate to your FUTURE learning

**Example**

In the photography unit, during the mini-wildlife assignment, I took an excellent picture of a groundhog placidly chewing one of the carefully tended carrots from my garden. The picture also made me realize that organizing knowledge into different subjects really limits how we see the world. Normally, the nature of light would be studied only in physics, backyard wildlife exclusively in biology, composition solely in art and the working of the camera in technology. However, in STEAM, we combined all forms of knowledge, allowing me to take this amazing wildlife shot. I have extended this into my real-life too, specifically into backyard water-gun fights. If you combine strategy, physics, art and playfulness together, you can make some epic shots. In my future courses, even when knowledge is taught separately, I won't be limited by the classification of knowledge. I will bring in content from other subjects allowing the creation of more complex and meaningful projects - 155 words

OR 3 - Select and discuss a different major project that shows an in-depth understanding of a Social Justice issue that you explored. Explain using specific examples.

**Description**

Outline social justice issue & project that used it

Explain how your project explored the social justice issue

Introduce Observations from 2<sup>nd</sup> Order Question

Explain learning about 2<sup>nd</sup> Order question (specifically related to STEAM example)

Explain how learning about 2<sup>nd</sup> Order question will relate to your FUTURE learning

**Example**

The social issue we explored was the limited accessibility of spacecraft. In the Star Wars unit, we redesigned the Millennium Falcon to allow for different passenger types. We changed labelling to include pictures for ELL learners, or even intergalactic aliens. As well, by increasing the contrast between the wall colours and writing, we helped low-vision passengers. This made us realize that a fundamental aspect of social justice is creating spaces that allow diversity. To do this, you should design spaces using the widest variety of users that you can brainstorm. This practice may have hidden benefits for groups that you didn't even consider. For example, our wheelchair lift also helped everyone from people with canes, to people who have heavy loads of supplies, to baby Yoda strollers, to BB8 droids, to non-humans with different appendages. Overall, in our future design endeavors, we will begin by brainstorming as diverse a list of stakeholders as we can to increase accessibility to our structures. – 161 words

OR 2 - Explain using examples from your learning journal how you will incorporate big idea(s) for each unit in your daily life.

**Description**

Outline STEAM example

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Outline real life example

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Explain how learning about 2<sup>nd</sup> Order question will relate to your FUTURE learning

**Example**

My favourite unit in STEAM was social media history. Our unit project was a lolcat series. While constructing our lolcats, we thought about how many students are passive consumers of technology. Lolcats and other memes are important because, as Clay Shirky states in Cognitive Surplus, “the real gap is between doing nothing and doing something, and someone making lolcats has bridged that gap.” Social media memes, with their low creative entry point, can help to re-engage students, to stop them passively consuming and to start engaging in the world around them. In a related example, my little cousin is obsessed with geocaching. This is an activity that anyone can participate in; both in hiding a cache and finding them. I have learned that I can’t be a passive consumer of media. The act of creation and participation is powerful and transformative. -141 words