

Unit 5 | Comparative Reproduction

Living Environment

18-25 days



Reproduction and development are necessary for the continuation of any species, and as such all species have unique but related strategies for reproduction. In this unit, students learn about continuity and diversity of life in a variety of organisms, including humans, and use their findings to discern evolutionary relationships. Exploring print texts, visuals, and hands-on experiences, students compare the mechanisms through which different living things reproduce, with a focus on comparisons to human reproduction.

Why do organisms have different types of reproductive strategies? How can comparing reproductive strategies provide us with evidence for the evolution of all life? How are humans uniquely suited for the reproductive demands of our species?

UNIT STORYLINE SNAPSHOT



Anchor Phenomenon: Comparative Reproduction as Evidence for Evolution

How can comparing reproductive structure and function provide us with evidence for the evolution of all life?

Performance Task: Cladograms



Meiosis

5E Instructional Model Plan

How are eggs across species both similar and different?



Gamete Production & Fertilization

5E Instructional Model Plan

How do organisms fertilize gametes in different environments?



[ons License](#)



Comparative Embryology

5E Instructional Model Plan

Why are there similarities and differences between embryos?



Comparing Sexual and Asexual

Reproduction

5E Instructional Model Plan

Why do some organisms reproduce asexually and others sexually?

PLANNING RESOURCES

[Knowledge and Enduring Understandings](#)

[Storyline and Pacing Guide](#)

[Common Core Standards](#)

[NY State Regents Exam Readiness](#)

[NY State Science Standards](#)

[Unit Vocabulary](#)

KNOWLEDGE AND ENDURING UNDERSTANDINGS

Knowledge: (Students will know. . .)

Enduring Understandings



ons License

High priority content - required

- Mitosis and cell division/replication
- Factors affecting reproduction and development
- Asexual and sexual reproduction
- Human adaptations and comparison to other species (asexual vs. sexual reproduction)

(Std. 4, Key Idea 3, PI 3.1, Key Idea 4 - PI 4.1)

Mid-priority content - recommended

- Genetics of asexual vs. sexual reproduction (Std. 4, Key Idea 2, PI 2.1)

- Cells make copies of their DNA and divide during growth, repair, and reproduction
- In sexual reproduction, organisms produce sex cells that contain half of the genetic information of the parent cell
- The development and health of a fetus is impacted by a variety of factors
- Organisms are both similar and different to one another, providing evidence of both common descent and adaptation environmental conditions

◆ Storyline and Pacing Guide

| | Time | Teacher Resource | Driving Questions | What students figure out <i>Ideas that contribute to student thinking about the anchor phenomenon and performance task</i> |
|---|--------|----------------------|--|---|
|  Launch Anchor Phenomenon | 1 Days | Link | <i>Why are there similarities and differences in the way that organisms reproduce?</i> <i>How can we use comparative reproduction as evidence for common descent and evolution?</i> | <ul style="list-style-type: none">● Reproduction is a process of all living organisms● There are some commonalities in reproduction (strategies, structures) across all living things● There are also a great diversity of reproductive strategies and structures |
|  Introduce Performance Task | 1 Day | Link | <i>How can we visually represent evolutionary relationships?</i> | <ul style="list-style-type: none">● Cladograms are diagrams that can be used to represent evolutionary relationships |



Meiosis **5-8 Days** [5E Plan](#)

How can we compare the structure and function of eggs across species?

Why are there both similarities and differences between eggs of different species?

How do environmental conditions impact egg development?

Why do sexually reproducing organisms generate eggs (ova) that have half the chromosome number of their body cells?

How can we compare gametes (ova and sperm)?

- There are startling similarities between the eggs of very different species (this may be due to common ancestry).
- There are some differences between eggs of different species (this may be due to natural selection / evolution).
- All gametes have half the chromosome number of body cells
- The process of meiosis occurs in all sexually reproducing organisms and produces haploid gametes
- The process of meiosis increases the genetic diversity of offspring (through recombination and allowing for fertilization)
- Environmental conditions, such as salinity, impact the hatching success of eggs. This may be due to a variety of factors, including optimum conditions for enzyme function.
- Ova and sperm have a different structure, which relates to their function in sexual reproduction





Gamete Production & Fertilization

5-8 Days

[5E Plan](#)

How can we compare sexual reproduction across species?

How do different structures of the reproductive system work together to generate offspring?

Why are offspring both similar to, and different from, their parents?

How can we use evidence of common reproductive structures to inform decisions on the Cladogram task?

- Plants, and other sexually reproducing organisms, have similar structures for generating gametes and for the process of fertilization
- In humans, there are several important reproductive structures including the gonads, fallopian tube, and uterus
- Fertilization is the joining of two haploid gametes (egg and sperm)
- At fertilization, a zygote is formed that contains genetic information from both parents
- The female reproductive cycle is an example of a feedback loop, that utilizes hormones, such as estrogen.
- The primary hormone involved in the male reproductive system is testosterone



Return to the performance task and engage students in revising their initial response to the cladogram task and their reasoning, based on the new evidence and ideas generated in the Meiosis and Gamete Production & Fertilization instructional sequences.

Revisit the **Unit Driving Question Board** - are there questions that have been addressed in these instructional sequences? -- have new questions been brought to the forefront?



[ons License](#)



Comparative Embryology

5-8 Days

[5E Plan](#)

How can we compare embryonic development across species?

Why are there so many similarities between the developing embryos of vertebrates?

How do embryos develop overtime? What types of things can impact their development?

How does the female reproductive system protect and nourish developing embryos?

- There are startling similarities between the embryos of very different species (this may be due to common ancestry).
- There are some differences between embryos of different species (this may be due to natural selection / evolution).
- Embryos across species develop in a similar manner
- After a certain point, embryos are considered fetus
- Human embryos / fetuses develop within the uterus - several female reproductive structures work together to protect and nourish the developing fetus
- The placenta serves as the site of gas, nutrient, and waste exchange between the mother and the fetus
- The uterus, amniotic fluid, and placenta work together to protect & nourish a fetus
- Environmental toxins, pathogens, and other substances may threaten a developing fetus



Return to the performance task and engage students in revising their initial response to the cladogram task and their reasoning, based on the new evidence and ideas generated in the Comparative Embryology instructional sequence.

Revisit the **Unit Driving Question Board** - are there questions that have been addressed in these instructional sequences? -- have new questions been brought to the forefront?



[ons License](#)



Comparing Sexual & Asexual Reproduction

4-6 Days

[5E Plan](#)

Why do organisms reproduce sexually? Asexually?

How does the environment impact reproductive strategies

How can we compare the role mitosis and meiosis play in reproduction and development?

- There are advantages and disadvantages to each type of reproduction
- Sexual reproduction increases genetic variation, which may be especially advantageous in unstable or challenging environments
- Sexual reproduction may have some relative disadvantages in that it may require more energy, time, and resources by the parents
- Asexual reproduction may be advantageous in more stable environments and may require less input of energy, time and resources from the parents
- In sexual reproduction the sequence of events is: meiosis, fertilization, mitosis (and differentiation)
- Asexual reproduction only involves mitosis

- Some similarities in reproduction and embryology may be due to common ancestry
- Some differences in reproduction may be due to adaptation and natural selection
- A cladogram can be used to represent the evolutionary relationships between organisms



Complete Culminating Task

1 Day

[Link](#)

Why are there similarities and differences in the way that organisms reproduce?

How can we use comparative reproduction as evidence for common descent and evolution?

How can we visually represent evolutionary relationships?



[ons License](#)

◆ NY State Regents Exam Readiness

| Regents Topics (from 1996 standards) | Historical Coverage (over the last 5 administrations of LE Regents) ¹ | More Details <i>How is this addressed in the unit?</i> |
|---|---|---|
| Evolution | 10% | This unit builds on the concepts of macroevolution and natural selection that have been introduced in Units 1 and 3. In comparing reproductive structure and function across species, students are able to make connections to common ancestry and how differences between species may be due to adaptation to specific environments. |
| Replication of Genetic Material | 8% | The roles of mitosis and meiosis are addressed in this unit, specifically how these processes result in characteristics being passed from parents to offspring |
| Species Reproduction | 7% | Sexual and asexual reproduction are discussed in this unit. |
| Human body structure and function | 4% | This unit discusses the structure and function of the human reproductive system. |

[Unit 5 Regents Item Bank](#)

◆ New York State Science Standards

¹ [Regents Tool](#); [Awesome table](#)



NY State MST Standards (1996)

This unit was designed to address the following NY State 1996 Standards.

NYSSLS (2017)

As designed, this unit works towards the following NYSSLS Performance Expectations, with partial alignment.



PI 2.1 Explain how the structure and replication of genetic material result in offspring that resemble their parents

2.1d In asexually reproducing organisms, all the genes come from a single parent. Asexually produced offspring are normally genetically identical to the parent.

2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.

2.1j Offspring resemble their parents because they inherit similar genes that code for the production of proteins that form similar structures and perform similar functions.

2.1k The many body cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions. This is because different parts of these instructions are used in different types of cells, and are influenced by the cell's environment and past history.

PI 4.1 - Explain how organisms, including humans, reproduce their own kind.

4.1a Reproduction and development are necessary for the continuation of any species.

4.1b Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.

4.1d The zygote may divide by mitosis and differentiate to form the specialized cells, tissues, and organs of multicellular organisms.

4.1e Human reproduction and development are influenced by factors such as gene expression, hormones, and the environment. The reproductive cycle in both males and females is regulated by hormones such as testosterone, estrogen, and progesterone.

4.1f The structures and functions of the human female reproductive system, as in almost all other mammals, are designed to produce gametes in ovaries, allow for internal fertilization, support the internal development of the embryo

HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.



and fetus in the uterus, and provide essential materials through the placenta, and nutrition through milk for the newborn.

4.1g The structures and functions of the human male reproductive system, as in other mammals, are designed to produce gametes in testes and make possible the delivery of these gametes for fertilization.

4.1h In humans, the embryonic development of essential organs occurs in early stages of pregnancy. The embryo may encounter risks from faults in its genes and from its mother's exposure to environmental factors such as inadequate diet, use of alcohol/drugs/tobacco, other toxins, or infections throughout her pregnancy.

PI 3.1 - Explain the mechanisms and patterns of evolution

3.1g Some characteristics give individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase.

[New York State Core Curriculum Standards Crosswalk - Living Environment](#)

◆ Common Core Learning Standards

Reading

Writing



[ons License](#)

9-10.R.ST.2**Reading: Key Ideas and Details**

Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

9-10.R.ST.3**Reading: Key Ideas and Details**

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text.

9-10.R.ST.9**Reading: Integration of Knowledge and Ideas**

Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Listening**9-10.W.HST.10****Writing: Range of Writing**

Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

9-10.W.HST.10**Writing: Text Types and Purposes**

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Speaking

◆ Unit Vocabulary

Consider using this list to guide the Explain or Elaborate portions of the 5E plans, and use it as reference for peer to peer vocabulary based discussions.

| Unit Vocabulary | Domain Specific | Tier II |
|-----------------|---|--|
| 5E: MEIOSIS | Eggs Salinity Osmoregulator Sexual reproduction Adaptation Natural selection Competition Predation Genetic diversity Enzymes Osmosis Internal / external development Meiosis Gametes Somatic Chromosomes Nucleus Sperm Hormones : estrogen, progesterone, testosterone, FSH, LH | Conditions Dormant Optimal Concentration Diversity characteristic |

| | | |
|--|--|---|
| <p>5E: GAMETE PRODUCTION & FERTILIZATION</p> | <p>Reproductive structures Pollen Egg / sperm Gametes chromosomes Fertilization Ovary Ovulation Menstrual cycle uterus Testes Fallopian tube Vas deferens Adaptation Genetic diversity Common descent Hormones : estrogen, progesterone, testosterone, FSH, LH</p> | <p>Advantageous</p> |
| <p>5E: COMPARATIVE EMBRYOLOGY</p> | <p>embryo Common descent Common ancestor Vertebrate Natural selection Adaptation Environmental condition Placenta Uterus vagina Umbilical cord Zygote Fetus Diffusion Substances Gas / nutrient / waste exchange Amniotic fluid Teratogen / toxin / carcinogen Differentiation</p> | <p>Comparative Similarities / differences / trends Stage Structure Nourish Development / developing Maternal Filter environmental</p> |



| | | |
|---|---|--|
| 5E: COMPARING SEXUAL AND ASEXUAL REPRODUCTION | Sexual reproduction Asexual reproduction Binary fission Genetic variation Mitosis Meiosis Fertilization Genetic clones Offspring Differentiation specialization | Advantages / disadvantages Unstable Challenging Survival Conditions Parenting growth |
| OVERALL UNIT / PERFORMANCE TASK | Cladogram Sexual / asexual reproduction Mitosis Meiosis | Comparative Internal / external Variation adaptations |

*terms that may be encountered, but not fully defined or explored in this 5E Cycle

[Click here to access the 2016-2017 version of this unit plan](#)