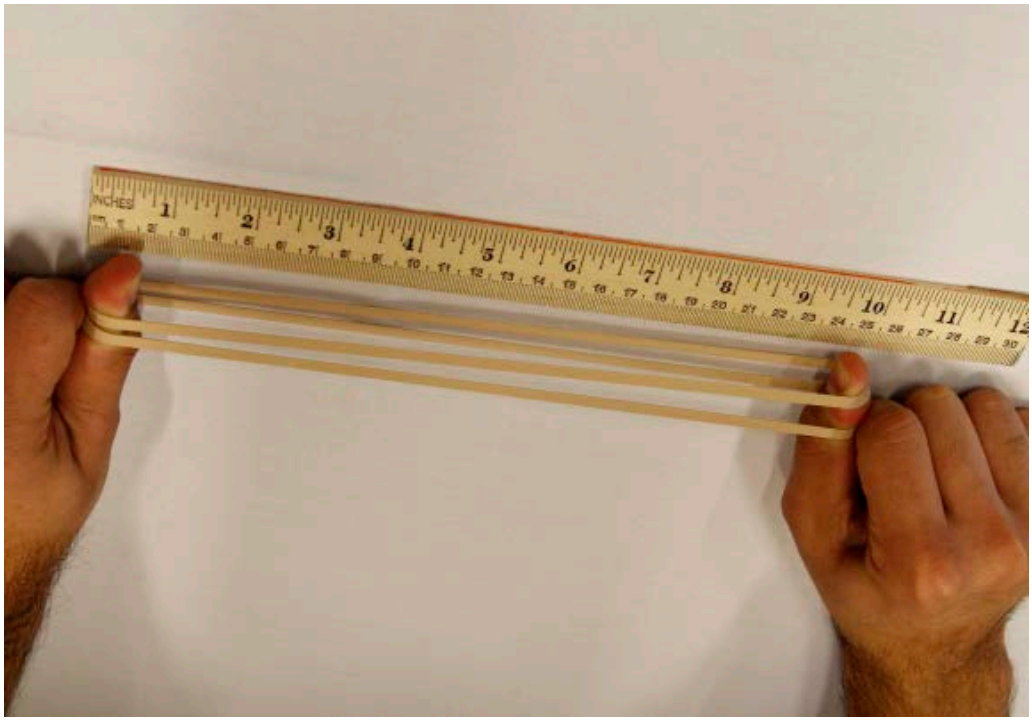
MUSCLE MODEL ACTIVITY GUIDE

What factors affect the strength of muscle?



FOR EDUCATOR

APPLICATIONS IN:

LIFE SCIENCES – Structure and Function/Physiology
PHYSICAL SCIENCES – Forces and Motion/Elasticity
MATHEMATICS – Graphing

NGSS* ALIGNMENT:	Elementary School	Middle School	High School
PS2.A Force and Motion	X	X	
PS3.B Conservation of Energy and Energy Transfer		X	X
PS3.C Relaionship Between Energy and Forces	X		X
LS1.A Structure and Function	X	X	X
ETS1.A Defining and Delimiting Engineering Problems	X	X	X
ETS1.B Developing Possible Solutions	X	X	X

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MUSCLE EXPERIMENT- Introduction for Educators

OVERVIEW

A handshake from a chimp can generate up to 50 pounds per square inch (psi) of pressure, but an adult human barely makes it up to 20 psi. Chimps achieve this strength despite having similar sized hands because of a higher density of muscle fibers. Humans have a set number of muscle fiber when they are born, but can increase their strength by increasing the size of their fibers through exercise. In these activities, students use rubber bands as models for muscle fibers and test their strength against the rubber bands by stretching them.

LEARNING GOALS

- Students explore how an increase in muscle density (number) or size (width) means the rubber bands "get stronger," making them more difficult to stretch
- Students discuss the validity of various models.
- Students design their own arm models or catapult designs.

HOW TO USE

Th e materials are segmented specifically for you to use what you need. You can have students simply explore ideas or follow a more quantitative approach. You can do everything either as a **demo** or **experiment**. We have provided pre-made **"concept overview," "record sheets," "questions to think about"** to use and hand out.

TIPS

For Activities:

- This activity uses rubber bands as models for muscle fibers. Have students discuss the pros and cons of this model.
- When stretching their own rubber bands, difficulty will increase with density and size. The distance they can stretch the rubber bands decreases because their strength remains the same. This idea may be counterintuitive for some students.
- It may be useful set this activity up as stations in your classroom.

For Design Challenge:

- It may be useful to create a "teacher" design and ask students to improve or manipulate aspects of your design.
- Discuss how the designs are models for muscles, including its strengths and weaknesses.

FOR EDUCATOR

ACTIVITY –
Exploring Muscle Density

Chimps are much stronger than you'd expect considering they have hand size similar to a human's. With this activity you will use an increasing number of rubber bands as a model for increasing muscle density.

FOR STUDENT

PREDICT

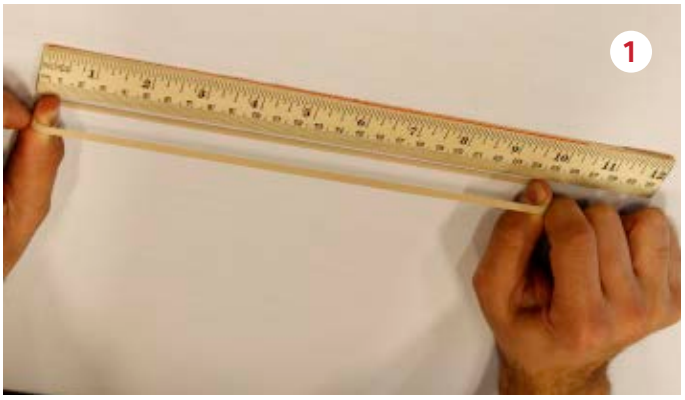
Will it get harder or easier to stretch the rubber bands as you increase the number?

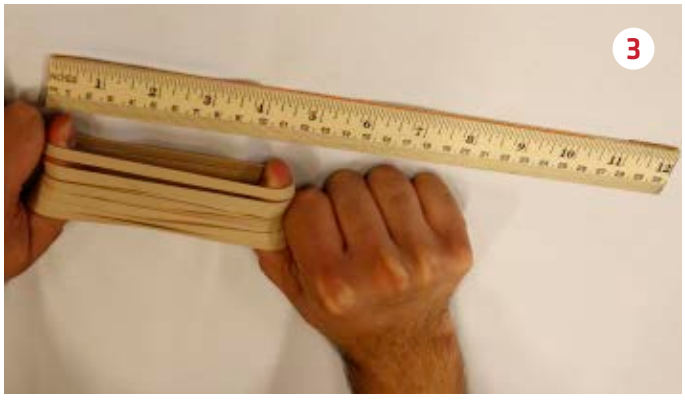
SUPPLIES

- Multiple Rubber Bands of the same width (0.5 inch band width is recommended)
- Meter Stick

WHAT TO DO

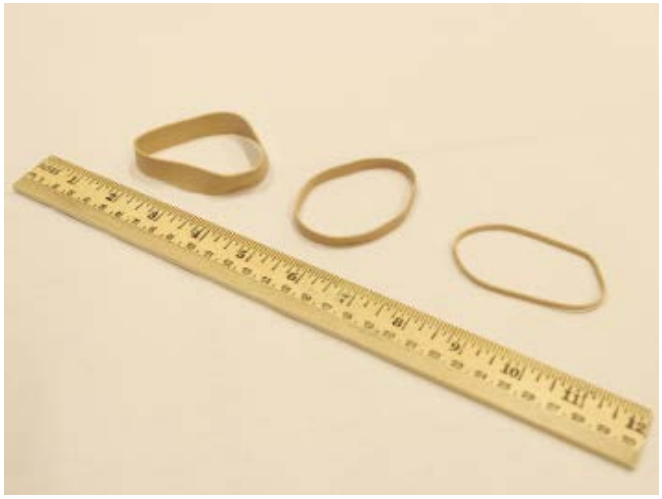
1) Using one rubber band, stretch it as far as you can without breaking it over a yardstick, lining your left thumb over the "zero" point on the ruler. Record how far you could stretch the rubber band by recording where your right thumb is against the ruler.
2) Double the number of rubber bands of the same width and repeat step 1. Measure how long you were able to stretch them. Record this information.
3) Repeat step 2 until you can't stretch the rubber bands anymore.





ACTIVITY –
Exploring Muscle Size

Most animals, including humans, are born with the exact number of muscle fibers they will have their entire lives. This means they cannot increase their density, but they can change the size of muscle fibers. Explore how fiber size affects strength in this activity.



FOR STUDENT

PREDICT

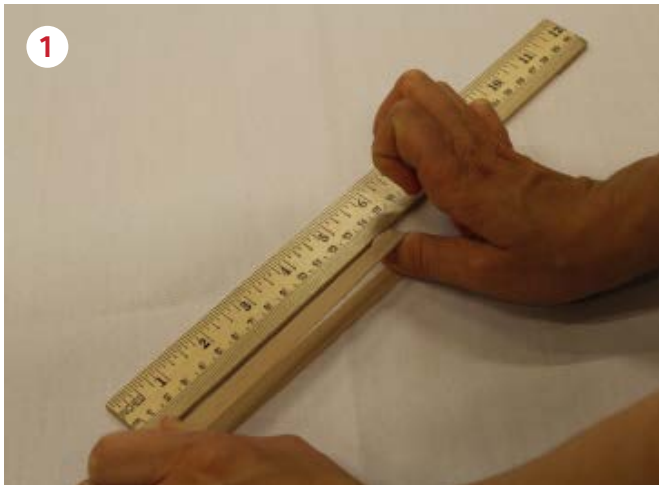
Will it get harder or easier to stretch the rubber bands as you increase the size?

SUPPLIES

- Multiple Rubber Bands of different widths (make sure they are of similar length, just different widths)
- Meter Stick

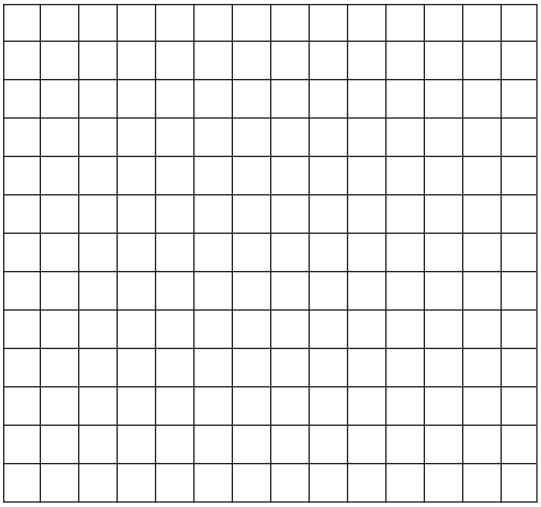
WHAT TO DO

1) Take one rubber band, measure the width in centimeters. Record this information.
2) Stretch the rubber band as far as you can without breaking it over a meter stick. Line your left thumb up with the "zero point" on the ruler and measure how far you stretched your right thumb over the ruler. Record this information.
3) Repeat step 1 using rubber bands of different widths. Record this information.



RECORD SHEET – Muscle Density

Number of Rubber Bands	Distance Stretched (cm)

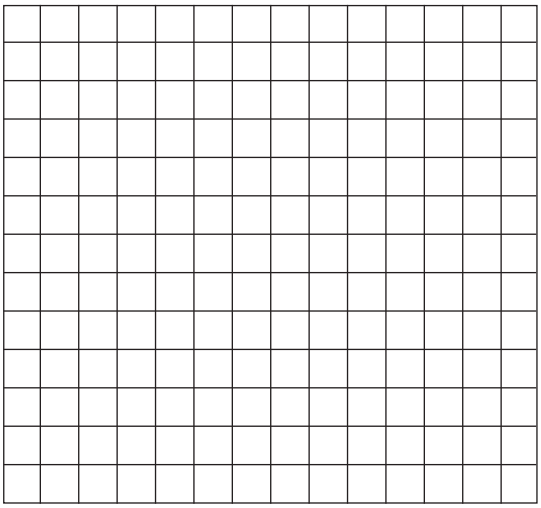


**Be sure to label axes*

FOR STUDENT

RECORD SHEET – Muscle Size

Size of Rubber Bands (cm)	Distance Stretched (cm)



**Be sure to label axes*

FOR STUDENT

QUESTIONS TO THINK ABOUT

1) How is the distance you can stretch the rubber band affected by the number (density) of rubber bands and by the width (size) of your rubber band? How does that impact strength?

2) Who was able to stretch the rubber bands the farthest and what does that say about their own muscle fibers?

3) How are rubber bands a model of muscle fibers? How was strength being measured/modeled?

4) What are some factors that could have made your experiment produce different results? How can you control those factors?

5) Is there a different way of demonstrating the idea of muscle size and muscle density? How would it be different?

6) How does your data compare to other students' data?

Notes:

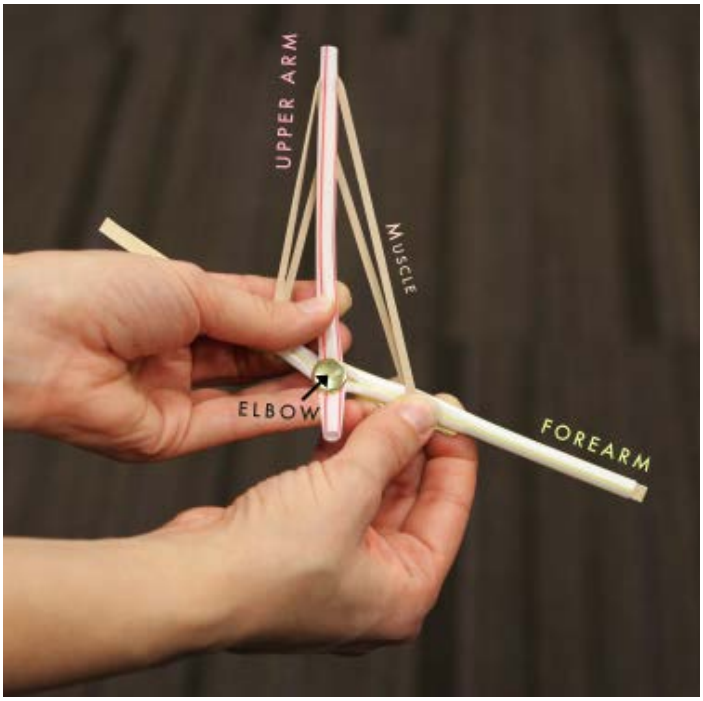
FOR STUDENT OR EDUCATOR

DESIGN CHALLENGE

Check out our other design challenges at http://biomechanics.fieldmuseum.org/explore/educational-resources/design-challenges

1) Arm Model

Design an arm model that uses rubber bands as a model for muscles. Figure out a means of testing strength.



2) Catapult

Design a catapult that uses rubber bands. Compare how far your catapult can toss a penny or similarly small object to other designs.

FOR STUDENT OR EDUCATOR

ADDITIONAL RESOURCES

Simple Arm Model Designs

Make a Model Arm – Kids Activities Blog:
http://kidsactivitiesblog.com/1800/arm-lesson

A Popsicle-Stick Arm – Krieger Science:
http://kriegerscience.wordpress.com/2010/10/11/a-popsicle-stick-arm/

How to a Muscle Model – eHow:
http://www.ehow.com/how_6762730_build-muscle-model.html

Simple Catapult Design Ideas on the Web

Catapult Designs for Kids – Spaghetti Box Kids:
http://spaghettiboxkids.com/blog/catapult-designs-for-kids/

How to Make a Catapult out of Paper Towel Rolls – eHow:
http://www.ehow.com/how_6769705_make-out-paper-towel-rolls.html

SPECIAL THANKS:

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