Your students will learn:

- What Regenerative Medicine and Tissue Engineering are.
- Examples of the kinds of injuries Regenerative Medicine can help heal.
- How stem cells are used in Regenerative Medicine.
- How scaffolds are used in Regenerative Medicine.

Full educational standards available at www.sepa.duq.edu/education
Dr. Allevable and Regenerobot invite you into their laboratory as they investigate the new and exciting field of regenerative medicine! The human body is vulnerable to injuries—bone breaks, skin burns, and heart attacks, and regenerative medicine can help us heal faster by enhancing the ways that the body heals itself.

Still from “Dr. Allevable’s Unbelievable Laboratory”

**Movie Guide**

**Time**

45 minutes

**More Resources**

Find more information about the bone and heart on-line at www.sepa.duq.edu/regmed

**Discussion Points**

Here is a viewing guide with suggestions of places to stop the movie and discuss. Ask your students to take notes in the “Your notes” section of their worksheets as they watch the movie and during discussion. Then, allow them to work in pairs or in groups of 3 to compare notes and complete the worksheet.

<table>
<thead>
<tr>
<th>Stop Point</th>
<th>Discussion questions and answers</th>
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<tbody>
<tr>
<td>3:45</td>
<td>What is Regenerative Medicine? A field of medicine that is looking for ways to help heal the body when the body can’t heal on its own. What can Regenerative Medicine do that other types of medicine can’t do? It heals injuries more quickly, and can heal some injuries that normal medicine can’t fix.</td>
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<tr>
<td>8:15</td>
<td>What is in the very center of the bone? Bones are not solid all the way through. The center is hollow and filled with a spongy material called the bone marrow. This is where blood is made. What so special about “young” cells? Young cells, also called “stem cells”, can become any type of cell in the body. The bone marrow is one place that stem cells are made.</td>
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<tr>
<td>9:40</td>
<td>What does a scaffold do? It helps to fill the break with a material that blood cells and capillaries can grow into. The scaffold gives the stem cells and capillaries a place to grow.</td>
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<tr>
<td>12:00</td>
<td>What is the extracellular matrix? Where does it come from? It is made by cells that secrete proteins that stick together to form a structure around the cells.</td>
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13:36 Bone review
How can Tissue Engineering help heal a broken bone?
They fill the gap with a scaffold to hold the bone in place, then they add stem cells to the scaffold. The stem cells become new bone!

16:45 What kinds of things can cause a heart attack?
Unhealthy foods, tobacco, or lack of exercise.

20:20 What happens during a heart attack?
A block in the capillaries - caused by a buildup of plaque - prevents blood from getting to the heart cells. Without the nutrients and oxygen in blood, some heart cells die.

23:24 - End Heart Review
How can Tissue Engineering help heal an injured heart?
First, they use a flexible scaffold as a patch over the damaged area. Next, they collect stem cells from the bone marrow. They inject these stem cells onto the patch and the stem cells become new, healthy heart muscle cells.

Regenerative Medicine Basics

1. Regenerative Medicine doctors and scientists are working on treatments to help people heal in __webpack__, not months, from serious injuries.

2. The type of engineering that works in collaboration with regenerative medicine to grow new cells to replace broken or diseased body parts is called __tissue__ engineering.

3. True or False? Circle the correct answer: Regenerative medicine is a new area of science that helps the body heal itself using scaffolds, stem cells, and growth factors.
   - True
   - False

4. ____Stem____ cells can become any type of cell in the body.

Bone

5. Without bones and a skeleton, humans would be a highly-evolved bunch of squishy organs, like which of the following animals?
   - a. starfish
   - b. jellyfish
   - c. angel fish

6. Tissue engineering doctors can help fill large gaps in a broken bone using a structure called a __scaffold___. This structure helps new tissue to grow.
7. __Capillaries__ are tiny blood vessels that carry blood throughout your entire body, including your bone, providing the nourishment that living tissues need to grow.

8. The bone marrow is like an amazing factory inside the center of your bones. What is made in the bone marrow?

   The bone marrow makes stem cells that become new bone and blood cells.

Write the matching letter of the word that fills in the blank.

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<tr>
<td>9. <strong>d. stem cells</strong> are found in the marrow and can be modified with growth factors to grow into a variety of different cells.</td>
<td>a. proteins</td>
</tr>
<tr>
<td>10. <strong>b. scaffolds</strong> can support stem cells and growing blood vessels while they make new bone. They are temporary and are replaced by new bone cells over time.</td>
<td>b. scaffolds</td>
</tr>
<tr>
<td>11. The extracellular matrix is made of <strong>a. proteins</strong> and is the structure outside the cells. It fills the space between individual cells in human tissue, like bones.</td>
<td>c. calcium</td>
</tr>
<tr>
<td>12. Humans need <strong>c. calcium</strong> to harden bones and keep them from being soft, bendy, and easily breakable.</td>
<td>d. stem cells</td>
</tr>
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The Heart

13. To treat heart conditions using regenerative medicine, stem cells are harvested from bone marrow and placed on a flexible __patch__, which is then placed on the heart. These new cells replace the dead cells found on the heart.
14. The heart is one of the largest and strongest muscles in your body, pumping ___2000___ gallons of blood through its chambers each day.

15. Your heart delivers oxygen from breathing and nutrients from the food you eat to your brain, muscles, bones and ___organs_____.

16. The health of the heart can be affected by aging, unhealthy foods, lack of ___exercise___, tobacco, and infection.

17. A ___heart_attack___ is an interruption of the squeezing heartbeat.

18. Heart attacks happen because plaque builds up and keeps the heart from having enough blood flow through the capillaries to feed the heart cells. Draw a picture of what plaque looks like in a capillary.

19. Heart attacks occur when blood cells try to fix a plaque burst and block the ___capillary___, keeping blood from feeding the heart's cells.

20. When heart cells die, the remaining cells form a scar on the heart. What effects does this scar have on the human body? Circle the correct letter(s).
   a. It weakens the heart.
   b. It causes an irregular heartbeat.
   c. It helps the heart beat faster.
   d. All of the above.

21. ___Patch___ therapy can treat heart tissue weakened by scars. This, along with a special pump and stem cells, can boost and improve blood flow again.
22. Now that you have learned about tissue engineering and regenerative medicine, draw a stem cell and a heart cell in the space below.

[Diagram of a stem cell and a heart cell]