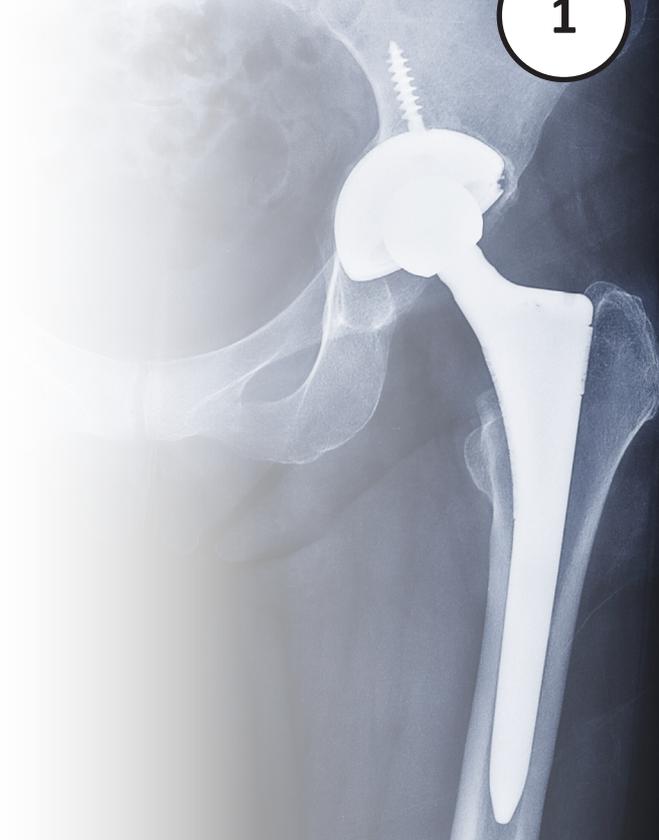


Question

Can you think of
other body parts
that are commonly
replaced ?



Answer

Possible answers:

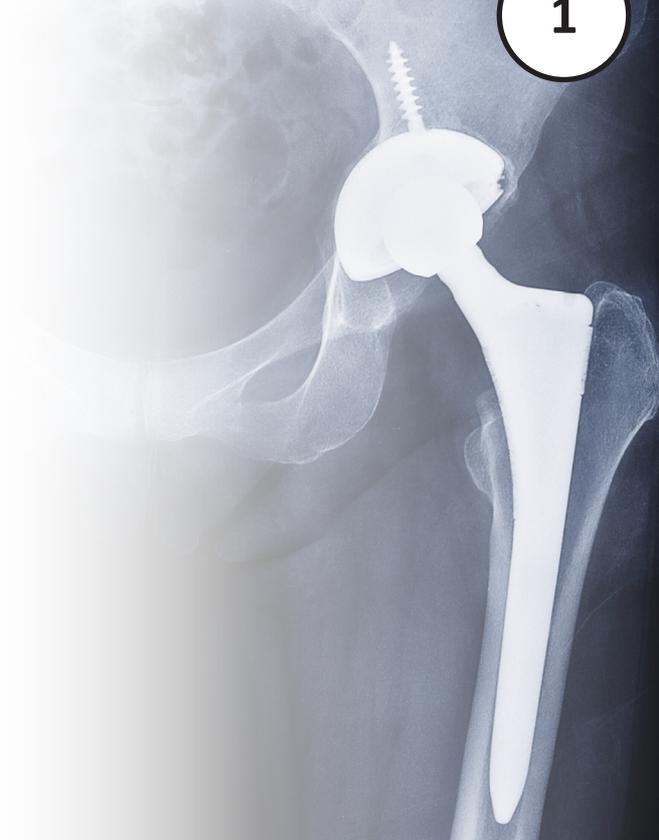
knees, teeth, heart, leg, arm



for master minds

*Are there differences in what to look out for when designing these artificial body parts?
(i.e. comparing knee with heart)*

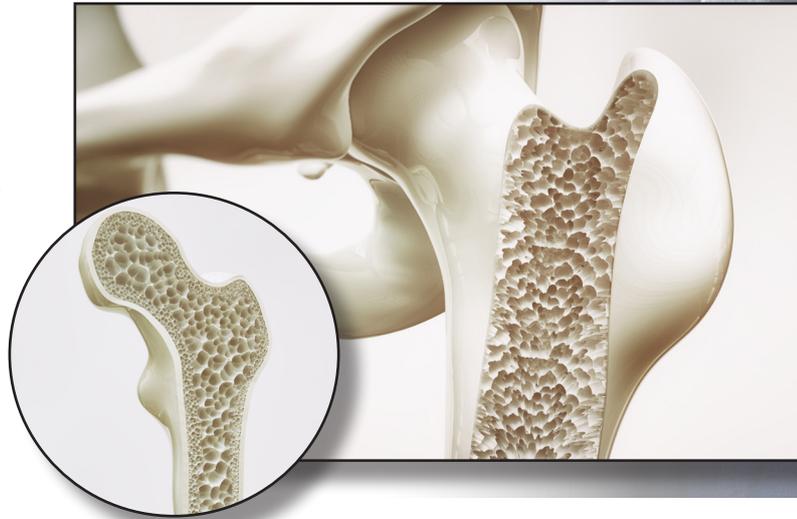
Knees, teeth, hips are hard body parts, a heart is soft body part. Design (shape) and materials need to consider that, as well as their function and location. Example: tooth implant: It not only has to function like normal teeth, it has to look the same too.



Question

These are images of **bone** - inside and outside

Describe
what you see.



Possible answers:

smooth outside surface,
lots of holes (also called pores) inside,
fibrous structure, holes seem to be
smaller towards the wall

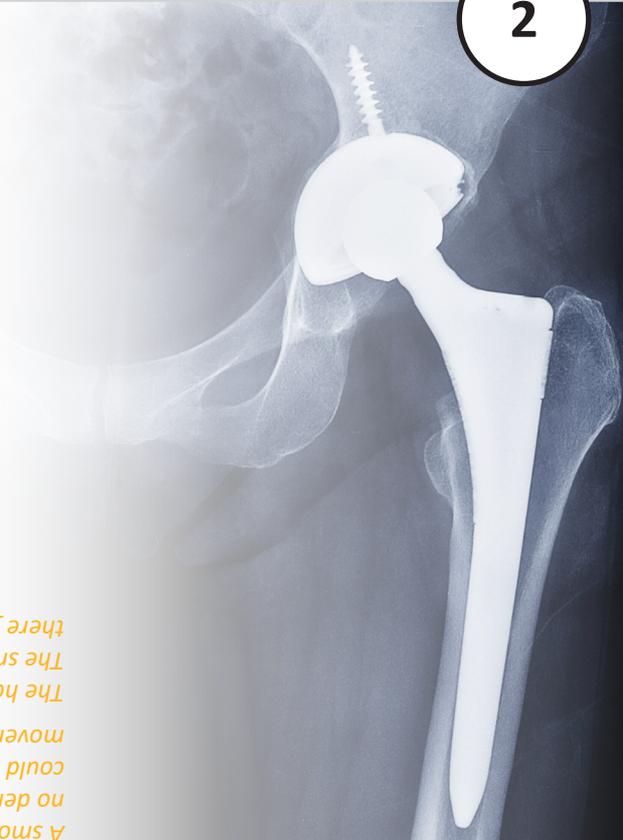


for master minds

What is the effect of the things you described on the bone?

(i.e. Why are there holes? Is there a reason for the surface to be smooth?)

A smooths surface means that there are no dents where any "dirt" (i.e. old blood) could collect. It also suggests smooth movement and less friction (so less/no pain). The holes/pores makes the bone lighter. The smaller pores toward the wall might be there for more stability closer to the wall.



Question



materials can be hard,
soft, light, strong, ...

Discuss
materials properties
for the **3 parts** of the
artificial hip.

Hints:

Should they all be made of the same material?
If not, why? How does the material affect the purpose of each part?
(Tip: Start with thinking about the liner in the middle.)

Answer

Possible answers:

The **“Cup”** needs to be fixed (i.e. screwed) into the pelvis. It is in direct contact with the bone. So the material of the cup needs to “get along” with the bone. It also needs to be very strong, so that it does not crack when the screws are tightened.

The **“Liner”** in the middle is acting as a cushion between cup and stem. So, it would make sense for it to be softer.

The **“Stem”** is also in touch with bone, so needs to “get along” with it. It also needs to be strong, so that it does not crack during movement.



for master minds

Can you suggest material types for each part?

(i.e. what are soft materials, what are hard or strong...?)



possible materials combination:

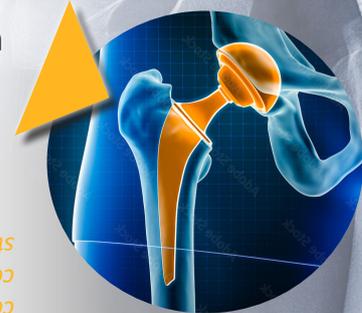
Answer

Possible answers:

The **stem** needs to be **long** enough to sit tightly inside the bone and not become loose over time.

Edges should be rounded off, i.e. edges of the holes for the screws, to not hurt the bone or other body parts by sharp edges.

Maybe some kind of **coating** (so painting the artificial hip with protective paint) can be applied to **protect** interactions between bone and material of the part (i.e. avoid corrosion).



for master minds

Bone is very light. Can you think of ways to make the artificial hip lighter, but still stable?

*The stem could be hollow inside, or it could contain holes, like bone.
Different possibilities (i.e. size and shape of holes, or amount of holes; thickness of wall) can be tested in a simulation program on the computer, to see if the stability of the stem stays the same, despite adding holes.*

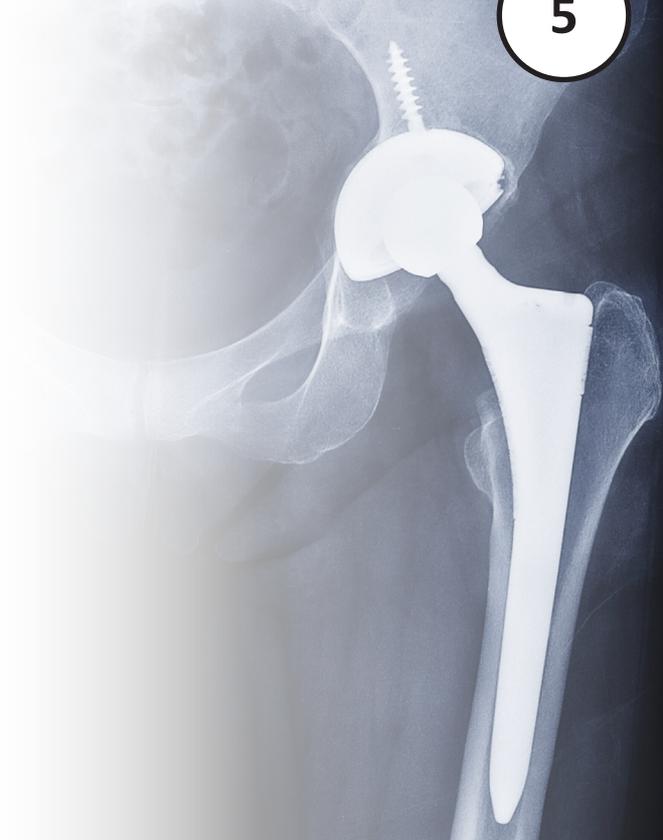
Question

What kind of
jobs/education do
people have, who
are **working on** an
artificial hip?

Hints:

Is it one person working on the artificial hip? Or several?

Who needs to think of what?



Activity Card

Grandma's Hip Replacement

GROUP
5

Answer

Possible answers:

Doctors: They need to make sure the shape/design and the different parts can actually be placed into the body during a surgery.

Material Scientists: They need to make sure the materials used will not cause any damage to the body (i.e. corrode when in contact with body fluids).

Bio-Engineers: They come up with the design of the artificial hip and find ways of improving the design (i.e. making it lighter).

Simulation experts: They know best how to test the artificial hip on the computer in a simulation software. For example: they know how to tell the software about realistic loadings on the hip during movement, rotation, and so on. And they know how to understand the outcome and then advice the bio-engineers what needs to be improved.



for master minds

Do you think these jobs have always existed?

If not, which ones are fairly new?
How do we benefit from them?

*Jobs like Bio-Engineers and Simulation Experts are fairly new (emerged in the second half of the 20th century.)
Jobs like that help improve the medical outcome, by doing tests on the computer and finding solutions, before placing the implant into the body.
(Example: increasing the time the implant stays intact before it needs to be replaced again)*