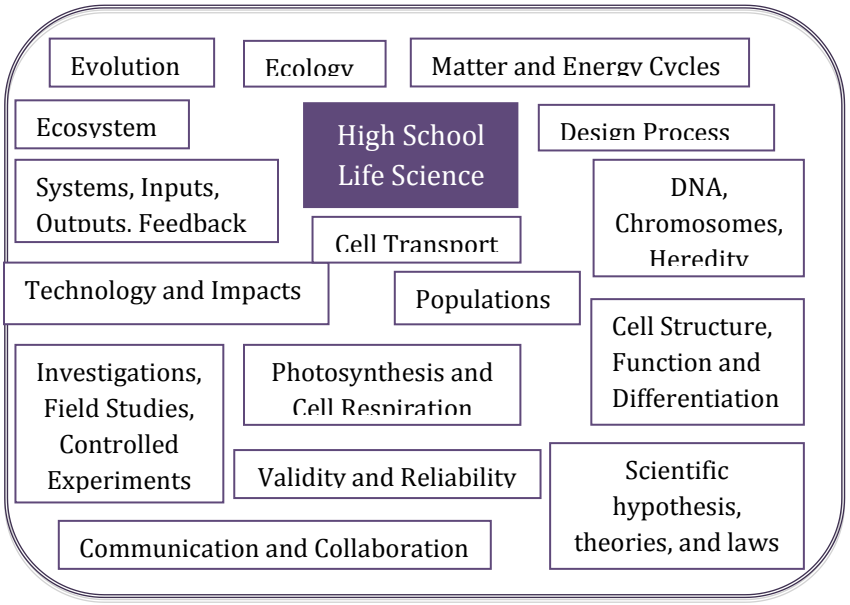
Life Science Standard **LS1I**

Content Standard:
Egg and sperm cells are formed by a process called meiosis in which each resulting cell contains only one representative chromosome from each pair found in the original cell. Recombination of genetic information during meiosis scrambles the genetic information, allowing for new genetic combinations and characteristics in the offspring. Fertilization restores the original number of chromosome pairs and reshuffles the genetic information, allowing for variation among offspring.



Performance Indicators:
Describe and model the process of meiosis in which egg and sperm cells are formed with only one set of chromosomes from each parent.
Model and explain the process of genetic recombination that may occur during meiosis and how this then results in differing characteristics in offspring.
Describe the process of fertilization that restores the original chromosome number while reshuffling the genetic information, allowing for variation among offspring.
Predict the outcome of specific genetic crosses involving two characteristics.

Reflective Questions for Students:
How do sex cells differ from regular body cells?
How are male and female sex cells different from each other?
How do sex cells become regular cells?
How is genetic information passed from parents to offspring?

Assessment Information

http://www.k12.wa.us/Science/Assessments.aspx

Item Specifications:
Describe the process of meiosis.
Describe that the processes of recombination during meiosis.
Describe the relationship between the unique combination of genetic information in an egg or sperm cell and the differing characteristics in offspring from a single set of parents.
Describe the process of fertilization as restoring the original chromosome number.
Describe that the process of fertilization allows for variation among offspring from a single set of parents.
Describe possible allele combinations in an egg or sperm cell given a combination of two traits and a parent's genotype for the two traits.
Describe the possible combinations of offspring in a simple Mendelian genetic cross for two traits.
Describe the possible combinations of offspring in a genetic cross involving co- dominance or incomplete dominance for a single trait.

Quick Links for Students:
The following links will help you visualize the process of meiosis.
Animal

- Meiosis: http://cellsalive.com/meiosis.htm
- Meiosis: How Chromosomes are passed from Parent to offspring http://www.contexo.info/DNA_Basics/Meiosis.htm
- This site contains an activity that allows you to identify the steps of meiosis. http://learngenetics.utah.edu/

Teacher Center
Elements of Effective Science Instruction

Disciplinary Core Ideas

In order to understand the concept of mitosis, students need background knowledge in the parts of the cell as well as understanding of the role of DNA in genetics and regulating cell function. See standards LS1E, LS1F and LS1G. LIMIT: Students do not need to **memorize** the every detailed step. Such memorization is likely to cause students to miss the big picture about the purpose and end results of this mitosis. The same goes for meiosis. Students should also be familiar with the idea of using models to represent or show a biological process.

Essential teaching components leading to the big ideas:

Student acquisition of the content of science involves opportunities to meet state crosscutting and domain standards and recognize how the big ideas fit within a large conceptual framework. Learning is best achieved through sequencing learning targets into learning progressions that inform teacher's instructional decision making.

- Chromosomes are made of DNA, which code for genes carried on chromosomes.
- Genes contain the genetic information passed from parents to offspring.
- Every animal cell contains 2 copies of each chromosome inside the nucleus.
- **Every cell** in the body of an organism contains DNA with all the genetic information of that living organism.
- All the animals of the same species have the same number of chromosomes in the nucleus of their cells. Examples: all humans have 46 chromosomes arranged in 23 pairs. Fruit flies have 8 chromosomes arranged in 4 pairs.
- Sex cells have half the number of chromosomes as regular cells so that the right number of chromosomes is formed as they combine with the opposite sex cell.
- LIMIT: Students do not need to **memorize** the every detailed step. Such memorization is likely to cause students to miss the big picture about the purpose and end results of this mitosis.

Additional supports and extensions for understanding how students grasp the concept:

- http://www.teachersdomain.org/resource/tdc02.sci.life.gen.mitosis/

Cross Cutting Ideas:
Designing for Learning

Strategies to reveal student understanding include:

- Paige Keeley's Formative assessment probes available through nsta.org
- Teacher's Toolkit: Misconceptions in the science classroom, Science Scope at www.nsta.org
  This article in Science Scope offers suggestions for identifying science misconceptions in general.
- http://www.doe.mass.edu/omste/ste/default.html Go to the life science file on this page for extensive descriptions of common student misconceptions about concepts in biology.
- http://www.rpdp.net/sciencetips_v3/L8A1.htm#misconcept This website gives common misconceptions for many concepts in genetics.

Prerequisite knowledge required:

In order to understand the concept of meiosis, students need background knowledge in:

- The parts of the cell
- Understanding of the role of DNA in genetics and regulating cell function. See standards LS1E, LS1F, LS1G and LS1H
- Students should also be familiar with the idea of using models to represent or show a biological process.
- Students need to know DNA is a macromolecule located in the nucleus of cells.
- Students need to know that DNA is the genetic molecule that transfers that information from parent to offspring.
- Students can describe that genes are carried on chromosomes
- Students can describe that most animal cells contain two copies of each chromosome, one from each parent, containing

the genetic information for body structure and cell function.
- Students can model the process of mitosis (the chromosomes are copied and each new cell receives exact copies of the original chromosomes), and show the product of mitosis (two cells, each with the same number of chromosomes as the original cell).

Learning progressions for meiosis include:

- Students can model the process of meiosis (each egg or sperm cell receives only one representative chromosome from each pair of chromosomes found in the original cell), and/or show the product of mitosis (egg and sperm cells with only one set of chromosome
- Describe the relationship between the unique combination of genetic information in an egg or sperm cell and the differing characteristics in offspring from a single set of parents).
- Describe that the process of fertilization allows for variation among offspring from a single set of parents.
- With a given combination of two traits and a parent's genotype for the two traits, describe possible allele combinations in an egg or sperm cell.
- Describe the possible combinations of offspring in a simple Mendelian genetic cross for two traits (given a Punnett square for two traits, fill in one missing cell.)
- Describe the possible combinations of offspring in a genetic cross involving co-dominance or incomplete dominance for a single trait.

Scientifically oriented questions focused on clarifying and extending student understanding include:

- How is the genetic blueprint that makes you who you are transferred faithfully from one cell to the next?
- Do all the cells of the body contain the same genetic information?
- What happens when something goes wrong during meiosis?
- What are the ways that mutations can happen during meiosis?
- How do genetic traits get passed from parent to offspring?
- How can diseases be passed from parent to offspring?

Activities supporting opportunities for students to make claims, use evidence and communicate reasonings include:

TBD

Cross Cutting Ideas: *Sense Making*	**Cross Cutting Ideas:** *Classroom Culture and Environment*
Planning time in the lessons to support time for students to make sense of what they are learning include: • The following website will assist teachers to develop strategies to deepen student understanding in genetics http://www.teachersdomain.org/resource/tdpd.sci.hlssc2/	**Activities that show how meiosis relates to students' everyday lives include:** These lessons at the following website will help student explore how diseases can be inherited. http://www.teachersdomain.org/resource/tdc02.sci.life.gen.lp_disorder
Strategies to focus on student conversations, interactive notebook prompts, model-building include: North Cascades and Olympics Science Partnership has many ideas and strategies for use in your classroom. http://www.ncosp.wwu.edu/	**Activities that show how scientists think and do science in relationship to this content standard include:** **http://www.teachersdomain.org/resource/tdc02.sci.life.gen.howtoconquer/** **http://www.teachersdomain.org/resource/tdc02.sci.life.gen.lp_genetest/** Both of these sites from Teachers Domain explore how scientists find out which genes cause a disease.