Monarch and Milkweed:
Migration, lifecycles and specialists.

Grade Level: Lower elementary: Although this lesson is designed for "elementary" students depending on the age and ability of your students you may need to adjust wording, provide more resources or expand on topics to make it a bit more challenging.

Essential Question:

What is the unique story of Monarchs? What can we learn about Monarchs in Wyoming?

Objectives:

At the end of this lesson, your students will be able to:

- *Understand* the life-cycle of monarchs.
- *Identify* a milkweed plant and its unique characteristics.

Assessment opportunities:

At the end of this lesson, you will be able to assess students through:

- The student's complete monarch and milkweed book.
- Student's field notes on milkweeds or monarchs.
- The creation of a butterfly garden.

Background information:

Interest in Monarchs has peaked in the last few decades due to a significant population decrease throughout North America. The life history of monarchs is fascinating due to their migration path, life cycles and intrinsic tie to milkweeds. Broadly, monarchs winter in either central Mexico (eastern subspecies) or costal California (western subspecies); come spring these butterflies start a migration north to breeding grounds throughout the U.S. During the northern hemisphere's summer months there will be a total of four generations of monarchs, each moving farther and farther north, following the phenology of milkweeds (the monarch larva's food source). By the time the final generation is born, fall has come, and they will start a slow migration south. This generation will live throughout the winter on stored up lipids in their bodies and will not reproduce until next spring.

Each of the four generations will go through complete metamorphosis (egg, larva, pupa and adult). The generations that don't overwinter have a life span of about 60 days, while those that do overwinter live for 6-9 months. During the northward migration, monarchs must find milkweeds to lay their eggs on, to continue the migration. Although monarchs will eat nectar from many species of flowers in their adult stage, during the larval stage the milkweed is their only food source. This plant has toxins in its leaves and as the larvae fatten up on it, they themselves take on the toxins making them poisonous to predators during both the caterpillar and adult stages of their lives. Both caterpillars and butterflies are brightly colored to warn predators that they taste bad and shouldn't be eaten. Scientists call this "aposematic coloration."

The decline of the monarch population has been directly attributed to the decline of milkweeds throughout the United States. With an increase of herbicide use throughout agricultural lands, milkweeds have been steadily declining. Also, logging, climate change and extreme weather patterns are thought to play a role in the butterflies declines.

Performance Expectations: Next Generation Science Standards:

K-LS1-1
Use observations to describe patterns of what plants and animals (including humans) need to survive.

K-ESS3-1
Use a model to represent the relationship between the needs of different plants and animals (including humans) and places they live.

2-LS4-1
Make observations of plants and animals to compare the diversity of the life in different habitats.

4-LS1-1
Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior and reproduction.

5-ESS3-1
Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Resources:

Conservation Status and Ecology of Monarch Butterfly in the United States, Jepsen et al., 2015.

Websites to refer too:
http://www.monarchbutterflyfund.org/node/148

The Monarch Lab has a great amount of information and extra lessons if you wish to focus more on details of the monarch: http://monarchlab.org

Part 1: Monarchs and Milkweeds

Materials:

- Coloring materials
- Book to read
- Copies of coloring book for each student
- Internet
- Depending on how much time you want to commit to the project there are lab kits for "growing" your own butterflies too.

Time Commitment:

1-2hours depending on how fast the students work through the book.

Preparation:

- Print out enough books for each student, you can have them put them together.
- Set up youtube video

Directions:

1. Introduce the subject by watching: https://www.youtube.com/watch?v=V3jpu2th34o

2. Then as a class read a kid's book on monarchs and milkweeds. There are lots out there, one we recommend is *Monarchs and Milkweeds* by Helen Frost.

3. Have students work through the coloring/drawing book. This will have all the major life cycle stages and complexities of the milkweed in it. Have resources available for students, or have them work in teams to answer questions.

Coloring book answers and details:

These details are meant to help provide quick answers, but there is a ton of information out there that would provide greater context to these answers. Also, feel free to change or add questions that fit your needs better.

Page 1: Cover page

Page 2: Migration

Students draw a picture of North America, with arrows pointing towards the Midwest and east coast if they were coming from Mexico, and inner west if they were coming from California Coast.

Answer 1: Central Mexico, Costal California

Answer 2: a few weeks

Page 3: First phase of monarch life cycle

Answer 1: upwards of 200; but only one at a time.

Answer 2: Milkweed

Page 4: Larval stage

Answer 1: 3-5days

Answer2: Its own egg shell!

Page 5: Milkweed adaptation page

Answer 1: it produces toxins

Answer 2: The use of herbicides.

Page 6: Caterpillars

Answer 1: Its mass will increase by 2000 times!

Answer 2: they molt, meaning they shed layers of skin.

Page 7: Attachment

Answer 1: The caterpillar, after feasting, will attach itself to a branch, leaf or some other strong structure, to start preparing itself for the chrysalis phase.

Answer 2: After attaching, the caterpillar body splits open beginning the process of the chrysalis.

Page 8: Chrysalis

Answer 1: 9-14 days

Answer 2: The structure will go through a color transformation. In the beginning stages it will primarily green until the end phase when it becomes transparent and you can see the colors that signify a monarch's wings (black and orange).

Page 9: Adult emergence

Answer 1: 2-6 weeks (if they are not over wintering)

Answer 2: Fluids that are stored up in the body are pumped out to the wings, allowing them to expand.

Page 10: 2nd generation life cycle

Page 11: 3rd generation life cycle

Answer 1: Complete metamorphosis

Page 12: Over winter generation and Migration

Answer 1: 6-9 months

Answer 2: Central Mexico or Costal California

Page 13: Winter

Answer 1: Temperate winter climates, warm enough to not freeze but cool enough to keep lipids from going bad.

Answer 2: These stored up lipids, or fats, are the energy source for the butterflies all winter. In addition, the butterflies require very little energy, because they are nearly sleeping (in torpor) all winter.

Part 2: Field Trip

Materials:

- Student coloring books
- Magnifying glasses
- Writing and coloring utensils
- Computers access

Time Commitment:

Depends (2hours- 1day)

Preparation:

Depending on how much time you have or how you wish to do this section there are different steps. Either way a field trip, or time outside is used.

1. Plan a field trip to the Biodiversity Center (call to step up a trip and get details).

2. Plan a local field trip

- Find somewhere locally where students could look at milkweeds or butterflies… information on population status of milkweeds and monarchs is still growing in the state.
- Organize field trip details: travel, equipment and student needs.

Directions:

The goal of this is for students to create a species account. Where they make direct observations of the species and engage with the subject they had been studying. Once they are back from the field trip they will have the opportunity to contribute to a growing dataset across the state (depending on student ability).

1. Have students engage with the final two pages of the coloring book. Here students will make direct observations of milkweeds and butterflies. This can be as structured or informal as you want.

2. Once back in the classroom, students can submit observations to WyoBio, and compare location(s) to where other monarchs and milkweeds have been reported (see below for more detail). Use the WyoBio's monarchs and milkweed website as a resource as well (MonarchsAndMilkweeds.org).

By going to the WyoBio map application students can see where other milkweeds or monarchs have been reported. This could be done either by the teacher, projecting it for the whole class to see, or if students are able, they can use the application on their own.

To find milkweed observations:

- Go to WyoBio's map page and click on the magnifying glass on the right hand side (these are professional observations)
- Select "Vascular plant" under organism group
- Select "Asclepias" under species. Make sure to select scientific name, there are a few different subspecies that have been observed.
- Finally click "observations" under *how you want to see your data*.

To find monarch observations:

- Go to WyoBio's map page and click on the binoculars on the right hand side (these are citizen science observations)
- Filter observations by "monarchs"

If students did make observations it important that they report this data on WyoBio, with such a small dataset, little is known about both species in Wyoming. As more people contribute to this information students will be able to see the migration of monarchs over time in the state.

Part 3: You can make a difference too

Materials:

- Call to action letter (see link on website)
- Milkweed seeds
- Gardening tools
- Computers access

Time Commitment:

Probably a few days, depending how much of the garden prep students are a part of.

Preparation:

- Figure where and if a "monarch garden" can be planted at your school.
- Order seeds (http://www.windriverseed.com/ have seeds that are native to Wyoming, it is important to plant species that would naturally be around you! Make sure to order some milkweeds, as well as mix of other flowers depending on if you want to attract other pollinators).
- Gather gardening tools
- Review the Monarch Lab's "Creating and using a schoolyard garden" http://monarchlab.org/education-and-gardening/gardening-for-monarchs/teaching-in-a-garden/

Directions:

Beyond the coloring book, field trip and collecting data is the reason why studying and helping with conservation efforts is important. The Xerces Society did a great report on the status of monarchs and milkweeds, outlining conservation efforts (*Conservation Status and Ecology of Monarch Butterfly in the United States)*. As mentioned in the background information on the cover page, there has been a sharp decline in the monarch population in recent decades, which has been directly attributed to the decline in milkweeds. Milkweeds are highly susceptible to herbicides used in large agricultural businesses, therefore reducing the primary food source for the monarch larvae . By planting a milkweed garden, students will have an opportunity to understand the complexities of these species as well as provide breeding grounds for the monarchs. This is also a great way to introduce the value and importance of pollinators in an ecosystem, other butterflies in Wyoming or endangered species that are at risk locally. Once again, all this should be adapted to how old or where your students are at as far as their ability.

1. Introduce milkweeds, and how COOL they are! You could have students draw a milkweed, or make other notes while you share some facts with them. Some quick facts include:
    - Milkweeds are poisonous, but monarchs have adapted to eat their leaves and able to take in these toxins (making these butterflies poisonous too).
    - Nectar is found deep in the flower, which is why the butterflies, with their long proboscis, are able to reach in and drink the sweet liquid. More than just monarchs use this as a food source, such as other butterflies, moths and bumblebees.
    - Milkweed flowers are very unusual, and don't look like "ordinary" flowers. Their petals are usually folded down (instead of making a cup around the reproductive organs), and there is an additional whorl of structures called hoods, unique to milkweeds. The hoods can be as showy as the petals, or more so. The pollen is hidden, and stuck together in pollinia, so an insect has to pull out the entire pollinium and move it to another flower. Sometimes insects get a leg stuck trying to get the pollinium, and either lose the leg or die on the flower.
    - There is a wide diversity of milkweed species in North America, and they are able to grow in a variety of places.
2. Read letter for a call to action from the Monarch Lab, explaining that creating habitat for milkweeds helps with the conservation of monarchs, as they become closer and closer to being listed on the endangered species listed. (http://monarchlab.org/images/uploads/attachments/Karen_letter_to_students_short.pdf)
3. Depending on how old your students are or their ability, have them prep and plant the garden.

Create a garden care plan; who is going to water and take care of it? Is this a class project, with weekly chores? Integrating growing observations also helps teach botany and biology to students