uBEATS Teacher's Guide:

Reproduction and Fertilization

(Grades 6-8)

This teacher guide is a supplementary text to support the use of the uBEATS "Reproduction and Fertilization" module for grades 6-8.

To help students develop the knowledge necessary for an incredible future in health care, we created UNMC Building Excellence in Academics Through STEM (uBEATS), an online health science resource for Nebraska students.

UNMC uBEATS modules are short (15 minutes or less), interactive online health science modules to supplement curriculum taught in grades 6 – 12. These do not replace curriculum but are a supplement for teachers and students incorporating evidence-based information and UNMC expert guided material. Each module is chunked into sections with formative and summative assessments with immediate feedback provided.

Tips on how to utilize uBEATS modules:

- Internet access is required to view uBEATS modules.
- For those who have access to one-to-one technology, modules can be used in or outside of the classroom as a topic introduction, extension, or review.
- For classrooms without individual student devices modules can be used in whole group instruction. Formative assessment questions can use the teacher's preferred call and response method and summative assessment questions can be displayed on the board and answered individually by students or printed and distributed to students after viewing the module.

Objectives

- Explain the differences between sexual and asexual reproduction.
- Distinguish between internal and external fertilization.
- Describe why an organism does not continue to grow throughout its life.

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Introduction

How do organisms grow and develop?

Organisms grow and reproduce constantly around us. All organisms reproduce using some method. After an organism is born, its development depends on several factors.

Let's explore the world of growth and development.

Prior Knowledge

Before beginning this module, the student should understand the Grade Band Endpoints for LS1.B. A Framework for K-12 Science Education

- ***By the end of grade 2*.** Plants and animals have predictable characteristics at different stages of development. Plants and animals grow and change. Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.
- ***By the end of grade 5***. Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles that include being born (sprouting in plants), growing, developing into adults, reproducing, and eventually dying.

Key Terms/Vocabulary

Organism, sexual reproduction, asexual reproduction, internal fertilization, external fertilization, genetic code, parent, offspring, parthenogenesis, budding, binary fission, fragmentation, daughter cell, gamete, egg cell, sperm cell, zygote, embryo, oviparity, ovoviviparity, viviparity, nutrients, yolk, placenta, spawning, dehydration, genetic diversity, predators, survival rate, template, parameters, environmental factors.

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Science Standards

Nebraska's College and Career Ready Standards for Science 2017 Nebraska Science Standards

Growth, Development, and Reproduction of Organisms: SC.6.9.3.A, 6.9.3.B, 6.9.3.C

Next Generation Science Standards (NGSS) featuring Three-Dimensional Learning

Core Idea LS1.B Growth and Development of Organisms A Framework for K-12 Science Education

- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.
- Animals engage in characteristic behaviors that increase the odds of reproduction.
- The growth of an animal is controlled by genetic factors, food intake, and interactions with other organisms, and each species has a typical adult size range.

Science and Engineering Practices NGSS

- Developing and using models
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Crosscutting Concepts NGSS

- Cause and effect
- Structure and function

Extensions of the lesson

- To help students become more familiar with the Key Terms of this module, the teacher can use the vocabulary list for a classroom Word Wall or integrate the vocabulary into classroom word games during review sessions.
- The teacher may need to address student misconceptions about these important concepts:
    - The difference between sexual and asexual reproduction is **not** about where the fertilization takes place. The difference is whether there are two parents or one.
    - In this module, the term "fertilization" does **not** refer to chemicals added to plants to enhance growth. In this module, the term "fertilization" means the union of two gametes (an egg and a sperm) to produce a zygote having a full set of chromosomes.
    - Regarding the two concepts above, some students have a difficult time separating the terms. They might incorrectly think that "sexual reproduction" is "internal fertilization", or that "asexual reproduction" is "external fertilization."

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- In-vitro fertilization is an example of sexual reproduction that involves external fertilization.
- Plants can reproduce sexually or asexually. When a plant such as an apple reproduces sexually, it uses internal fertilization through which the egg and sperm join inside the female body.
- Egg cells and sperm cells are microscopic living cells and must be protected from drying out. For that reason, most external fertilization occurs in water environments. On the other hand, internal fertilization involves transfer of sperm cells from one location to another, requiring special protection from dehydration during the process. This protection can be in the form of pollen capsules or bodily fluids that surround the sperm cell.
- Once fertilization has occurred, there are two ways the developing embryo can be fed its needed nutrients: yolk or placenta. Placental organisms keep the developing offspring inside the female body, keeping it moist and feeding it internally through blood vessels. On the other hand, some organisms pack all of the needed nutrients into a yolk sac and then surround the yolk and embryo with a shell. The shell protects the embryo from the environment while the embryo gets all its nutrients from the yolk inside the shell with it.
- When an eggshell surrounds the yolk and embryo, some organisms (such as birds) release those eggs out of the body (oviparity). On the other hand, some organisms keep the eggs inside the body (ovoviviparity) until the eggs hatch, so the female releases fully developed babies.
- An example of an organism that uses ovoviviparity is the human Guinea worm. These parasitic nematodes enter the human digestive system as larvae which mature inside a person. The adult worms then use internal fertilization to create new zygotes. After this, the male worm dies but the female lives on and protects the developing embryos inside her own body. Each embryo gets a yolk sac and protective shell, but they remain inside the mother's body until she breaks out through the human's skin so she can release the fully developed larvae into the outside environment.
- Another example of ovoviviparity is the slowworm. This organism is not a worm at all—it is a legless lizard that looks like a worm. After internal fertilization, the mother does not lay the eggs outside but keeps them inside until they hatch. When she releases them, it looks like live birth (viviparity).
- After an embryo is fully developed and is no longer connected to a yolk or placenta, its growth and development depends on the limits placed on it by its own DNA, but also depends on availability of proper conditions in the environment.

Enrichment

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- For information about career opportunities, see UNMC's Careers in Healthcare.
- To make connections in your community, contact local hospitals, healthcare clinics, zoo, nurses, doctors, veterinarians.
- Encourage students to follow current events involving in-vitro fertilization.
- An example of a classroom activity on growth and development could be an embryology study in which chicken eggs are incubated and hatched in the classroom.

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