SOME BASIC CONSIDERATIONS ABOUT MODERN BIOLOGY

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1. Biology focuses on organisms, including subcomponents and interactions with the natural world.

   A. Includes a body of knowledge (both written and unwritten), as well as a process of discovery involving research.

   B. Biological knowledge is dynamic; it changes as new discoveries are made through research and fortuitous observation. Often, old concepts are shown to be wrong and are discarded.

   C. Biology interacts with other sciences.

2. Biology is often divided into different subdisciplines

   A. Generally view two major areas within biology

      1. Organismal Biology - taxonomy, morphology, ecology, organismal physiology, Mendelian genetics

      2. Cellular / Molecular biology - molecular biology, molecular genetics, cell biology

   B. Thanks to advances in molecular genetics in the 1970s, much attention has been paid to cell / molecular biology.

   C. Led to shifts in funding, hiring, curricula.

   D. A synthesis between the two fields is emerging in past several years.

MORE BASIC CONSIDERATIONS ABOUT MODERN BIOLOGY

3. Compelling reasons for people to learn about biology.

   A. To gain more enjoyment of the natural world

   B. To help us learn more about ourselves

   C. To help us make money (as a career)

   D. Biology is in the news

4. Our economy is increasingly based on biology, especially through advances in genetic engineering and novel uses of organisms.

5. Natural ecosystems have value in form of ecosystem services.

   A. natural air and water filtration

   B. prevent soil erosion

   C. help regulate climate (carbon sequestration)

   D. sources of natural products

MORE BASIC CONSIDERATIONS ABOUT MODERN BIOLOGY

6. Natural ecosystems are storehouses of biodiversity – four components.

   A. Taxonomic diversity

   B. Phylogenetic diversity

   C. Genetic diversity

   D. Interaction diversity

7. Natural ecosystems face peril. Problems include

   A. species extinctions

   B. global changes in climate

   C. introduction of exotic, invasive species that threaten existing ecosystems

   D. loss of sustainability and biocomplexity.

      1. Definition for sustainability

      2. Definition for biocomplexity

         a. Human component

         b. Non-linearities

MORE BASIC CONSIDERATIONS ABOUT MODERN BIOLOGY

8. Renewed interest in biological collections

   A. Centerpiece of biology for centuries

   B. Collections help us understand biodiversity, educate public

   C. Collections associated with museums, educational institutions. Some private

   D. Collections became passé in last 50 years.

   E. Now being digitized, records help us understand biodiversity patterns, especially changes.

9. Biology has a public policy dimension.

   A. Government support of research

      1. Before World War II

      2. Role of Vannevar Bush

      3. Investigator-initiated research

      4. Concerns with investigator-initiated research.

      5. Proposed cutbacks in governmental funding.

      6. Congress and general public.

      7. Directed research.

      8. Tension between investigator-initiated vs. directed research

MORE BASIC CONSIDERATIONS ABOUT MODERN BIOLOGY

9. Biology has a public policy dimension. (cont.)

B. Legislation deals with biological issues

1. Conservation of biological diversity

2. Stem cell research

3. Drugs, alcohol and tobacco

C. Ethics plays a major role in biology

1. Use of animals in research

2. Use of stem cells from fetal tissue

3. Controls in clinical research

4. Human cloning now a reality

5. NIMBYism as a viable conservation strategy

MORE BASIC CONSIDERATIONS ABOUT MODERN BIOLOGY

9. Biology has a public policy dimension. (cont.)

   D. Public education in biology is undergoing scrutiny.

      1. Do we teach content or process of discovery?

      2. Relate to Bloom's taxonomy

      3. Should we teach controversial concepts like human sexuality, evolution, AIDS, and conservation biology?

   E. Public engagement in science issues

      1. Cloning, vaccines, chemtrails, GMOs, flat earth

      2. Information easy to get online, unfiltered

      3. Are we living in a post-truth society?

10. Like other sciences, biology can be approached from different perspectives

   A. <u>Basic biology</u> emphasizes knowledge for its own sake

   B. <u>Applied biology</u> emphasizes knowledge to help mankind

   C. Researchers often focus on one of the two approaches

   D. Leads to tension between two

   E. Both are important and often feed one another

MORE BASIC CONSIDERATIONS ABOUT MODERN BIOLOGY

11. Computers are revolutionizing biology, affect the way that we gain, store, manipulate, and transmit information. Particularly important innovations include:

A. Powerful computers (servers, desktops, laptops, tablets, handhelds)

B. Input and output devices (digital cameras and scanners, sound recorders, projectors, smart-boards, printers, iPods, iPads)

C. Cheap storage (high-capacity hard drives, Flash-media, Cloud-based computing)

D. Software for manipulating and analyzing text, data, images, and sounds. Apps rapidly evolving – permit field IDs, crowd sourcing.

E. Sophisticated mapping hardware and software (GIS, GPS, GoogleEarth)

F. Electronic communication (e-mail, social media, podcasts, Skype)

G. Electronic publishing and bibliographic searching

H. Seeing convergence and integration

I. Enhanced communication and portability allowing citizen science and crowd sourcing

MORE BASIC CONSIDERATIONS ABOUT MODERN BIOLOGY

11. Computers are revolutionizing biology (cont.)

J. Bioinformatics

1. Involves digitization, exchange, and analysis of biological data.

2. Well established in cell / molecular biology.

3. Increasingly important in organismal biology – biodiversity and ecology.

4, Data-mining and meta-analyses will be important activities in biology.

5. QA/ QC also important