**ACTIVITY: Bone minerals**

**Activity idea**

In this activity, students investigate how bone strength varies with its mineral content and the solubility of bone minerals in neutral and acidic solutions.

By the end of this activity students should be able to:

* relate bone strength to its mineral content
* recognise that hydroxyapatite is soluble in acid solutions
* identify hydroxyapatite as a calcium phosphate mineral
* describe bone as a specialised form of connective tissue.

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**Introduction/background**

Hydroxyapatite is the main mineral found in bone. It is a calcium phosphate mineral and has the formula Ca10(PO4)6(OH)2.

Bioceramics based on hydroxyapatite have been developed and are used with some forms of dental implants. Research into its use as a bone repair material is ongoing. Investigations by Dr Michael Mucalo at the University of Waikato involving this mineral as a bone substitute have shown promising results.

Students will prepare chicken bone samples and then soak them for several days in water, hydrochloric acid and Coca Cola soft drink.

The strength and flexibility of the bones will then be qualitatively assessed.

Bone composition in vertebrate animals does not vary markedly, and for the purposes of this experiment, cooked chicken thigh bones, cleaned of any tissues, will be used.

**What you need**

* Copies of the student worksheet
* 3 similar sized cooked chicken bones, free of any attached tissues
* 3 250mL beakers
* 100ml of 20% hydrochloric acid, 100mL of coca cola, 100mL of water
* Paper towels
* Cling wrap

**What to do**

1. Make sure each student has the necessary materials and equipment and the student worksheet.
2. As a class, discuss what students know about bone minerals and have them complete the first box.
3. Have students carry out the observations described on the worksheet.

**Discussion questions**

* If a similar experiment were to be carried out using human teeth in place of chicken bone, what would the results show?
* Bone is a specialised connective tissue. Apart from the presence of hydroxyapatite, what other materials are present?

**Extension ideas**

* Refer to the article [Bone and tooth minerals](http://link.sciencelearn.org.nz/resources/1796-bone-and-tooth-minerals) and look carefully at the bone structure diagram. Find out how bone cells such as osteocytes and osteoclasts build and reconstruct bone.
* The bones act as a store in the body for calcium and phosphate. What uses other than bone formation does the body have for these substances?
* What is osteoporosis?
* If the hydroxyapatite has dissolved in the acidic solution, it should be possible to test for the presence of calcium and phosphate in the solution. Find out how this can be done.

**Student worksheet – Bone minerals**

The main mineral present in bone is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The elements present in this mineral are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Its chemical formula is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Get 3 similar sized clean chicken femur bones and test the flexibility of each of the bones by applying bending and twisting forces.

***Observations – flexibility before soaking***

1. Test the hardness of each bone by using your fingernail to scratch the surface.

***Observations – hardness before soaking***

1. Into the three 250mL beakers, place 100mL of each of 20% (6 molar) tap water, hydrochloric acid and Coca Cola soft drink. (Take care with the hydrochloric acid.)
2. Seal off the top of each beaker with cling wrap. Set the beakers aside in a safe place and leave for 3 days.
3. Carefully pour off to waste the remaining liquid from each beaker. (Make sure the hydrochloric acid is flushed to waste with plenty of water.) Thoroughly rinse each bone with tap water. Dry the bones with a paper towel.
4. Inspect each of the bones, noting any significant changes in appearance from when they were first placed in the soaking solutions. Test the flexibility of each of the bones by applying bending and twisting forces.

***Observations – flexibility after soaking***

|  |  |  |
| --- | --- | --- |
| **Water** | **Hydrochloric acid** | **Coca Cola** |
|  |  |  |

1. Compare the hardness of each bone by using your fingernail to scratch the surface.

***Observations –hardness after soaking***

|  |  |  |
| --- | --- | --- |
| **Water** | **Hydrochloric acid** | **Coca Cola** |
|  |  |  |

**Conclusions**