

Bay Area Scientists in Schools Presentation Plan

Lesson Name Bones

Presenter(s) Martha Singer MD

Grade Level 5th Standards Connection(s) Physical sciences- Calcium is an element; Life Sciences-bones are part of a specialized system of the human body, help in mobility; Earth Sciences- Gravity helps form strong bones! Measurement and Geometry-Long bones are hollow tubes

Abstract: Kids' bones are different from adult bones. Bones grow longer and stronger during elementary school. Strong bones come from a combination of good food choices (calcium) and weight bearing exercise (running, jumping, dancing). The long, weight-bearing bones have a special design (cylinder) that helps them support body weight. Gravity helps bones become strong. Astronauts who spend time away from earth's gravity have to exercise in a special way to keep their bones strong.

Vocabulary/Definitions: 3 – 6 important (new) words:

- Calcium-the mineral in your body that makes your bones and keeps them hard and strong (also an element)
- Cylinder-a geometric shape like a bone
- Orthopaedic Surgeon – A doctor who specializes in bone and joint injuries and surgeries.
- Weight bearing exercise-an activity in which your body works against gravity so your feet, legs, or arms are carrying your weight. Jogging, walking, stair climbing, dancing and soccer are some weight-bearing physical activities you can do alone or with friends
- Femur- thigh bone
- Humerus-bone of the upper arm
- Tibia and fibula-bones of the lower leg

Materials:

What you'll bring with you

I will bring in plastic bones, x-rays, magnifying lenses and cow bones for the kids to examine with the lenses,

What students should have ready (pencils, paper, scissors):

Pencil, ability to wash hands after inspecting bones.

Classroom Set-up:

Students will start as a group (discussion) will then break up into smaller groups



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Classroom Visit

1. Personal Introduction: 5 Minutes

Who are you? What do you want to share with students and why? How will you connect this with students' interests?

I am an orthopaedic surgeon (bone doctor) and take care of kids and adults. Orthopaedists take care of broken bones as well as other problems like sports injuries and joint replacements. Bones are interesting because they help us to grow and move.

Topic Introduction: 10 Minutes

Big Idea(s), vocabulary, assessing prior knowledge. What questions will you ask to learn from students?

Is a bone an animal vegetable or mineral?

Who knows what calcium is?

I will show some plastic human bone models, kids guess which part of the body they are from and learn names of some bones.

Kids bones are different from adult bones-will show some photos or x-rays- kid bones have special areas where they are still growing longer. Kids are also growing their bones stronger (putting down more dense, calcified bone) up until the bones are at their strongest around age 20.

What makes bones strong? Calcium and weight bearing exercise.

What foods have calcium in them? How does the calcium in the foods you eat get to your bones?

In order to grow stronger bones, weight-bearing exercise is important. Bones that rest inside a cast start to lose density quickly. What can astronauts do to keep their bones strong?

2. Learning Experience(s): 35 Minutes

Demonstrations, hands-on activities, images, games, discussion, writing, measuring... What will you do, what will kids do? Describe in order, including instructions to kids.

- 1) Show poster of human skeleton (handout: labeled skeleton diagram). Pass around bone models for observations: what do they observe? Where do they think bones fit into the human skeleton? Can they name the bones they found? Show femur, humerus, tibia, fibular. What other bones/names interest you? Which is your funny bone?
- 2) Tubular strength: demo – with kid volunteers kids try balancing a book on the end of a thin tube-even a toilet paper roll can hold a book. But when the book is placed on the tube that lies on its side, the book easily crushes the tube. Why? A tube or cylinder shape allows your bones to hold up a lot of weight—the weight of your body—but is lighter than if the bone was a solid tube.



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- 3) Pass around X-rays of kid and adult bones – what is different about kid bones? See what a growth plate looks like on an x-ray
- 4) Observation of real specimens: Kids go to table groups. Each table group gets bone specimen(s) to inspect with lenses and diagrams of different parts of bones. On a blank page, draw a picture of the bone(s) and show how it is organized into different areas- hopefully seeing it is shaped like a hollow tube or cylinder. Guess what part of the animal the bone comes from. (Is it from a mature or a young animal? –*this might be a gross-out question! but would link to their previous observations...*) Label the parts of the bone you can observe. What might be missing from your specimen? ...

3. Wrap-up: Sharing Experiences and Building Connections 5 **Minutes**

Putting the pieces together – how will students share learning, interpret experience, build vocabulary?

Ask about what kids observed when they inspected the bones. Was it what you expected? Are bones dead or alive? Do you think your bones look like these? What happens when bones don't get used- like when they are in a cast or in space and there is no gravity?

Bendy Bones - Show (I hope) a “pickled” bone or egg, where the bone or eggshell has had the calcium removed—it is wiggly and soft-to demonstrates how calcium makes bones hard.

Ask about what food are good for bone strength, and what exercises build bone strength.

****Rubber Bones** (Children's Museum of Houston) Over 1 or 2 days, learners use vinegar to remove the calcium from a chicken bone. They then explore how the bones have changed. An accompanying video with Mr. O further explores the relationship between cartilage and bone and explains how bones grow. <http://www.cmhoustonblog.org/2011/02/01/rubber-bones/>

4. Close: 5 **Minutes**

How can kids learn more? Thanks and good-bye! Clean-up.

List of calcium containing foods to share with family-attached

TOTAL 50 – 60 **Minutes**



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Follow-up – After Presentation

Suggest students write a letter explaining “How we learned about bones and calcium?”

For girls: <http://www.cdc.gov/powerfulbones/boneup/index.html>

About broken bones (for kids) http://kidshealth.org/kid/ill_injure/aches/broken_bones.html

For kids (museum): http://kidshealth.org/kid/ill_injure/aches/broken_bones.html

For teachers:

<http://yucky.discovery.com/teachercenter/pg000064.htm>

Calcium content of foods: <http://ods.od.nih.gov/factsheets/calcium.asp>

Staying Strong: Where to get calcium

For strong bones, kids need plenty of calcium and lots of weight-bearing physical activity every day. Here are some great tasting ways to get the calcium you need.

Calcium content varies depending on ingredients for many foods. That means a food may have a little more or a little less calcium than what is listed on this chart. This is because different brands sometimes have slightly different ingredients. Check **food labels** to see how much calcium is in different foods. Choose fat-free or low-fat versions of these foods most often. Aim for 1300 milligrams or 130% of the **daily value (DV)** everyday.* **Add it up!**

Food	Portion	Calcium	
Milligrams	%DV*		
Plain, fat-free yogurt	1 cup	450	45
Grilled cheese sandwich**	1 sandwich	371	40
American cheese	2 ounces	348	35
Ricotta cheese, part skim	1/2 cup	337	35
Fruit yogurt	1 cup	315	30
Cheddar cheese	1 1/2 ounces	305	30
Milk (fat free or low fat)	1 cup	300	30
Orange juice with added calcium	1 cup	300	30
Soy beverage with added calcium	1 cup	250–300	25–30
Mozzarella cheese, part skim, low moisture	1 ounce	207	20
Tofu (with calcium sulfate on ingredient list)	1/2 cup	204	20
Waffle, homemade with milk, 7-inch	1	191	20
Macaroni and cheese	1/2 cup	180	20
Collards, boiled, frozen	1/2 cup	179	20
English muffin, whole wheat	1	175	20
Rice beverage, with added calcium	1 cup	150–300	15–30
Pudding, made with milk — chocolate, vanilla, lemon, banana	1/2 cup	147–160	15
Cheese pizza	1 slice	111–147	11–15
Collards, boiled	1/2 cup	118	10
Frozen yogurt (fat free or low fat)	1/2 cup	105	10
Broccoli, cooked or fresh	1 cup	90	10
Kale, boiled	1/2 cup	90	10
Seeds, sesame seeds, whole, dried	1 tablespoon	88	10
Ice cream	1/2 cup	84	8
Bok choy, cooked or fresh	1/2 cup	80	8
Cottage cheese, 2% fat	1/2 cup	78	8
Almonds, dry roasted	1 ounce	71	8
White bread	2 slices	70	8
Cottage cheese, 1% fat	1/2 cup	69	6
French toast, made with milk	1 slice	65	6
Oatmeal, instant with added calcium	1 packet	100	11
Cereal with added calcium	1 ounce	300	30
Milk, Lactose Reduced	1 cup	300	30



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* % DV = % of Daily Value used on food labels. The Daily Value for calcium is 1,000 milligrams (mg). 5% DV or less of a nutrient is low; 20% DV or more is high. Label values are rounded. Visit the [KidsHealth](#) and [FDA](#) Web sites to read more about food labels.

** Using 2 slices of white bread, 1 1/2 ounces cheese, nonstick cooking spray.

Sources: American Dietetic Association's *Complete Food and Nutrition Guide*, by Roberta Larson Duyff, Chronimed Publishing, 1996; *Bowes and Church's Food Values of Portions Commonly Used*, revised by Jean A.T. Pennington, Lippincott-Raven Publishers, 1998; USDA Nutrient Database for Standard Reference (Release 14, 2001); Imagine Foods Rice Dream and Pacific Foods.

Sources: United States Department of Health and Human Services, *Dietary Guidelines for Americans*, 2005, Appendix B - Food Sources of Selected Nutrients: Appendix B-4: Non-Dairy Food Sources of Calcium.

Sources: *Bone Health and Osteoporosis, A Report of the Surgeon General*, 2004, Chapter 7: Lifestyle Approaches to Promote Bone Health, Table 7-2: Selected Food Sources of Calcium, pg 161.

Note: % Daily Value numbers are often rounded. That means the %DV numbers may not be the exact value. Rounded numbers are easier to work with. Numbers that end in 1 through 4 are generally rounded to the next lower number that ends in 0. For example 74 rounded to the nearest ten would be 70. Numbers that end in a digit of 5 or more are generally rounded up to the next even ten. For instance the number 88 rounded to the nearest ten would be 90.

[Department of Health and Human Services' Office on Women's Health*](#)
[Centers for Disease Control and Prevention](#)
[National Osteoporosis Foundation*](#)



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Rubber Bones

(Children's Museum of Houston)

<http://www.cmhoustonblog.org/2011/02/01/rubber-bones/>

The things we typically think of as “bones” – the hard, white parts – don’t typically grow. They’ve already ossified (which is just a fancy way of saying that calcium has been deposited to make them nice and hard).

The long bones (like arm and leg bones) are the best examples to describe bone growth. As kids, like our most dynamic visitors at the Children’s Museum of Houston, our bones are mostly hard. But, near the ends of the bones, are two areas of cartilage. Cartilage is a stiff but flexible tissue. Your ears and parts of your nose are composed of cartilage, which is why you can smooch and twist them around.

The cartilage in your bones (growth plates in the case of long bones) is the stuff that grows. As it grows, special cells in your body called osteoblasts, cause calcium and other minerals to deposit into the cartilage, making it into bone. But the cartilage is still there! Want to see it?

What You Need:

- Chicken bones – I recommend the bones from hot wings. The bonus is you get to eat the hot wings!
- Vinegar
- A Cup
- Some time

What to Do:

1. First, you have to clean the bones. This means first eating the meat off the bone (or having someone else do it), then gently boiling the bones for about 30-45 minutes.
2. Once boiled, let the bones cool and then pull off the connective tissues. The boiling helps to soften the tissues and will often remove part of it in the process, but in the end you will need to do some of it by hand.
3. Place the bones into a cup
4. Fill the cup with vinegar so the bones are totally covered
5. Place the cup out of the way. The bones will need to soak for at least 24-48 hours.
6. Once done soaking, you should be able to gently bend the bone without breaking it. You can always keep a few out of the vinegar for comparison purposes.

What’s Happening?

Vinegar, or acetic acid in scientific terms, reacts with calcium. This reaction removes the calcium from the bones, leaving just the cartilage behind. Like I said, cartilage is a stiff, but flexible tissue. So, you can now bend the bones without breaking them (but if you are too rough, you can tear the cartilage).

By the way, around your late teens to early twenties, your growth plates will ossify (aka harden) which is when you finally stop growing (upward, at least).



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