

Mastering Stem Cells

Molecular Biologist Peggy Goodell:
Unveiling Stem Cell Genetics

Findings

Department of Health and Human Services
National Institutes of Health
National Institute of General Medical Sciences

Goodell Examines Stem Cells



Molecular biologist Goodell wants to improve health with stem cells

Stem cells

- Start out as “generic” cells
- Come in 2 varieties: embryonic and adult
- Divide indefinitely

Question:

Can all stem cells
make any kind of cell?

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Answer: No

Adult stem cells are already specialized

- **Differentiated:** Adult stem cells in skin can only make skin cells, and adult stem cells in blood can only become blood cells, for example
- **Undifferentiated:** Embryonic stem cells are blank slates that can make any kind of cell (skin, blood, or nerve, for instance)

Unlimited Potential

- Human embryonic stem cells (HESC) can make 220 different cells
- HESC can be used to
 - Study normal human cells
 - Understand the causes of birth defects
 - Test drug safety and effectiveness

Stem cell colony

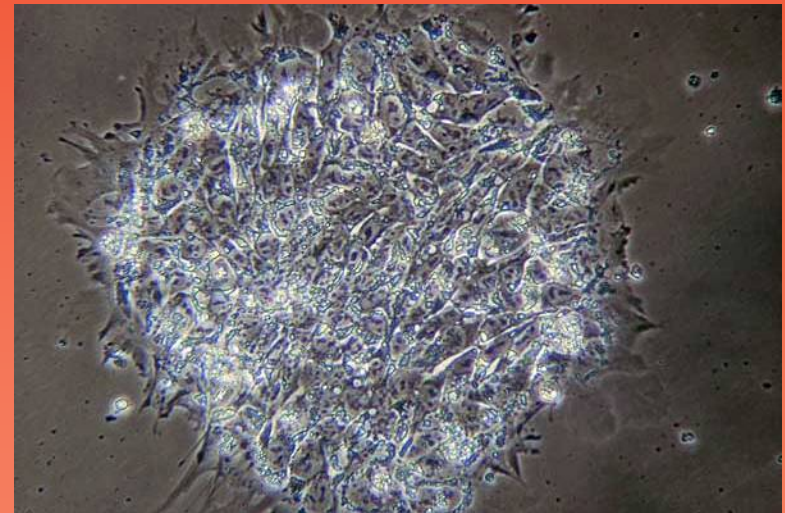


Image: Jeff Miller

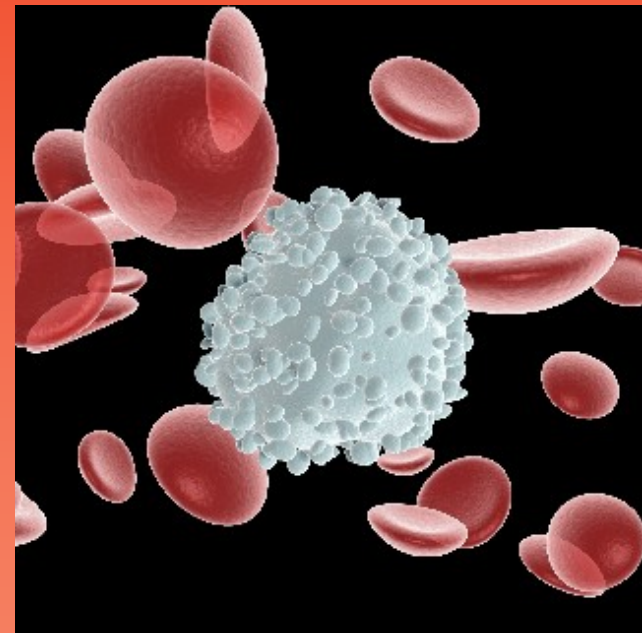
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Specialized Cells

Hematopoietic stem cells (HSC)

- Adult stem cells that manufacture all blood cells (red and white)
- Found mostly in bone marrow
- Replenish sick and dying blood cells



Addressing a Challenge

Background: Patients get bone marrow transplants (containing less than 1% HSC) to produce healthy blood cells. More HSC would make bone marrow transplants safer.

Problem: Bone marrow doesn't contain a dense concentration of HSC.

Challenge: Get HSC to make more of itself.

Mastering HSC Production

Tactic: Study how HSC divide and how they decide to differentiate

Method: Identify HSC genes and study the roles they play in each process

Adult stem cells (HSC)

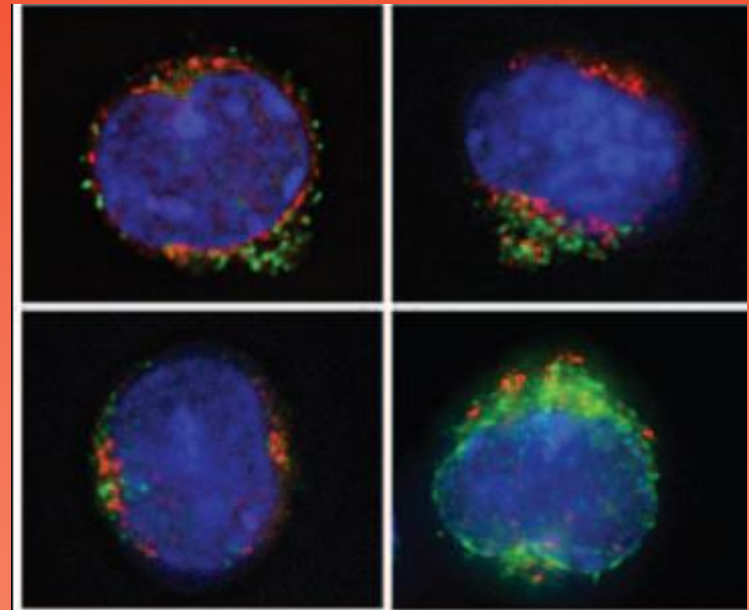


Image: Kuan Lin

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Student Researcher: Solving Pieces of the HSC Puzzle

David Weksberg

- MD/PhD student in Goodell's lab
- Studies an HSC gene with at least 2 functions
 - Helping HSC divide
 - Triggering immune response to bacteria

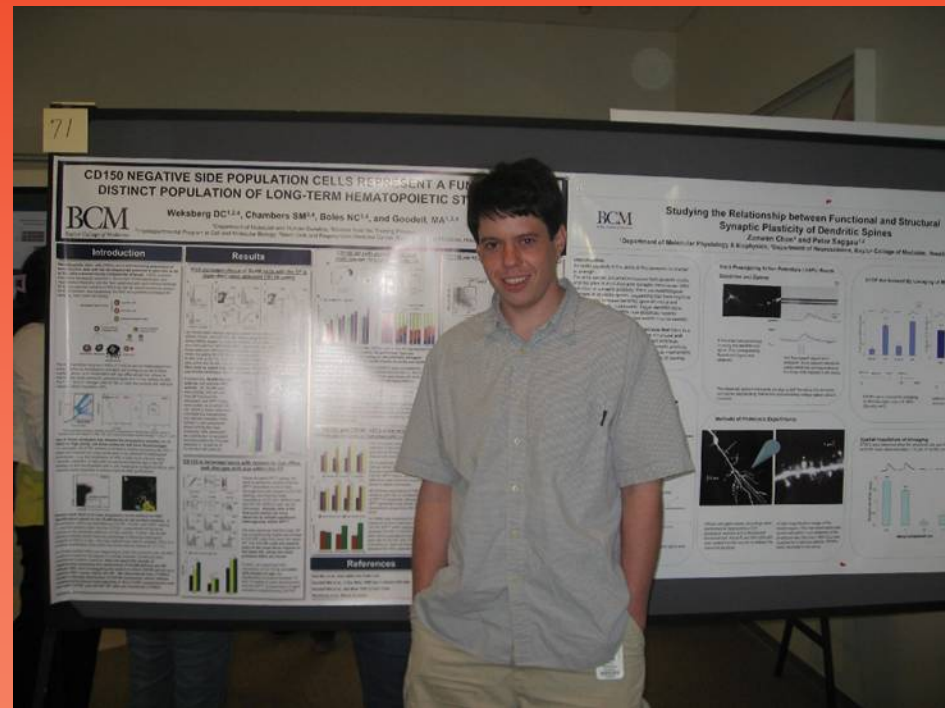


Image: Allan Weksberg

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Making Connections

Question 1: Do stem cells (HSC) grow old?

Experiment: Transplant mice with HSC from young or old relatives.

Result: Aged HSCs made fewer new blood cells.

Question 2: Could improving the function of aged HSC improve health?

Making Connections

Discovery: Stem cells and cancer cells have similar patterns of gene activity.

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graph TD; A[Discovery: Stem cells and cancer cells have similar patterns of gene activity.] --> B[Implication 1: The similar patterns may explain why stem cells and cancer cells can divide endlessly.]; A --> C[Implication 2: Understanding the genes that control stem cell growth could lead to being able to stop cancer growth.];
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Implication 1: The similar patterns may explain why stem cells and cancer cells can divide endlessly.

Implication 2: Understanding the genes that control stem cell growth could lead to being able to stop cancer growth.

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Research Applications

What are some of the possible medical outcomes of stem cell research?

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