

# Ecology: Interdependence and Interactions in Dynamic Ecosystems

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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



**Lab-aids**  
INCORPORATED

EXPERIENCING SCIENCE

# Lab-Aids, Inc.

- Publishes and supports the use of SEPUP materials in classrooms across the United States
- Publishing quality science curricular materials, providing curricular support since 1963
- Based in Ronkonkoma, New York

# 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: Energy Flow Through an Ecosystem

- Occurs mid-unit (7 out of 19)
- Students have basic understanding of ecosystems, producers & consumers
- Students comfortable with 4-2-1 model and literacy strategies
- Addresses TEKS 12 a, c, d, f

Fox

Acorns

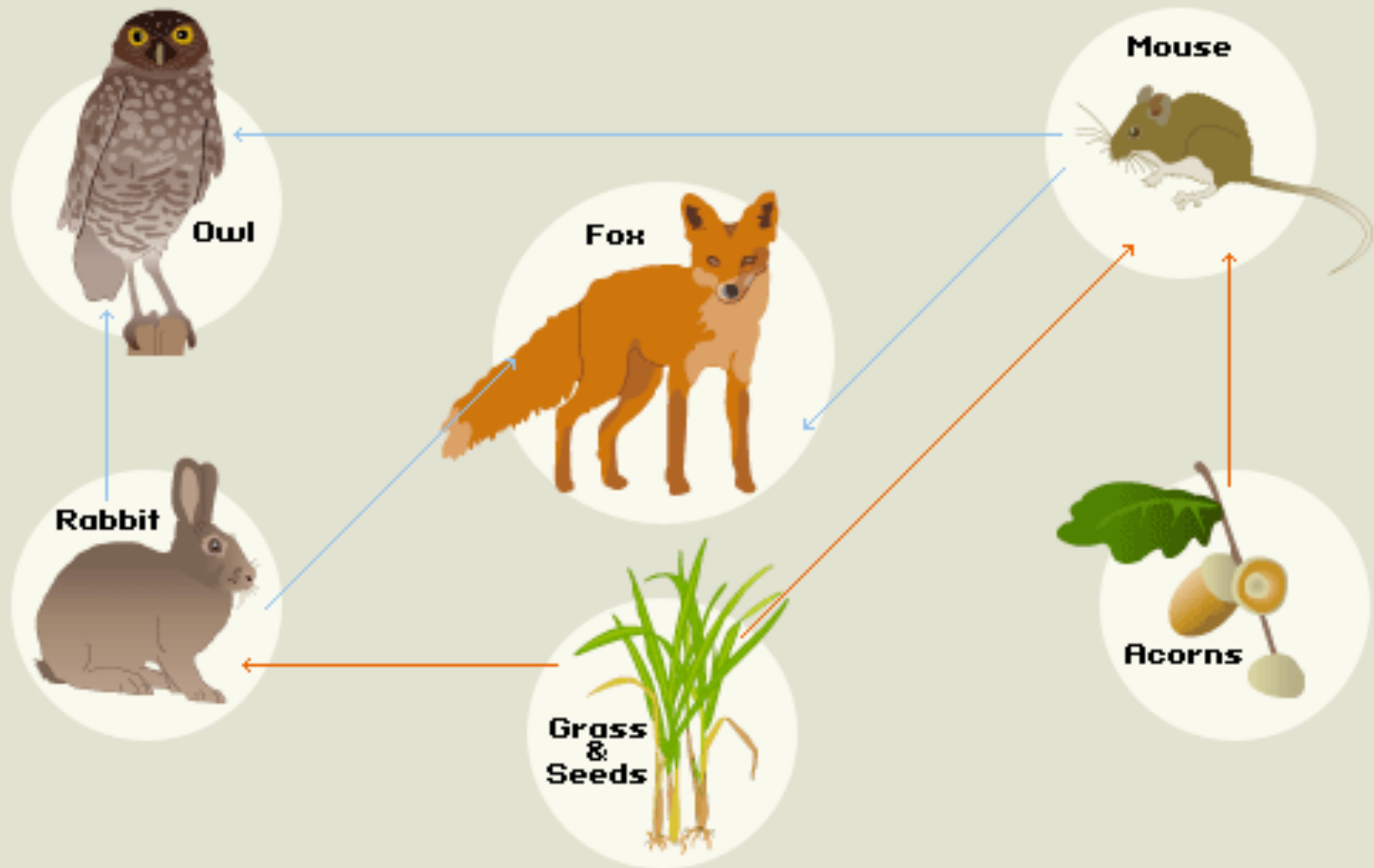
Grass

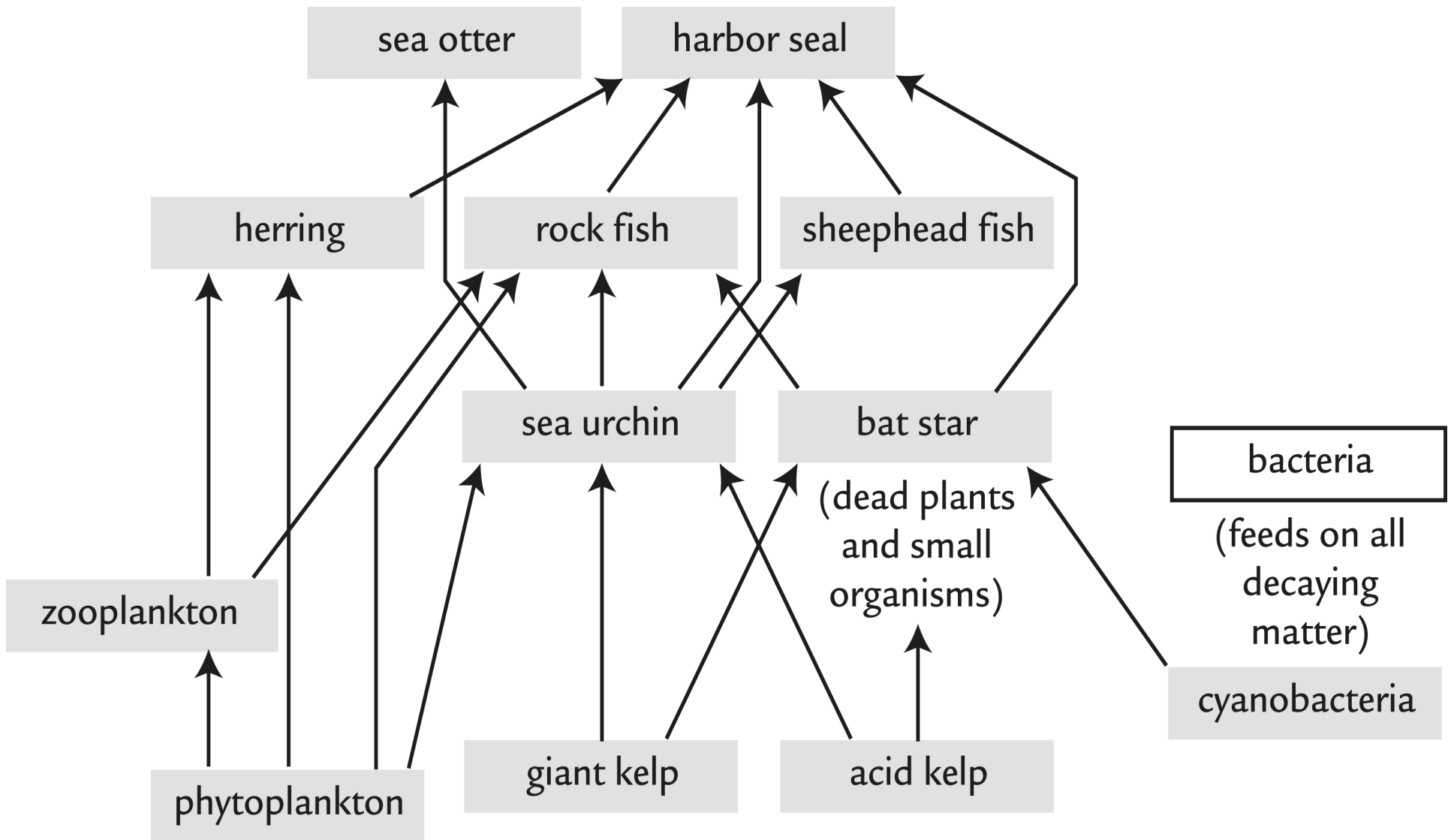
Mouse

Owl

Rabbit

## A food web

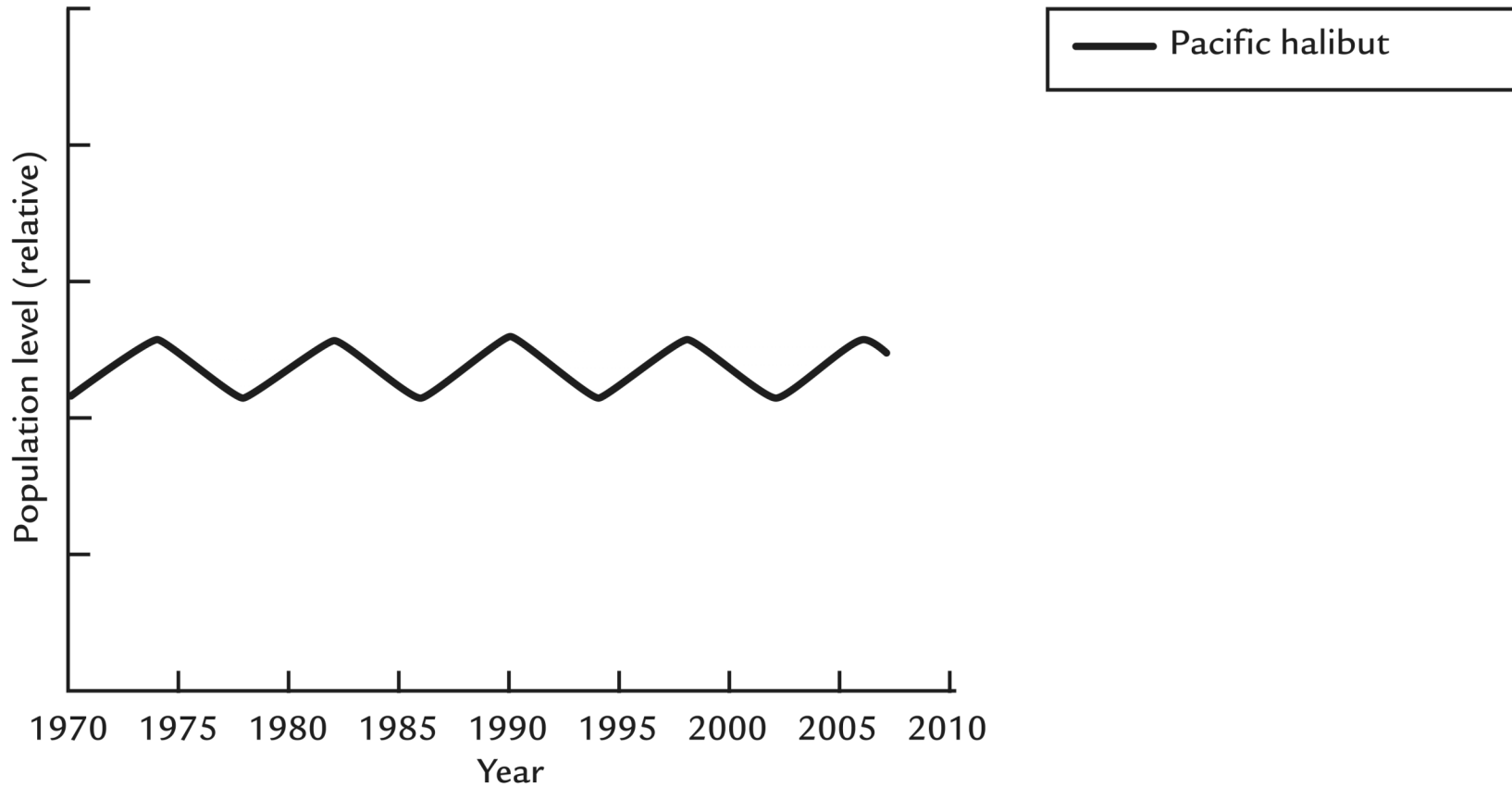




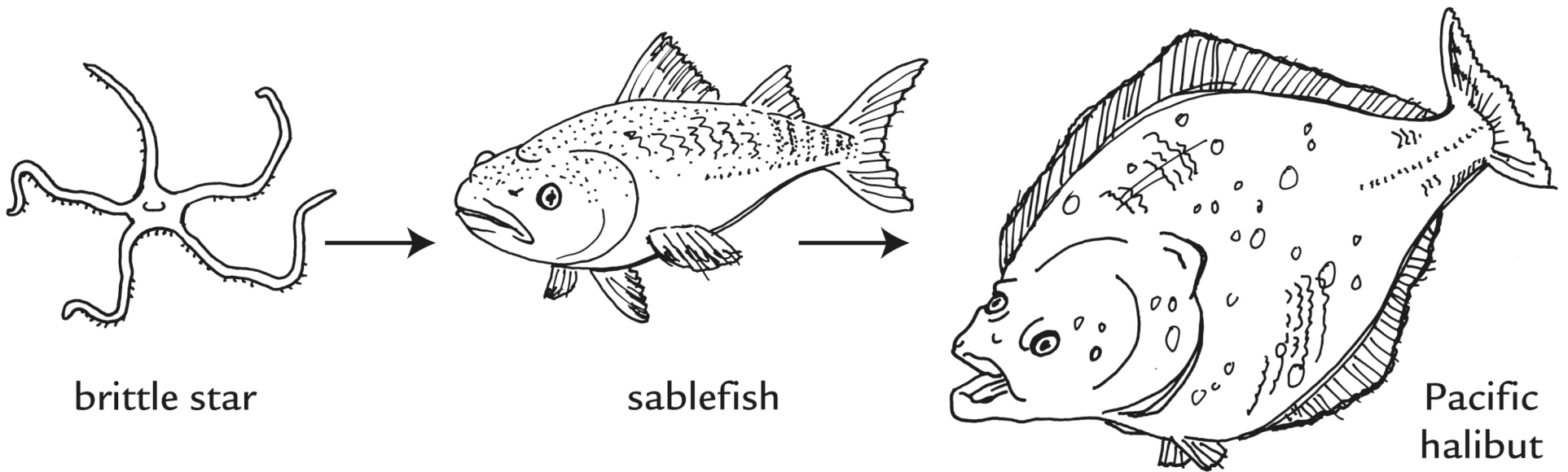
# Activity: Ecosystems Out of Balance

- Occurs near end of unit (16 out of 19)
- Students have developed understanding of:
  - Basic ecosystem dynamics
  - Photosynthesis & cellular respiration
  - Cycling of nutrients
  - Population dynamics

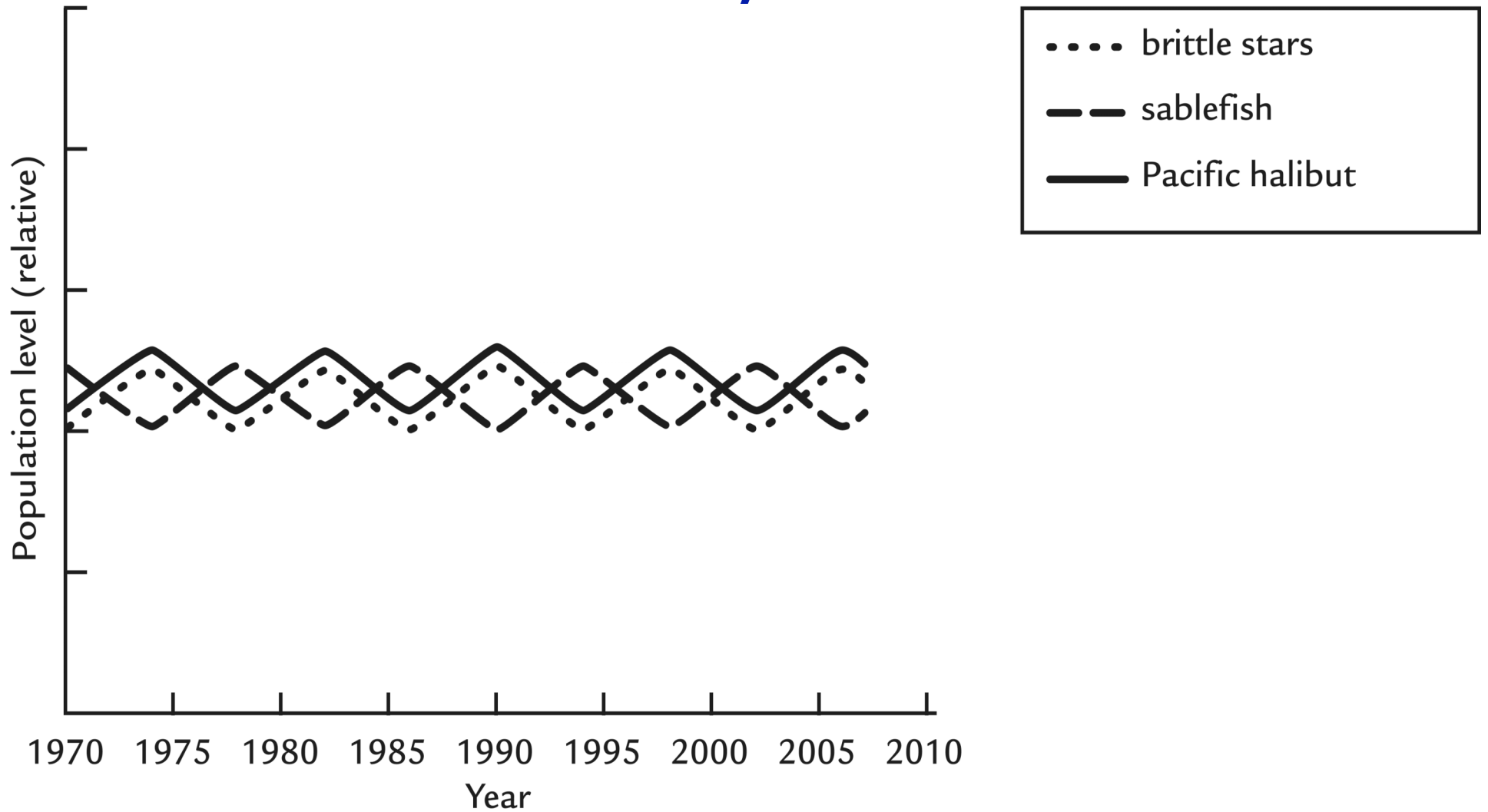
# Pacific Halibut Population



# Pacific Halibut Food Chain



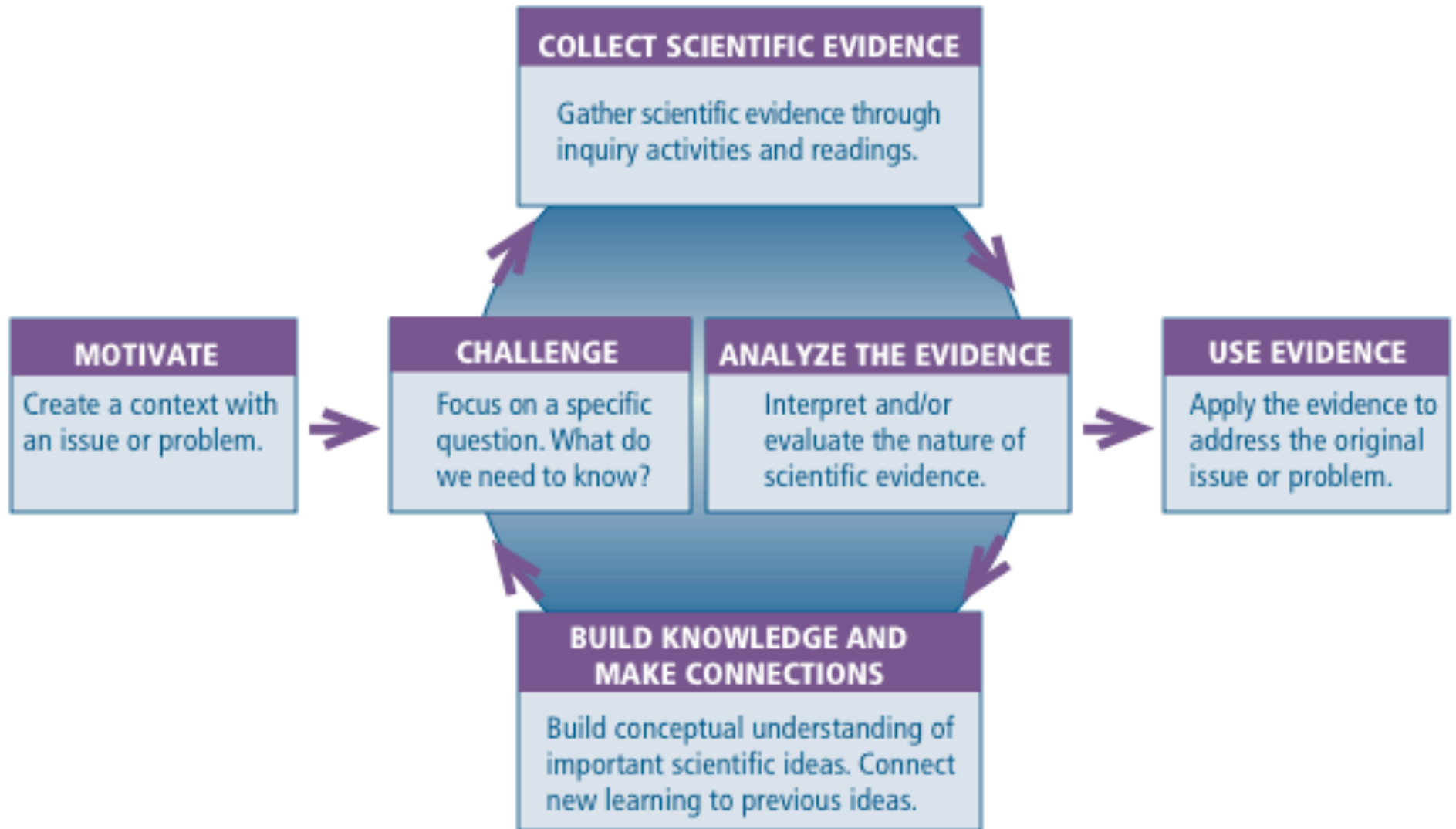
# Pacific-halibut Dominated Ecosystem



# Ecology Topics

- Biomes
- Ecosystems
- Invasive species
- Human & natural impacts on ecosystems
- Ecosystem disturbance, resistance & resilience
- Population dynamics, carrying capacity, limiting factors
- Food webs, energy pyramids, trophic roles
- Eutrophication
- Carbon and nitrogen cycles
- Photosynthesis & cellular respiration
- Symbiotic and predator-prey relationships

# SEPUP: Instructional Model for Issue-oriented Science



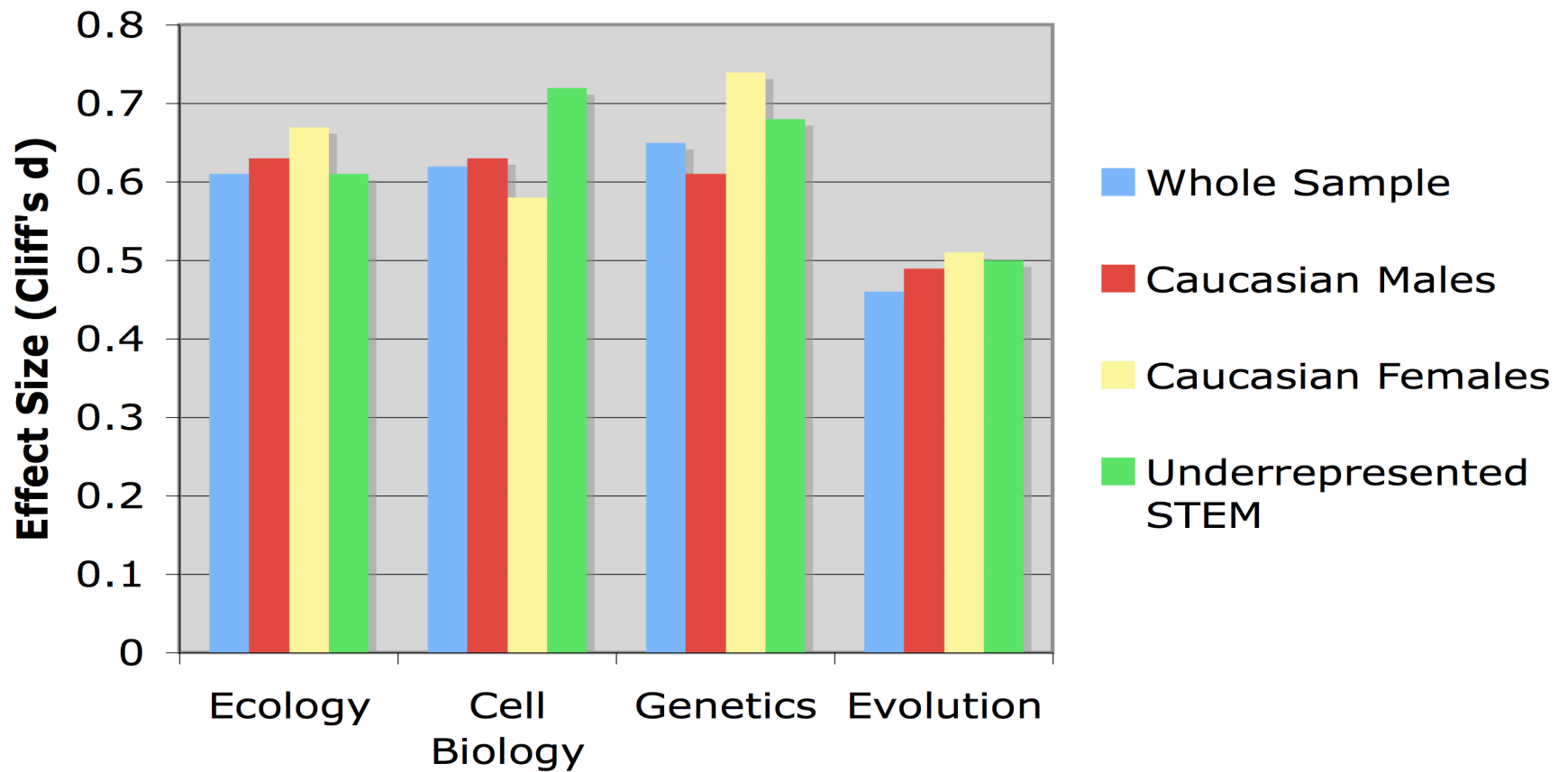
# Why Issue-oriented Science?

- 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 Pre-Post 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).

# SGL 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

# Science and Global Issues: Biology

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