

# Genetics: A Novel Method for Teaching Gene Expression

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THE LAWRENCE  
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# Science and Global Issues: Biology

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# Science Education for Public Understanding Program

- Science curriculum design and professional development
- Based at the Lawrence Hall of Science, University of California at Berkeley
- Designing science curriculum, working with teachers, and supporting quality science instruction since 1983
- Major funding for curriculum work from the National Science Foundation



# Science and Global Issues (SGI)

- NSF curriculum development project
- Uses sustainability as the unifying context for studying important biological concepts
- Inquiry-based, issue-oriented science...
  - Students talk, think, and discuss content as it relates to personal, societal, and global issues
  - Students learn to use evidence in the decision-making process
- Embedded assessments and literacy strategies
- Research-based and extensively field tested

# Science and Global Issues: Biology

Unit	Content focus	Sustainability focus
Sustainability	Interdisciplinary	Sustainability from a personal, community and global perspective
Living on Earth	Ecology	Human influence on ecosystems
World Health	Cell Biology	Global health issues
Feeding the World	Genetics	Use of genetically modified organisms
Maintaining Diversity	Evolution	Changes in and threats to biodiversity

# Sustainability

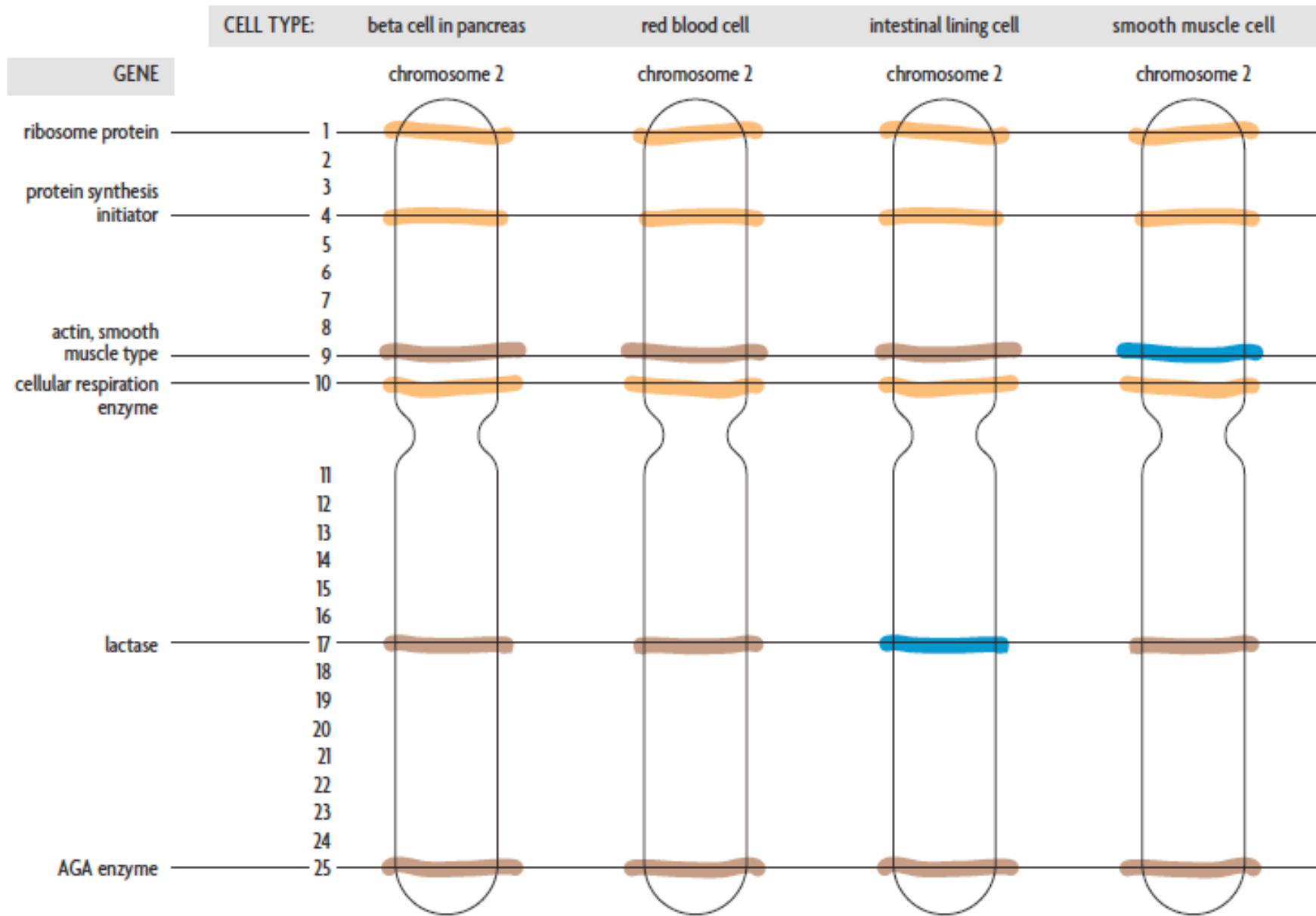
- In the context of human development:
  - Meeting the needs of the present without compromising the ability of future generations to meet their own needs
- Examined through three perspectives:
  - Environmental, economic, and social
- Considered on three levels:
  - Personal, community, and global

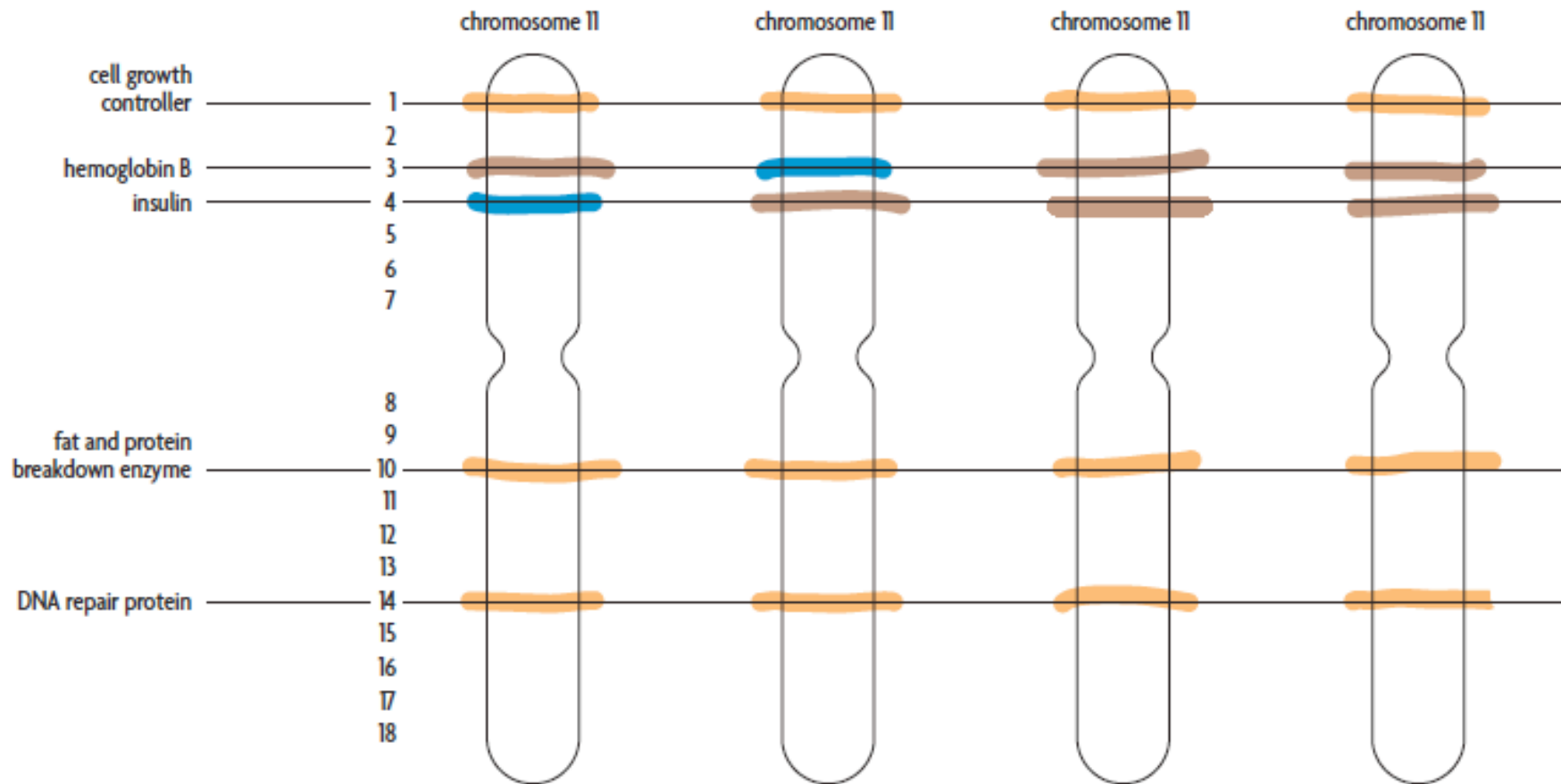
# Activity: Cell Differentiation and Gene Expression

- Occurs late in the unit (17)
- Students have basic understanding of major genetic concepts
- Students comfortable with 4-2-1 model and literacy strategies
- Several case studies already covered

# Activity: Cell Differentiation and Gene Expression

- Read Introduction
- Part A: Work in groups of four





# Activity: Cell Differentiation and Gene Expression

- Part B: Complete Procedure steps 8-16
- Part C: Read Procedure steps 17-20, skim case study - “Terminator Technology”

# Read, Think, and Take Note

## Read, Think, and Take Note: Guidelines

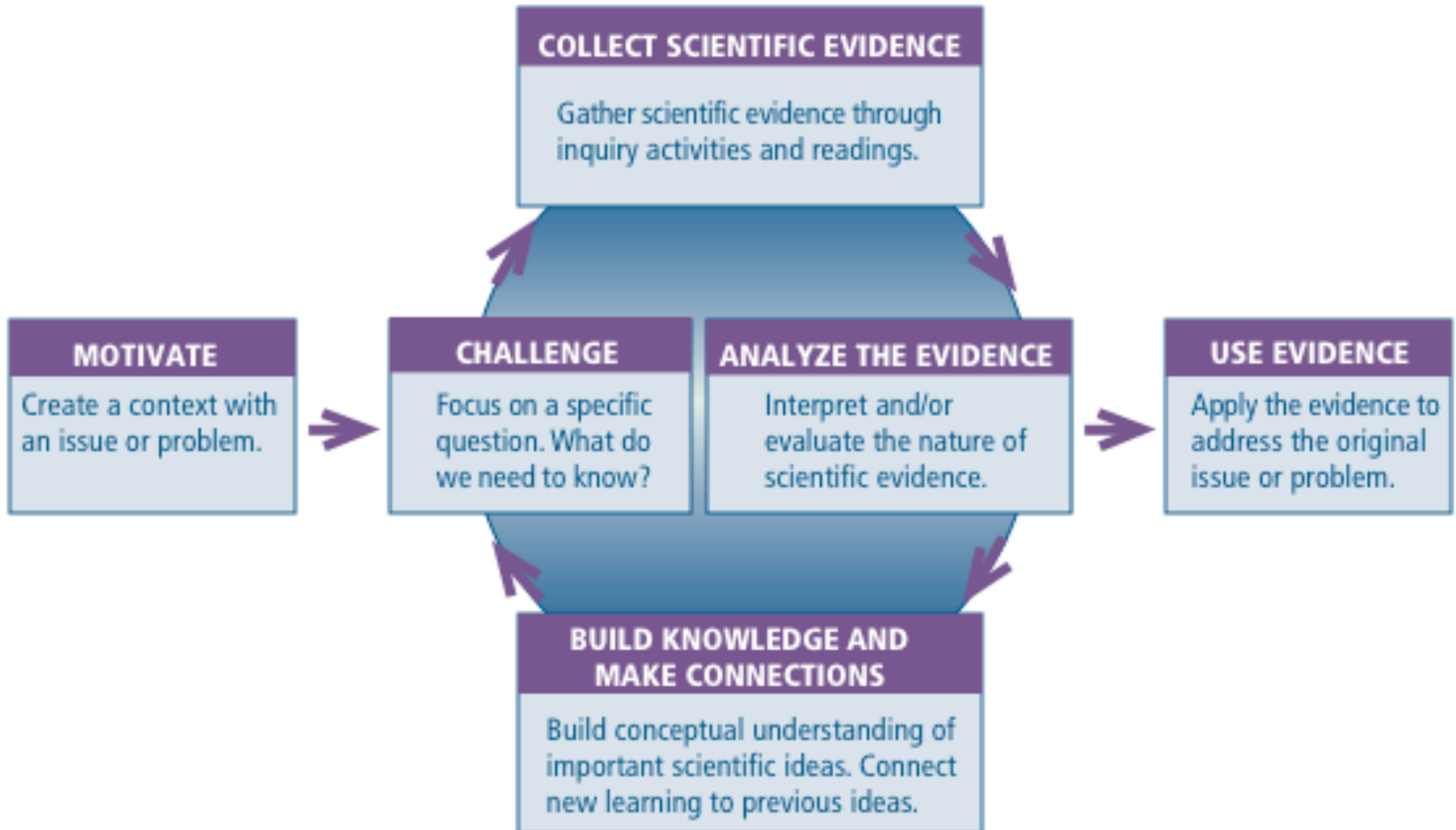
As you read, from time to time, write one of the following on a sticky note:

- Explain a thought or reaction to something you read.
- Note something in the reading that is confusing or unfamiliar.
- List a word that you do not know.
- Describe a connection to something you learned or read previously.
- Make a statement about the reading.
- Pose a question about the reading.
- Draw a diagram or picture of an idea or connection.

# Genetics Topics

- Basic genetic concepts
  - Genotype and phenotype
  - Punnett squares
  - Mono- and dihybrid crosses
  - Genes, alleles, chromosomes & DNA
- Mendel's work
- Mechanisms of inheritance
- Selective breeding
- Mitosis and meiosis
- Genetic modification
- Gene expression
- DNA structure & replication
- Protein synthesis

# SEPUP: Instructional Model for Issue-oriented Science



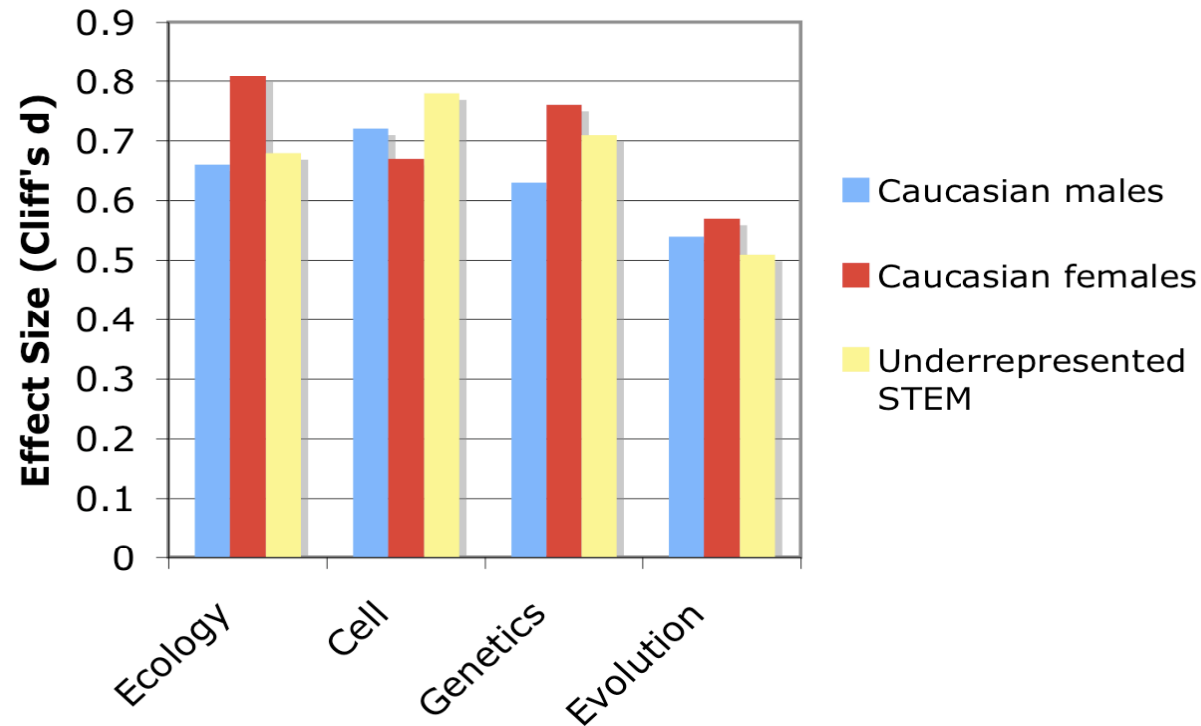
# Why Issue-oriented Science?

- Integrates sciences & science with other subjects
- Realistic view of how science contributes to solving problems and the role of science in careers
- Real-world connections
- Use of science in daily life
- More authentic science, for ALL students
- Helps students learn science
- Improves student attitudes toward science

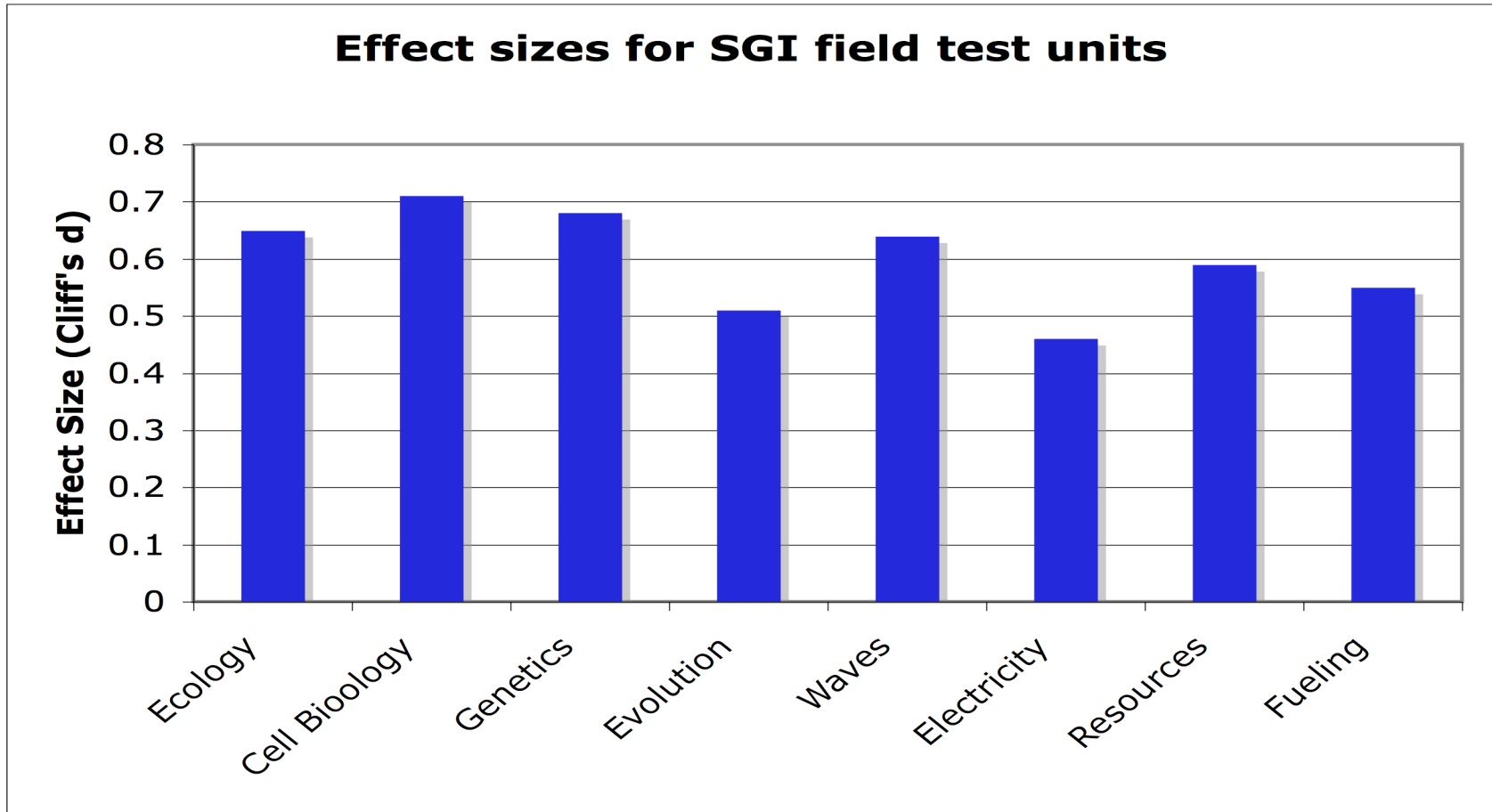
# Development Process

- Iterative process of development, testing, expert review, evaluation, and revision developed and refined over 22 years of NSF funding
- Develop learning outcomes, assessments, and rough activities; pilot locally
- Refine activities and field-test nationwide; teachers receive PD; 1-2 cycles per unit
- Evaluate
  - Internal evaluation of usability for T and S
  - External evaluation of learning outcomes and pedagogy
  - External evaluation of scientific content

### SGI: Biology Field Test Effect Sizes



Small effect size Cliffs  $d = 0.147$ ; medium effect size Cliffs  $d = 0.330$ ; large effect size Cliffs  $d = 0.474$  (Cliff, 1993; Romano et al, 2006).



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# SGI Addresses 21<sup>st</sup> Century Skills

- Digital-age Literacy
  - Scientific and informational literacy
- Inventive Thinking
  - Higher-order thinking, sound reasoning
- Effective Communication
  - Team work and collaboration
  - Personal, social, and civic responsibility
- High Productivity
  - Effective use of real-world tools
  - Ability to produce

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