NO PREP

The Biology of Healing

How the Body Repairs After Injury

Includes: Student reading, case study, differentiated questions, teacher key

Name: Period: Date:

The Biology of Healing: How the Body Repairs After Injury

Phases of Wound Healing: Hemostasis and Inflammation

Immediately upon tissue injury, the body initiates hemostasis to halt bleeding. Platelets adhere to exposed collagen, aggregate into a plug, and secrete growth factors—such as PDGF (platelet-derived growth factor)—that recruit neutrophils and macrophages. Within hours, the inflammatory phase peaks: neutrophils phagocytose bacteria and debris, while macrophages release cytokines (IL-1, TNF-α) that orchestrate the transition to repair. Although inflammation is vital for clearing pathogens, excessive or prolonged inflammatory responses can lead to secondary tissue damage, as seen in chronic wounds. Clinicians monitor C-reactive protein and other markers to ensure inflammation resolves appropriately before progression to the

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Proliferation and Angiogenesis: Building New Tissue

Around day 3 post-injury, the body shifts from defense to construction. Angiogenesis, stimulated by VEGF (vascular endothelial growth factor), sprouts new capillaries into the wound bed, forming granulation tissue rich in fibroblasts and extracellular matrix. Fibroblasts deposit type III collagen, creating a scaffold for cellular migration. Epithelialization follows, as keratinocytes migrate across the wound surface to reestablish the skin barrier. In organs like the liver, parenchymal cells can regenerate original architecture; in skin and muscle, however, repair leads to scar tissue, which restores continuity but lacks full biomechanical function. Proper oxygenation, nutrition, and absence of infection are critical for robust proliferation.

Remodeling and Scar Formation

From week 3 onward, the wound enters the remodeling phase, which can last months to years. Matrix metalloproteinases (MMPs) degrade excess extracellular matrix, while fibroblasts transition to myofibroblasts, contracting the wound and aligning collagen fibers along tension lines to increase tensile strength. Type III collagen is replaced by stronger type I collagen, and new blood vessels regress through apoptosis. Although remodeled tissue recovers up to 80 percent of the original strength, it remains less elastic and more prone to reinjury. Interventions (such as silicone gel sheeting, pressure garments, and corticosteroid injections) help modulate excessive scar formation (keloids) and optimize functional outcomes.

Clinical Interventions and Patient Engagement

Modern wound care integrates biological understanding with targeted interventions. Debridement removes necrotic tissue to prevent infection; hyperbaric oxygen therapy enhances oxygen delivery and supports angiogenesis in chronic or irradiated wounds. Topical growth factor dressings and bioengineered skin substitutes—composed of human fibroblasts in collagen matrices—provide scaffolds for healing. Equally vital is patient engagement: proper nutrition (adequate protein, vitamin C, and zinc), smoking cessation, and guided physical therapy preserve range of motion around joints. Memorial Day adaptive sports demonstrate that active participation accelerates functional recovery, underscoring how biology and behavior together shape healing trajectories.

Key Information

Term	Definition
Platelet-Derived Growth Factor (PDGF)	Protein released by platelets that recruits cells for repair
Angiogenesis	Growth of new blood vessels into healing tissue
Granulation Tissue	Vascularized, fibrous tissue filling wounds during proliferation

Term	Definition
Matrix Metalloproteinase (MMP)	Enzyme that degrades extracellular matrix during remodeling
Myofibroblast	Cell that contracts wound edges to reduce wound size

Case Study Excerpt: Healing Corporal Lee's Combat Wound

Corporal Jasmine Lee sustained a deep laceration to her calf when her convoy struck an explosive device. In the field, medics applied hemostatic gauze and a pressure dressing, achieving hemostasis within ten minutes. Evacuated to a forward surgical team, she underwent surgical debridement: devitalized tissue was excised, and the wound was irrigated with antibiotic solution. By day 4, granulation tissue had filled two-thirds of the defect, and Doppler ultrasound confirmed robust angiogenesis. Her regimen included twice-daily wound inspections, debridement of slough, and application of a bioengineered dermal substitute containing live human fibroblasts. Concurrent hyperbaric oxygen sessions enhanced oxygen tension, pushing her healing rate ahead of standard expectations. Jasmine's dietitian prescribed a high-protein plan enriched with leucine and vitamin C to support collagen synthesis. Physical therapists guided gentle range-of-motion exercises to prevent joint contractures. At eight weeks, her wound had contracted by over 80 percent; a silicone gel sheet regimen prevented hypertrophic scarring. By three months, Jasmine returned to light duty, her leg healing a testament to coordinated biological interventions and disciplined self-care.

1. Which phases of healing did the medics' initial interventions (hemostatic gauze and pressure dressing) target?

2. How did hyperbaric oxygen therapy and nutritional support enhance Jasmine's proliferative phase?

Multiple Choice

1. The primary function of MMPs during remodeling is to:
    a) Degrade excess extracellular matrix
    b) Promote platelet aggregation early
    c) Stimulate angiogenesis in wounds
    d) Recruit neutrophils for cleanup

2. Granulation tissue is rich in:
    a) New capillaries and fibroblasts
    b) Mature collagen fibers laid in parallel
    c) Keratinized epithelial cells of the skin
    d) Myofibroblast scars in tissue

3. Silicone gel sheeting helps prevent:
    a) Hemorrhage from bleeding wounds
    b) Infection through microbial invasion
    c) Angiogenesis in the wound bed
    d) Excessive scar formation (keloids)

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ PDGF	A) Enzyme class that breaks down extracellular matrix
2. ___ Angiogenesis	B) Tissue formed by new capillaries and fibroblasts
3. ___ Granulation Tissue	C) Cell type that contracts wound edges
4. ___ MMP	D) Growth factor recruiting cells for repair
5. ___ Myofibroblast	E) Process of new blood vessel growth

Fill-in-the-Blank

1. Platelets release _____ to attract immune cells and initiate repair.

2. Hyperbaric oxygen therapy increases tissue _____ to support healing.

3. Silicone gel sheets and pressure garments help minimize _____ formation.

Short Answer

Answer each question in 2-4 complete sentences.

1. Explain why controlled inflammation is critical for successful healing.

_____

_____

_____

2. Describe two benefits of bioengineered skin substitutes in wound management.

_____

_____

_____

3. In your view, how can patient self-care (nutrition, exercise) maximize recovery outcomes?