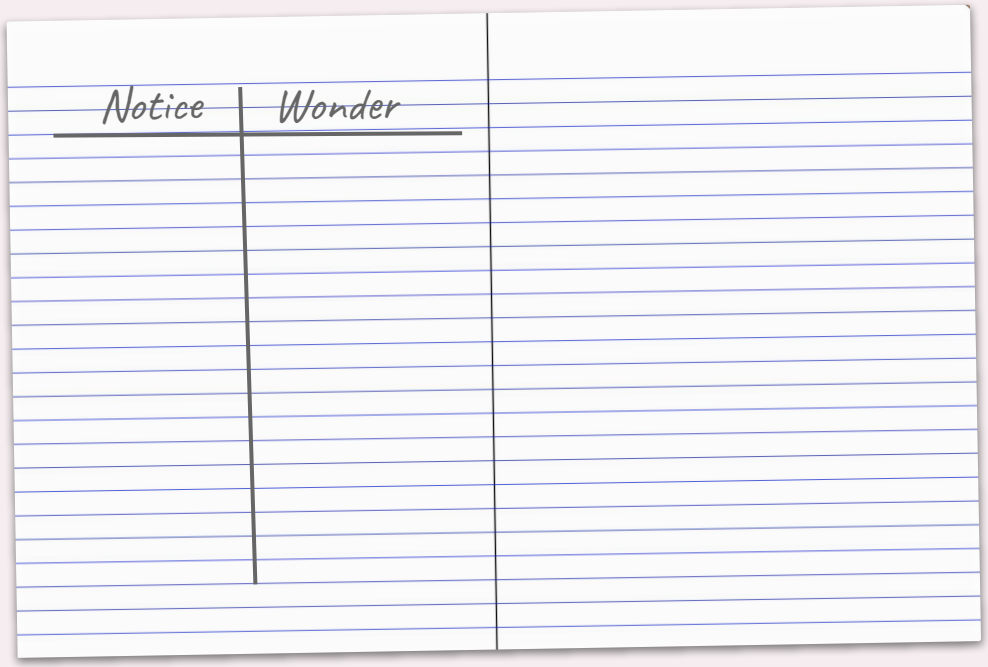
Slide A

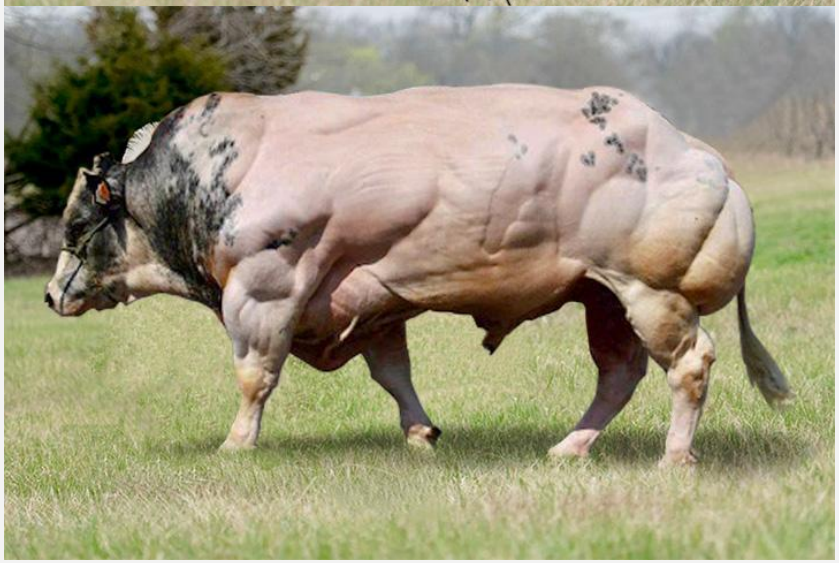
Get Ready to Make Some Observations ...

Make a T-chart in your science notebook where you can record your noticings and wonderings.



Slide B

What is different between the animal on the top vs. bottom?



Use the T-chart in your science notebook and record what you notice and wonder about these animals.

Notice	Wonder

Top to Bottom: Wright Charolais; Druet, T., Ahariz, N., Cambisano, N. et al. Selection in action: dissecting the molecular underpinnings of the increasing muscle mass of Belgian Blue Cattle. BMC Genomics 15, 796 (2014). https://doi.org/10.1186/1471-2164-15-796

Slide C

Share Observations with a Partner

Turn and Talk

As you share with a partner, be sure to reference specific details in the photos.

- What differences did you observe between these two animals?
- What are you wondering about?

→ Be ready to share your thinking with the whole class in a minute.

Initial Ideas Discussion

Whole Class

As you share, refer to specific details in the photos so everyone understands your thinking.

- What did you notice?
- What are you wondering?

➔ Record these initial ideas on a classroom Notice and Wonder chart.

Observe More Animals

That animal is not the only one that has such big muscles ...

Agriflanders, CC BY 2.0

Slide F

Dogs

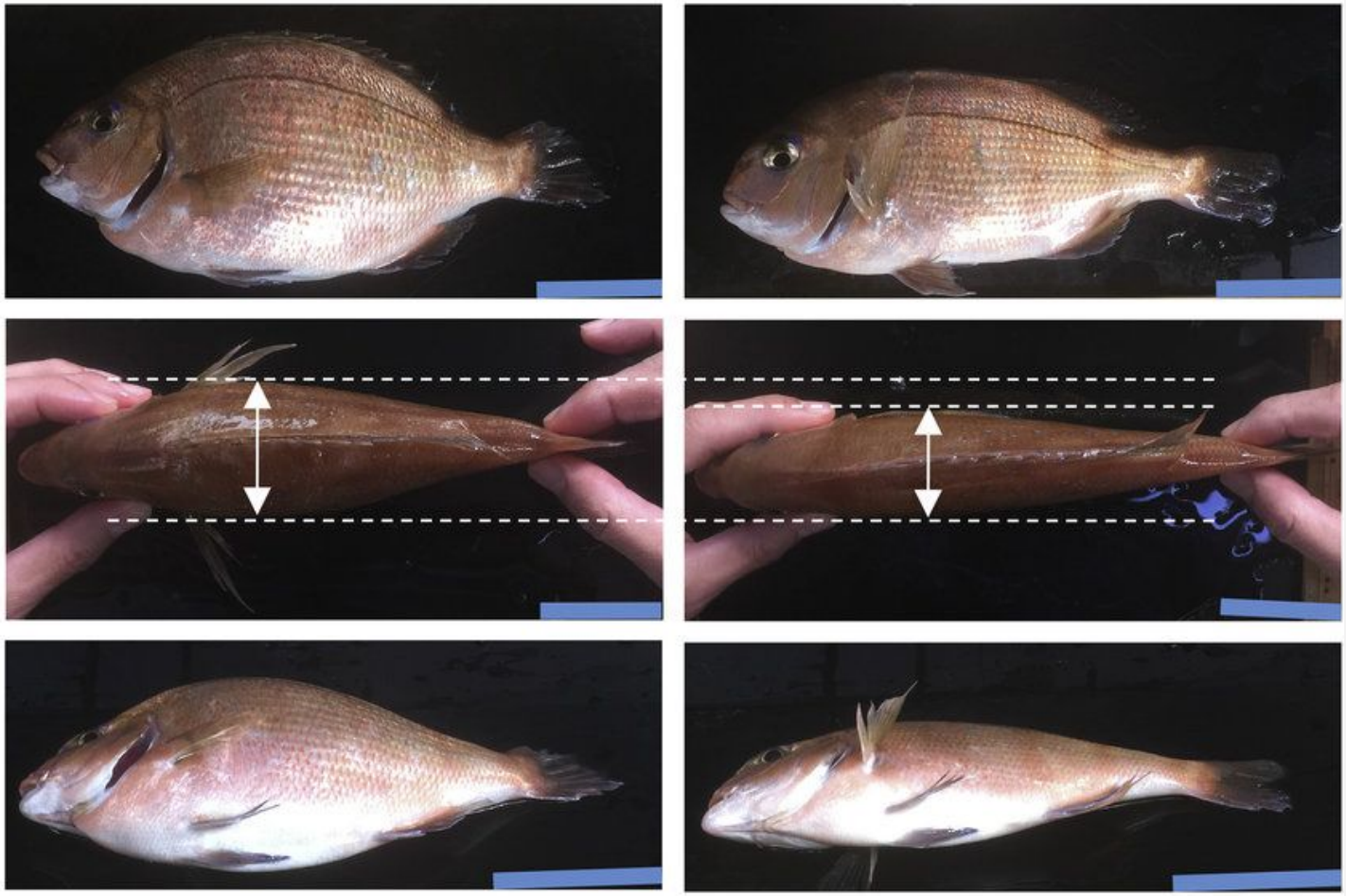
Extra-Muscled Dog

Photo courtesy of Dr. Elaine Ostrander, Chief & NIH Distinguished Investigator Cancer Genetics and Comparative Genomics Branch, National Human Genome Research Institute of NIH. https://www.genome.gov/

Typical Dog

Slide G

Fish



By permission of Masato Kinoshita

Extra-Muscled Fish

Typical Fish

Slide H

Mice

Extra-Muscled Mouse

Typical Mouse

Rabbits

These rabbits are exactly the same age! Scientists gave them a shave so we could look at their muscles more clearly.

Extra-Muscled Rabbit

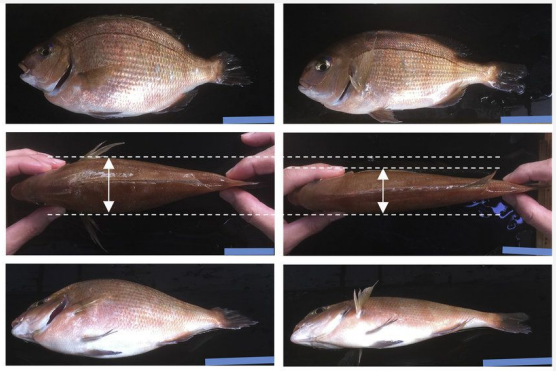
Typical Rabbit

Left and right: Lv, Q., Yuan, L., Deng, J. et al. Efficient Generation of .... Rabbit by CRISPR/Cas9. Sci Rep 6, 25029 (2016). https://doi.org/10.1038/srep25029 Center: Zhang, T., Lu, Y., Song, S., Lu, R., Zhou, M., He, Z., Yuan, T., Yan, K., & Cheng, Y. (2019). 'Double-muscling' and pelvic tilt phenomena in rabbits with the cystine-knot motif deficiency of myostatin on exon 3. Bioscience reports, 39(5), BSR20190207. https://doi.org/10.1042/BSR20190207

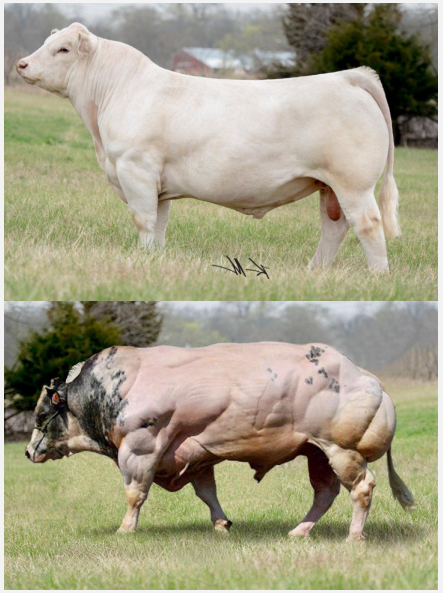
Slide J

What patterns do you notice with all these animals?

Fish



Cattle



Rabbits

Dogs

Mice

Slide K

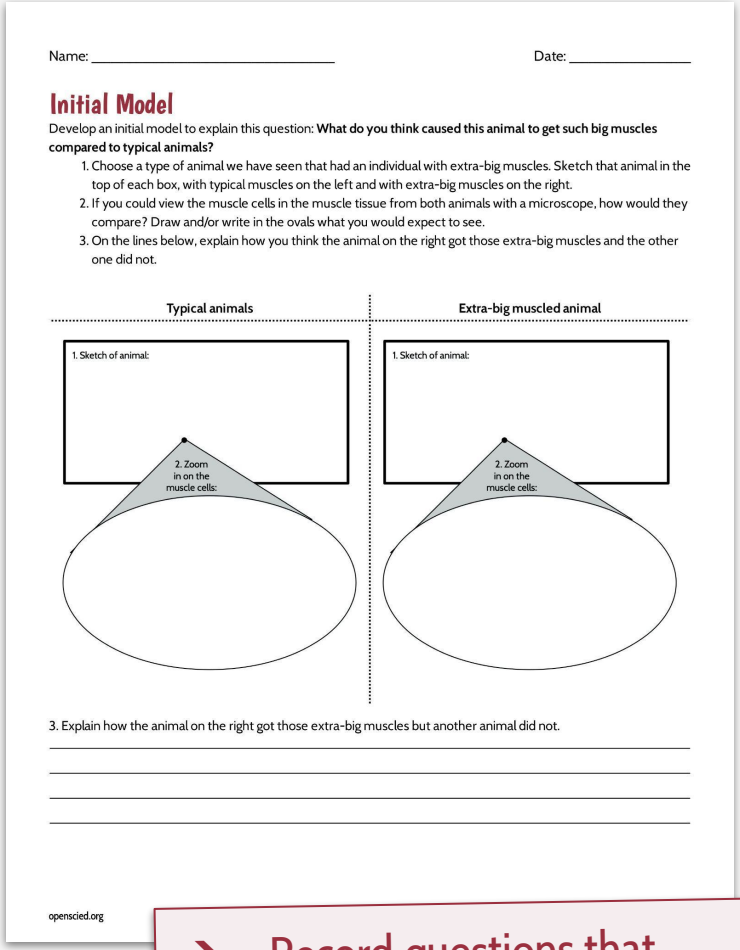
Develop Initial Models: Choose Your Animal

Choose an animal we have seen that has bigger-than-usual muscles.

Develop an initial model to explain **"What do you think caused this animal to get such big muscles compared to typical animals of the same kind?"**

Then, if you had special glasses that could zoom into the muscle cells in the muscle tissue of both animals, how would they compare? What would you see?

Use pictures, symbols, and words in your model to help represent and explain what you think is happening.



Name: _____ Date: _____

Initial Model

Develop an initial model to explain this question: **What do you think caused this animal to get such big muscles compared to typical animals?**

1. Choose a type of animal we have seen that had an individual with extra-big muscles. Sketch that animal in the top of each box, with typical muscles on the left and with extra-big muscles on the right.
2. If you could view the muscle cells in the muscle tissue from both animals with a microscope, how would they compare? Draw and/or write in the ovals what you would expect to see.
3. On the lines below, explain how you think the animal on the right got those extra-big muscles and the other one did not.

3. Explain how the animal on the right got those extra-big muscles but another animal did not.

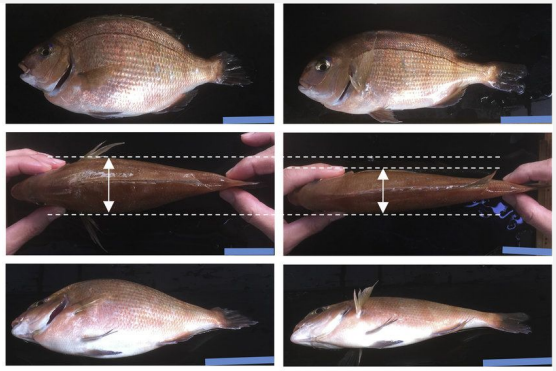
openscied.org

➔ Record questions that come to mind as you are constructing your model.

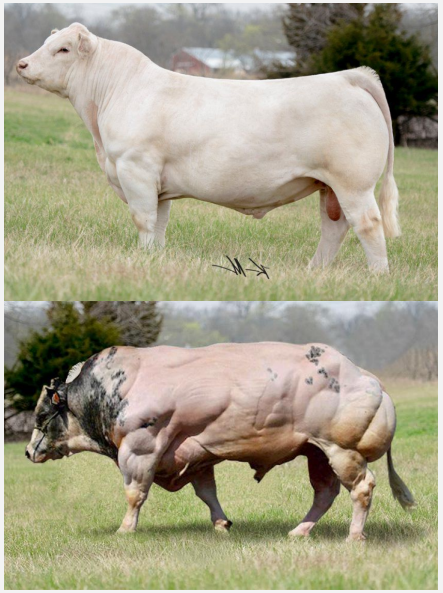
Slide L

What do you think caused that animal to get such big muscles?

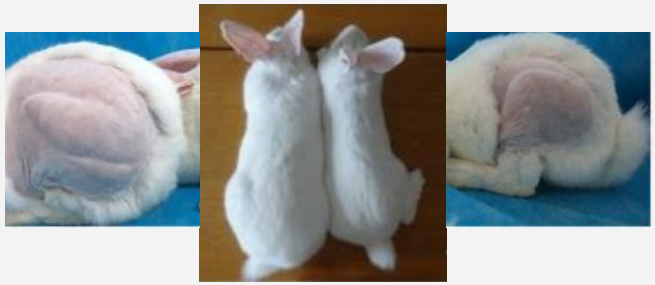
Fish



Cattle



Rabbits



Dogs

Mice

Compare Initial Models

Stand Up, Hand Up, Pair Up

Share your model with a partner. Look for similarities and differences between your models.

Make a T-chart in your science notebook. Keep track of the similarities and differences in this chart.

Similarities between our models	Differences between our models

→ Be prepared to share your thinking with the whole class.

Teacher note

Suggested End of Day 1

Initial Consensus Model Discussion

Whole-Group Consensus Discussion

Develop a whole-group record of what we agree on and where we have competing ideas across our initial models.

- What do we all seem to agree on?
- What do we disagree on?
- What are some new ideas that we may want to consider?

Are "extra big" or "typical" the only options for muscles?

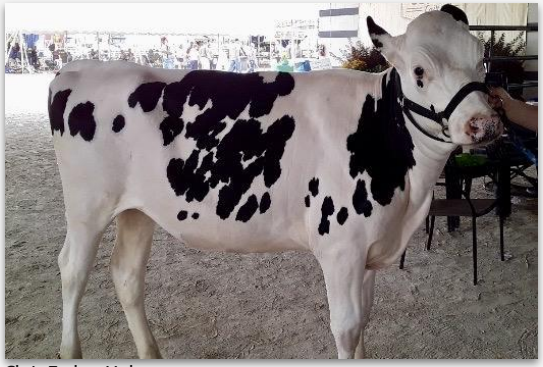
We developed a model to explain extra-big versus typical muscles, but do we think there are just these two sizes of muscles animals can have? Could there be other sizes of muscles, too?

Turn and Talk

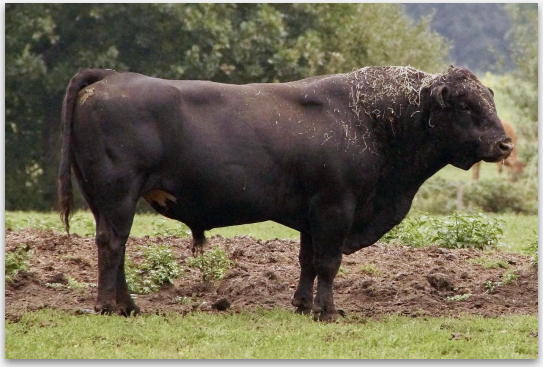
- Do you think animals like cattle come in just two sizes of muscles: extra big and typical?
- Why or why not?

Observe More Cattle

What do you notice about the **muscles** of these cattle?
How could you organize them?


Chris Embry Mohr


Rob Walsh


AStoKo


Courtesy of the Department of Animal and Food Sciences, Oklahoma State University


Kyle Kehrli & Wilbur Kehrli, American Blue Cattle Breeders. Rights reserved.


dendoktoor

Observe Differences in Tulips

With Your Group

Choose a trait these tulips have. Then organize the photos by the variations of that trait.

Record in your notebook the trait(s) and variations you see.

➔ If you have time, reorganize the tulips by variations in another trait.

Share Observations as a Whole Group

With Your Class

- What were some traits and variations you saw?
- What can you say about the amount of variation you saw?

Where have you seen something else like this?

Add a "Related Phenomena" page to your science notebook and jot down other experiences you have had that relate to what we have observed so far.

Use this question to guide your brainstorming:

- **What other examples have you seen of living things that are basically similar but have different variations in a characteristic or trait?**

Home Learning

Go into your community and find a type of organism that has differences between individuals in some characteristic or trait. Look for two (or more) of that type of organism to show variations.

Share what you found by

- taking pictures or video of the differences and bringing the pictures to class,
- drawing the differences you notice, and/or
- writing about the organism in your notebook or on scratch paper and bringing the paper to class.

Teacher note

Suggested End of Day 2

Share Related Phenomena

With Your Class

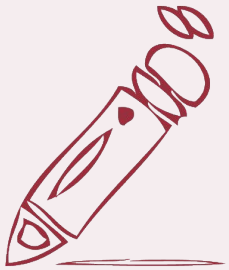
As we share our examples of related phenomena, we will list them on a chart to refer to later.

- *What other examples have you seen of living things that are basically similar but have different variations in a characteristic or trait?*

While you listen to others' ideas, be thinking about these questions:

- Which examples stand out to you the most? (Why?)
- Which examples had you never encountered before?

What questions do you have?



Jot down any questions you have that relate to what we have observed so far. To help you brainstorm your questions, look back at these resources:

- your Notice and Wonder chart
- your initial model
- our chart of related phenomena
- the class's consensus model

Write one question per sticky note.

Write in marker--big and bold.

Put your initials in pencil on the back.

Possible sentence starters

- Why ...?
- How ...?
- What causes ...?

Driving Question Board (DQB)

Bring your sticky notes with questions to our Scientists Circle, along with your science notebook.

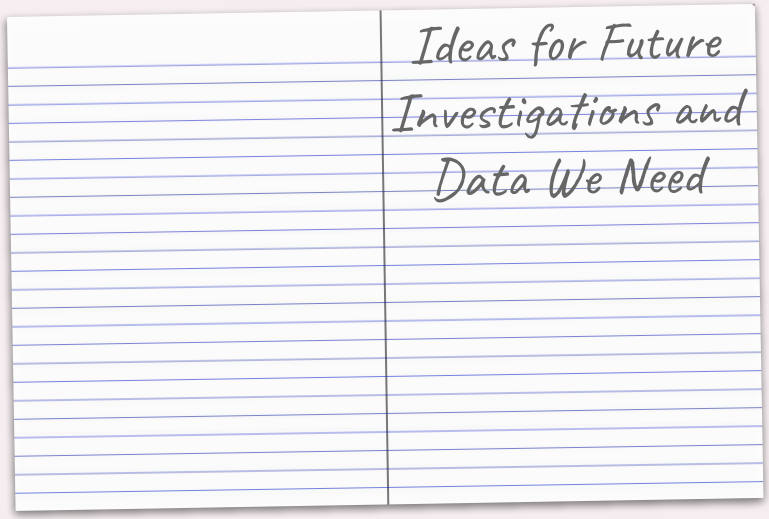
Let's build our Driving Question Board (DQB).

Develop Ideas for Investigations

What kinds of investigations could we do and/or what additional sources of data might we need to figure out the answers to the questions we have on our DQB?

Add your ideas to a new notebook page titled

Ideas for Future Investigations and Data We Need

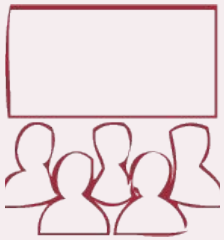


Individual ➡ Partner Talk

➔ Be prepared to share these ideas with the whole class.

Slide Y

Share Ideas for Investigations



- What do you think we can do to investigate some of our questions?
- What data will we need to find or collect to answer our questions?