Extraordinary Engineering Impacts on Society: Tissue Engineering Research and Implications

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Extraordinary Engineering Impacts on Society, a National Academies Symposium

August 18, 2022

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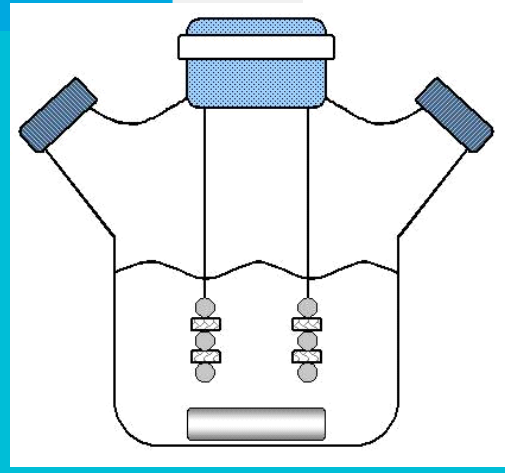
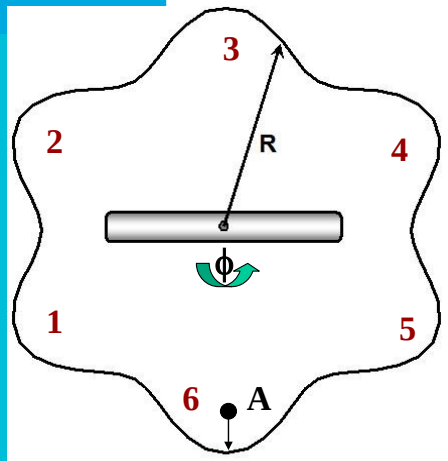
The case of the wavy-walled bioreactor



Smooth waves provide the effect of baffles at reduced shear stress.



$$R(\theta) = R_{avg} + A\sin(N\theta)$$

$$R_{avg} = 3.35cm$$

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National Science Foundation Grants

NSF 9627117 VPW: Cultivation of Cell Polymer Tissue Constructs in Novel Bioreactors

NSF 0602608 CBET: Development of Novel Models for the Growth of Tissue Engineered Cartilage

- NSF 9627117
- NSF 9012209
- NSF 9110461
- NSF0602608
- NSF 0544823
- NSF 0541573
- NSF 1229954

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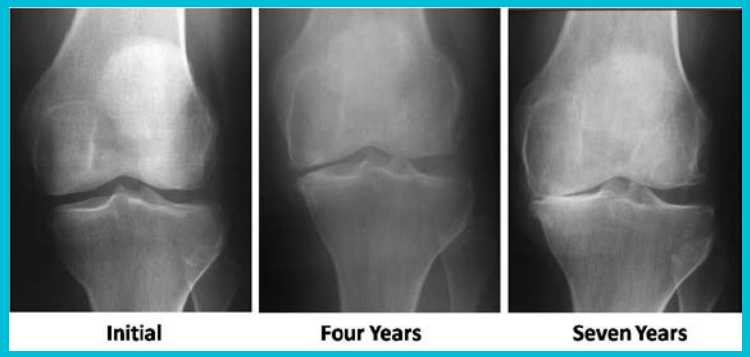
Cartilage Disorders

Expected to double by 2040

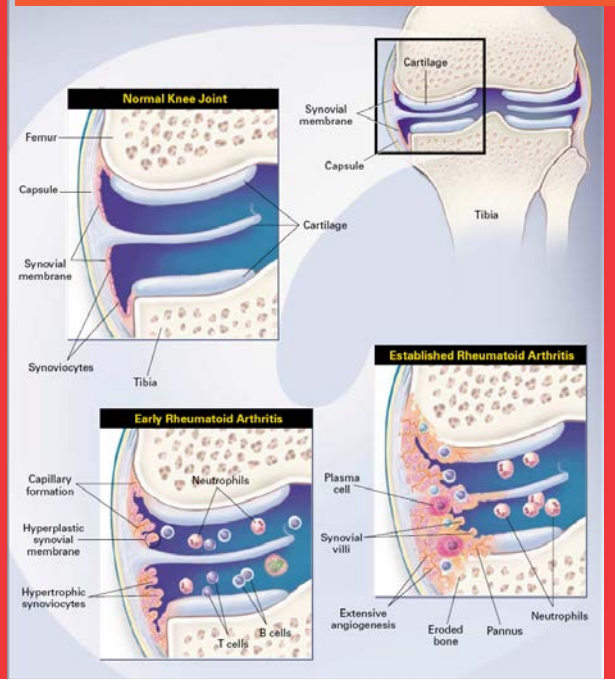
// Aging



// Injury

// Osteoarthritis

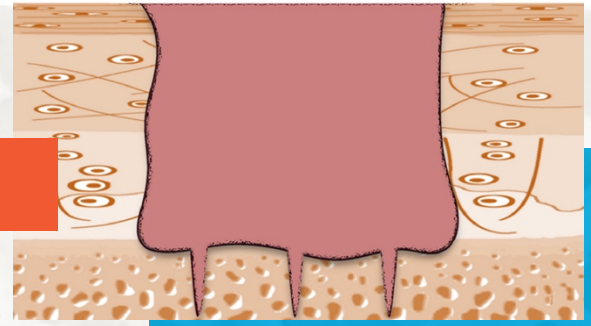
// Rheumatoid arthritis



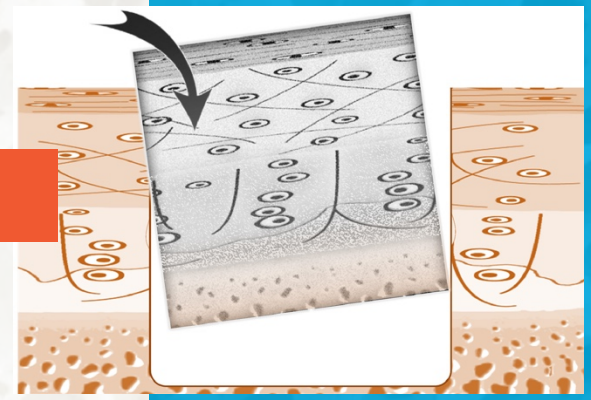
www.nejm.org, NEJM, 344:907, 2001

Cartilage Treatment Strategies

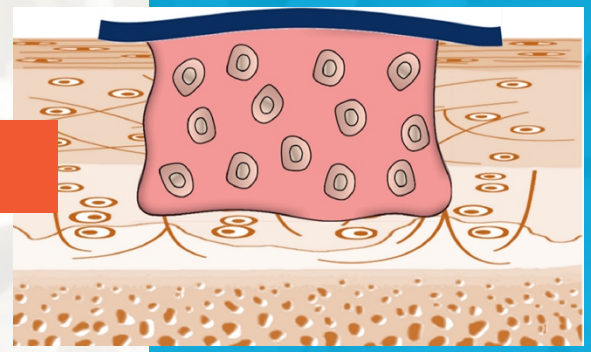
marrow stimulation



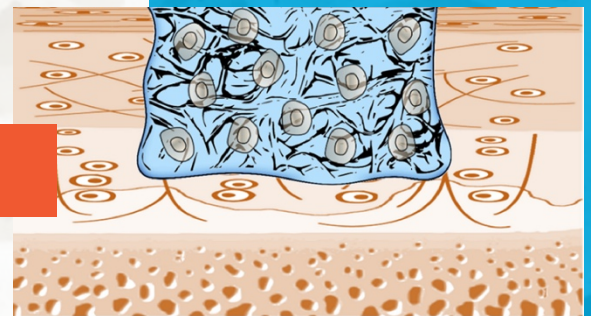
transplantation



implantation



assisted implantation



Current Research in Translational Medicine 69 (2021) 103299

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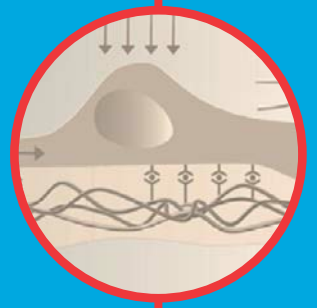
Cartilage Tissue Engineering

Autologous Chondrocytes // Autologous Chondrocytes are isolated from the patient's articular cartilage

Scaffold // Chondrocytes are seeded in a porous biomaterial, molded into the shape of the defect



Mechanobiology // Understanding the role of different biophysical stimuli in chondrocyte behavior presents the first step towards bridging the gap between cartilage engineering research and clinical translation.

Preclinical/clinical studies // Preclinical studies in animal models, early and mid stage clinical trials in humans present the last step towards clinical translation

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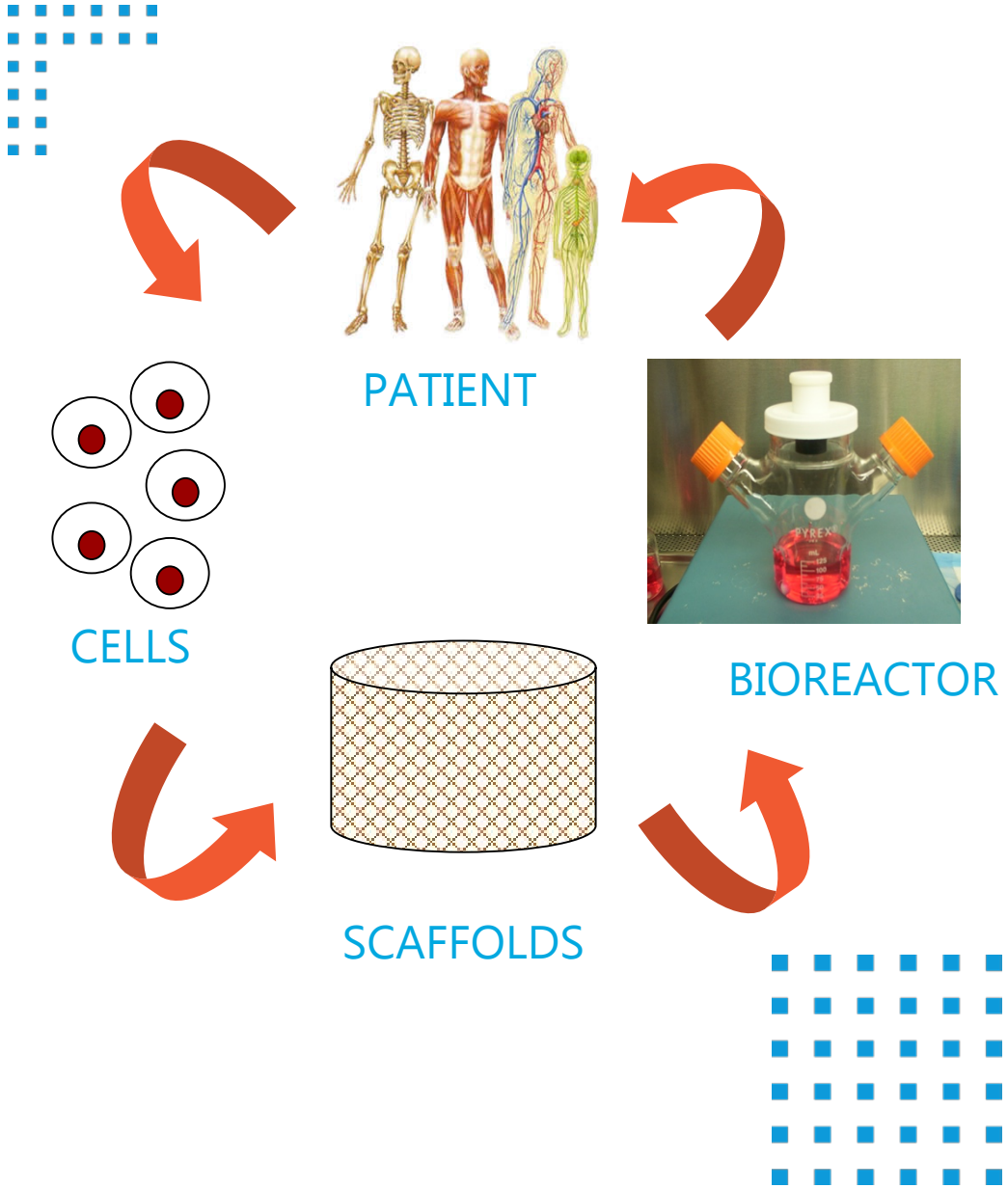
Impactful Studies

- Flow visualization and characterization within bioreactor
- Elucidation of influence of biophysical environment on development of engineered tissues
- Models of tissue development and pathology



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Societal Impact

- Collaboration across disciplines with clinicians and industry practitioners
- Translation of basic discoveries
- Models and progress towards clinically relevant tissue constructs
- Improved treatment and therapeutic approaches to injury and disease
- Improved long-term health and mobility
- Academic training, career development and enhanced career trajectories

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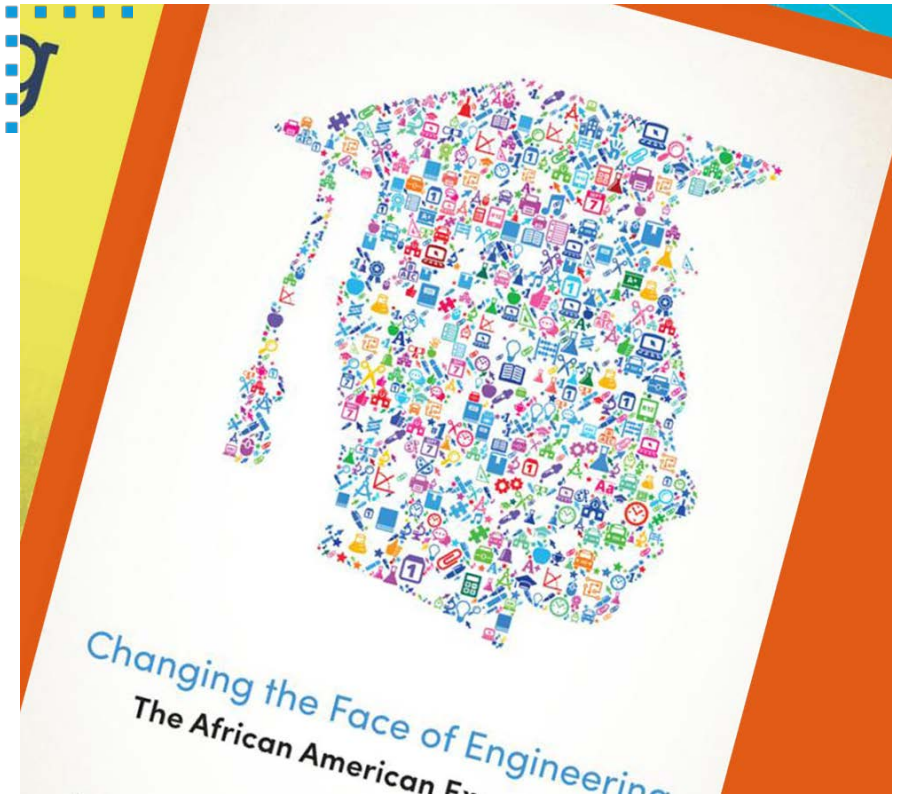
Socialization

"Socializing African American Female Engineers into Academic Careers: The Case of the Cross-Disciplinary Initiative for Minority Women Faculty,"

Cheryl B. Leggon and Gilda A. Barabino



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Award 0544823

Development

- *Motivation*: dearth of underrepresented minority faculty, lack or role models
- *Purpose*: provide opportunities for professional development, networking and collaboration
- *Outcomes:* increase number and career success of URM faculty

Award 144965

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Participation

- An engineering deans-driven vehicle to support a national network for sharing and disseminating, convening, and building partnerships toward the training and preparation of a diverse engineering workforce

Award 1724672

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Entrepreneurship

- *Motivation*: dearth of women and underrepresented minorities participating in STEM innovation and entrepreneurship
- *Purpose*: facilitate national level conversation to broaden participation from underrepresented groups in entrepreneurship
- *Format*: a venue for access to and connections between knowledgeable experts in the academy and industry, investors, and existing and aspiring innovators and entrepreneurs

FORUM ON INCLUSIVE STEM ENTREPRENEURSHIP

Award 1733679

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Thank You

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