Summary
This Webquest is developed around acquiring new knowledge about bones: how they are formed, how they can be broken, and new regenerative medicine technologies being developed for bones.

Time
40-45 minutes

Standards
This activity fulfills standards in Science in Personal and Social Perspectives, and has Performance Indications regarding technology.

Full educational standards available at www.sepa.duq.edu/education
More Webquests
Explore the bone, the heart, the immune system and more on-line with free webquests at:
www.sepa.duq.edu/education

Visit our Websites

◊ Dr. Allevable's Unbelievable Laboratory, grades 3-6+
www.sepa.duq.edu/lab
◊ Partnership for Education, for teachers and older students
www.sepa.duq.edu/regmed

Teacher Background

Topic Description
This Webquest was developed as part of the multimedia educational project “Regenerative Medicine – Partnership for Life.” This project is funded by the National Institutes of Health and the National Center for Resource Research.

The Webquest is developed to help students acquire new knowledge about bones: how they are formed, how they can be broken, and new regenerative medicine technologies being developed for bones.

Grade Level
This Webquest is designed for students in third to fifth grade. Instructors at the middle school level, however, can adapt the Webquest for use in their classrooms as well.

Performance Indicators
All students should have opportunities to demonstrate the following performances.

Prior to completion of Grade 5 students will:

1. Use keyboards and other common input and output devices (including adaptive devices when necessary) efficiently and effectively. (1)
2. Discuss basic issues related to responsible use of technology and information and describe personal consequences of inappropriate use. (2)
3. Use general purpose productivity tools and peripherals to support personal productivity, remediate skill deficits, and facilitate learning throughout the curriculum. (3)
4. Use technology tools for individual and collaborative writing, communication, and publishing activities to create knowledge products for audiences inside and outside the classroom. (3, 4)
5. Use technology resources for problem solving, self-directed learning, and extended learning activities. (5, 6)
6. Determine when technology is useful and select the appropriate tool(s) and technology resources to address a variety of tasks and problems. (5, 6)
Bone Webquest

Every single person has a skeleton with a lot of bones…206 of them to be exact! These bones keep your body in the right shape and help you move around. If you didn’t have bones, you would just be a pile of mush on the ground! In addition to supporting your body like a scaffold, bones also protect the organs in your body from injuries, allowing your body to work properly.

The bone is a living tissue! Inside each bone there are blood vessels that supply your bones with calcium and important nutrients, keeping them strong and healthy. At the center of some of your bones is bone marrow which is kind of a factory for making new cells. In between the layers of blood vessels and marrow is a light, spongy layer. This layer makes bones lighter for easier movement.

Bone is constantly being broken-down and rebuilt by the process of bone remodeling. This process ensures that bones are as strong as possible. Bone remodeling makes the bone a good candidate for healing itself from small traumas! Some breaks are so bad, however, that bones can’t heal on their own, even with a cast! New advances in regenerative medicine can help the body heal itself in these cases. With the help of regenerative medicine, healing can happen faster.

Inside all of us in our bone marrow, there are young cells, called stem cells, that make new bone. Doctors can remove a small number of these, take them to the lab to grow more, then put them back into the broken bone. The young cells help grow new bone much more quickly than if the bone healed on its own.

Resources and Materials

- Computer lab/computer area
- Computers (one for each pair of students)
- Photocopies of the “Dr. Allevable’s Bone Module Webquest” (one copy for each student)
- Pencils

Process

Your students will use the internet to explore the fascinating human bone. Students will work in pairs to complete the interdisciplinary Webquest activity during one class period (30-45 minutes). Plan for more time if you feel your students need it. Please advise your students to follow the directions in the Reading Guide and check off each box as a step is completed.

After all the steps on the task list are completed, students can start the evaluation assignment in class. The assignment is to be completed with their partner. Decide how many days your students will have to complete their assignment and set a due date. Pairs will then present their project in front of the class.
Regenerative Medicine Partnership in Education

This Teaching Resource Guide has been developed in parallel with the Dr. Allevable’s Lab Website. To view this site, download Complementary Resources, and find links for Online Teacher Resources, please visit: www.sepa.duq.edu.

Why Use This Webquest?

In the emerging field of tissue engineering, scientists, engineers, and medical experts are devising new ways to replace or support defective or injured body parts. They are also developing and producing new molecules and proteins to support tissue growth. By working with young cells and these new growth-promoting molecules (called growth factors), scientists and doctors can help cells, tissues, or organs heal that could not be healed before.

By using this Webquest, in conjunction with Dr. Allevable’s Laboratory Website and the "Dr. Allevable and Regenerobot’s Exploration Adventure" workbook, regenerative medicine will come alive in your classroom! This Webquest, in particular, helps integrate technology into your classroom and bring your students new knowledge in a fun, interactive, and engaging manner.

Things to Consider Before Implementing this Webquest in the Classroom

◊ Pair students into effective cooperative partner groups (see below)
◊ Reserve time/class period in the computer lab
◊ Review proper computer lab etiquette
◊ Copy Bone Webquests Reading Guides for students
◊ Implement necessary academic adaptations (see below for suggestions)

Academic Adaptations

◊ Students should work in pairs in the computer lab to create an evaluative product. The partners can be previously chosen by the teacher to ensure that all levels of learners are able to complete this task (i.e., a lower-level learner may be paired with a higher-level learner). This pairing style helps students work collectively and practice cooperative skills and social skills. Additionally, students can practice delegation of roles and division of tasks to complete and create the assignment.
◊ Students will present their finished evaluative products to the entire class with a partner. As partners, students scaffold each other’s learning and create more advanced products/ideas than if they worked on an individual basis.
◊ If a student has a visual learning impairment, feel free to create learning guides using larger print or Braille. Additionally, consider using a mouse with a magnifying feature to aid them in reading smaller texts on a website.
◊ This activity should not create problems for students with auditory impairments as the Dr. Allevable Lab Website does not contain sound effects that would impede comprehension.

Skills

◊ Associate
◊ Create
◊ Describe
◊ Draw
◊ Differentiate
◊ Explain
◊ Identify
◊ Illustrate
◊ Infer
◊ Name
◊ Order
◊ Predict
Website
This lesson plan has been developed for the website:
Dr. Allevable's Unbelievable Laboratory
http://www.sepa.duq.edu/thelab

Additional Resources
The following resources provide additional information and activities:

Bone. The counterpart website to Dr. Allevable’s Ubelievable Laboratory for teachers and older students.
http://www.sites.duq.edu/sepa/regmed/bone

Mr. Bones - Online Assembly Activity
http://sv.berkeley.edu/showcase/pages/bones.html

The Big Story on Bones - Interactive Information Website for Kids
http://kidshealth.org/kid/body/bones_noSW.html
Instructions and Answer Key

Part 1:  (Please check off when complete)

◊ Go to the following website: http://www.sepa.duq.edu
◊ Click “Visit the Lab!”
◊ Give the lab a chance to load
◊ Click on “Bone Module”
◊ Read the Introduction page that pops up
◊ Click on text normal bone growth
◊ Read the normal bone growth page and answer the following questions:

1. What roles does cartilage play in the process of bone formation?
   1. Serves as a frame for your skeleton while you are growing
   2. Stands in place for bones in certain parts of your body (ears, nose) to give your skeleton greater flexibility

2. Describe the process of bone renovation, step-by-step. (Answer should contain the following elements, in some variation.)
   1. New, soft cells release tiny particles (proteins) to their environment
   2. The proteins attract calcium and other substances
   3. The squishy bones harden and transform into solid bone

Part 2:

◊ Click the black BONE INJURY tab at the bottom of the Bone Module screen
◊ Read this section and answer the following questions:

1. A bad fall from your bike or a collision on the soccer field can cause a bone to break. Name three other activities that can put too much pressure on bones, causing a break as well.
2. True or False? Bone renovation (turning squishy cells into hard bone) only happens when you are young. If false, explain why it is false and change the statement so it is true. (Answer should contain the following elements, in some variation.)

False: Bone renovation does not exclusively occur in young bones. This process occurs on an everyday basis. Your bones are constantly being renewed so that bone tissues remain strong and healthy.

Correction: Bone renovation is always happening. All the time, soft cells are becoming hard bone.

Part 3:

- Click the black MODERN MEDICINE tab at the bottom of the Bone Module screen
- Read this section and answer the following questions:

1. Arrange the following sentences into the correct chronological order using numbers (1-6).

   1. Bone is broken.
   2. Broken blood vessels break and begin to clot.
   3. Cells clean the clot and create bendable cartilage.
   4. New cells eat the cartilage and begin to grow new bone.
   5. New, strong bone is formed by the cells.

2. Explain why it is important for a cast to be placed on a broken bone? What would happen if a broken bone did not receive the proper treatment? (Answer should contain the following elements, in some variation.)

   It is important for a cast to be placed on a broken bone so the bone is held into place while it heals and re-grows. If a broken bone did not receive the proper treatment, it would not heal correctly.
**Part 4:**

- Click the black **REGENERATIVE MEDICINE** tab at the bottom of the Bone Module screen
- Read this section and answer the following questions:

1. **Why would using young cells to heal broken bones be a benefit? Explain.**

   *Using young cells to heal broken bones is a benefit because they can make healing happen faster, so that a broken bone heals in three weeks instead of six.*

2. **Click on the movie button and watch what happens. Draw your interpretation of each slide and write a caption describing your illustration!**

<table>
<thead>
<tr>
<th>1.</th>
<th>2.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The space between the break is too big and the bone can’t heal by itself with a cast.</td>
<td>Doctors use a scaffold like cartilage to support the blood vessel’s growth.</td>
</tr>
<tr>
<td>3.</td>
<td>4.</td>
</tr>
<tr>
<td>Then, doctors inject new, young stem cells.</td>
<td>New bone replaces the scaffold as young cells become bone and blood vessels fill the scaffold.</td>
</tr>
</tbody>
</table>
If there is extra time in your classroom, your students can also look at...

**More Websites!**

- **Mr. Bones:**
  Students can look at the image of an assembled Mr. Bones, click to mix up his bones, and then attempt to correctly put all of his bones back together.
  http://sv.berkeley.edu/showcase/pages/bones.html

- **The Big Story on Bones:**
  Students can find more answers to their questions here, along with cool diagrams of bones that seem to come to life.
  http://kidshealth.org/kid/body/bones_noSW.html

**Evaluation Choices:**

At the end of their research, you can have your students show what they have learned by creating a visual presentation with both images and writing that features at least 6 things they learned about bones and regenerative medicine. Remind your students to cite their sources! Some possible ideas include:

- An informative poster about new medical advances associated with Regenerative Medicine and bones
- A brochure about medical care for broken bones
- A flip book detailing the processes that occur when a bone breaks
- Discuss more ideas with your students!