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Background Information:

Any moving electrical charge surrounds itself with a magnetic field. The electrons moving around within atoms are no exception. In most materials, the electrons are spinning and moving in random directions and their individual fields cancel out, leaving the material with no overall magnetic field. In some materials, however, the electrons can be organized so they all spin and move alike. Now their individual magnetic fields add together to produce an object with an obvious overall magnetic field.

Such an object, called a magnet, has a field with two poles, north and south. Like polls repel each other and opposite polls attract. These forces diminish in strength as the distance between the magnets increases.

Magnetic fields can affect the electron motion within certain metals, like iron and steel, causing them to become temporarily magnetic. Such materials are only attracted to magnets, not repelled. Other metals, such as aluminum, are not affected in this way.

These properties can be used to make many useful devices.

A push or a pull, a force, is needed to set an object in motion. This requires objects to interact with one another. Types of interactions may be grouped into two broad categories. Direct contact between and among objects, such as friction, is one group. Interactions may also occur across a distance. Magnetic and gravitational forces are included in this category. Results of these forces are observable. Careful observations can lead to prediction of future results of interactions. The use of qualitative and quantitative observations assist in the development of predictions.

All living organisms go through life cycles, which consist of stages from birth to death. While these stages are similar, the appearance of organisms in the various stages varies.

Weather and climate are related to one another. Current conditions to seasonal descriptions are considered weather, which include precipitation, temperature, wind speed and direction, cloud cover, and barometric pressure to name a few. Each season has its unique features based on weather and amount of daylight. Years' worth of weather pattern data are analyzed to determine climates. Annual and monthly temperatures, as well as precipitation data are the basis for climate zones. Landforms, proximity to oceans, and sea level also contribute the traits of the zones.

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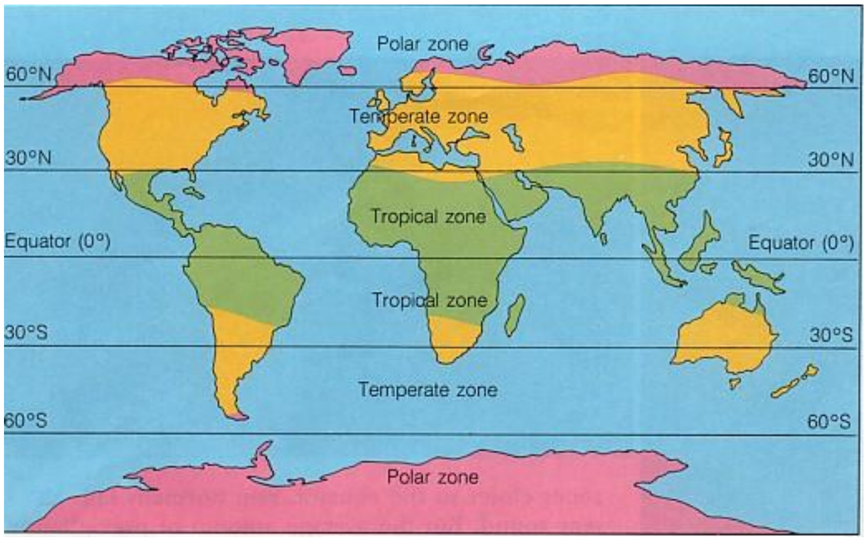
As illustrated in the map below, latitude is used to delineate the zones. The higher the latitude, the less sunlight received.[4] Tilt of the Earth also contributes rather than distance from the sun. When tilted farther away from the sun, the sun's rays are less direct than when the hemisphere is tilted toward the sun. Greater amounts of energy are absorbed the Earth when it is tilted toward the sun resulting in warming trends. (*Note climate zone identities found in this map will be used by students in this activity.)



The Earth can be divided into different regions, or biomes, based on having similar climate and living organisms. These biomes may be on different continents, but climatic conditions will be similar and the living organisms will have like adaptations to survive and can be transplanted fairly easily.

The climate of each biome serves as an average of the conditions, but extreme weather conditions can cause certain hazards that must be overcome by animals, plants, and humans residing in the biome. Plants and animals may have adaptations to survive these extreme conditions. Humans regularly build structures to reduce the impact of the climate, but extreme weather conditions can tax normal structures and new ones need to be constructed.

<u>Activity: Life Cycle</u>

3-LS1-1 From molecules to Organisms: Structures and Processes
Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death

Objectives:

- Students will identify similarities and differences of living organisms' life cycles through observations.

- Students will organize organisms based on attributes.
- Students will develop models of the life cycle of living organisms.

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Materials:
- Life Cycle Cards
- Life Cycle Venn Diagram (optional)
- Art Supplies
- Materials for Developing Models
- Art Paper (optional)

Suggested Approach:
Venn diagrams may be used as strategy for comparing and contrasting attributes on items, in this case living organisms and their life cycles. Distribute a set of the Life Cycle Cards to each group. Suggested group size is 4 students. Students turn the cards face up on their table. Allow time for them to explore. You may wish to prompt thinking with questions such as:
- ☆ *What are on the cards?*
- ☆ *What might they be "telling" us?*

Option for Playing Card Game: Direct students to organize their cards. They may then group them according to common traits. A gallery walk may develop new strategies for groups to use in sorting the cards. Allow time for this to occur. Have groups share how and why they grouped their cards. Guide groups to consider organizing the cards to tell the story of each organism's life.

Option for Playing Card Game: Students deal the cards until the deck is gone. Cards may be held in player's hands or turned face up/face down on the table. The student who begins the play turns one card face up in the center of the table. Anyone who has a card that goes along with the card that was played puts their card next to the other card in the center of the table. This continues until all of the cards for that organism are in the center of the table. Next, the group comes to consensus to the chronological order of the cards and puts the cards in that order. Play continues until all cards have been used.

If needed, explain how to use a Venn diagram to the class. No matter which option is used to play the game, groups complete the Venn diagram. Ask groups to consider what two items they are comparing. Coach them to plants and animals. Assist groups while they complete their diagrams.
- ☆ *With the whole group, ask questions such as:*
- ☆ *What are differences among the cards?*
- ☆ *What are similarities among the cards?*

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- ☆ *What categories could the cards be place in no matter if they are a plant or an animal?*
- ☆ *What do the cards tell us about the lives of plants and animals?*
- ☆ *What do you think the stages/phases of life cycle are?*

Share materials available for modeling the concept of a life cycle. Ask groups to consider, "How could you model the idea of a life cycle?" Allow time for groups to plan and build their models.

After models are complete, groups should share and explain their work.

Debrief:

- ☑ *What does your model represent?*
- ☑ *What are the stages of a life cycle?*
- ☑ *Do all living things need to go through all parts of the life cycle? Explain your thinking.*

<u>Activity: Patterns and Prediction</u>

3-PS2-2: Motion and Stability: Forces and Interactions

Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Objectives:

- ➢ Students will identify a question to investigate patterns of motion.
- ➢ Students will develop and conduct a procedure, identify data to be collected, and interpret data for investigating the identified question.
- ➢ Students will collect qualitative and quantitative data.
- ➢ Students will use evidence to support prediction of future motion.

Advanced Preparation:

- □ Determine what materials will be available for investigation.
- □ Determine how materials will be arranged for student use.
- □ Determine if additional materials will be available for the second part of the investigation, such as more/multiple sizes of marbles.
- □ Determine what formats and materials are available for presentations .

Materials:

- *Ruler/Tape Measure*
- *3 Tennis Balls*
- *Washers*
- *String/Yarn*

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- *Marble Runs*
- *Car Tracks*
- *Bowl*
- *Items that roll, such as marbles, multiple sizes of ball bearings, ping pong balls*
- *Chart Paper*
- *Art Supplies, such as markers, coloring materials*
- *Presentation Materials*
- *Ping Pong Balls and Other Objects that Roll (Optional)*

Suggested Approach:
Groups of 2-4 are suggested. You may wish to ask the class a question such as, "*What is needed for something to move?*" (Note: Students would have been introduced to forces in Kindergarten.)

Share with the class that they are going to observe how objects behave when forces are applied to the objects. Introduce each of the stations and materials to the group. Stations such as the following may be included:

- ☆ *One tennis ball*
    - *Tennis ball stays in contact with the floor.*
- ☆ *Two tennis balls*
    - *Tennis balls stay in contact with the floor.*
- ☆ *A string and washer suspended from a dowel/ruler*
    - *(Students may bring up the idea of a swing.)*
- ☆ *A bowl with a marble in it*
- ☆ *Car tracks with a car*
- ☆ *Marble run stations*
    - *Separate pieces into multiple stations*

At each station, students should explore how the materials move and interact with one another, as well as what they wonder about these interactions. Recording of observations and questions occurs as exploration happens. Divide students into groups and the stations at which they will begin. Provide plenty of time for groups to explore prior to having groups switch to new stations. Groups should visit multiple stations as this will provide more details and ideas for further investigation. When completed, have students return to their seats.

Discuss results of each station using the chart paper recordings. There are multiple methods for this discussion. The objectives of the discussion are examining data, identification/development of potential investigable questions, and the connection between the use of patterns to develop predictions of future

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motion. Based on your advanced decision regarding additional materials, share what will be available for student use. Once this has been completed for each station, assign groups to a station, and allow ample time for investigation. Each group identifies a problem/question to be investigated, develops a method for investigation, and completes the investigation.

Based on your prior decision regarding the sharing of findings, groups should organize how they will share results and predictions of future motion. Student group share their findings and predictions.

Debrief:

- ☑ *What patterns did you observe at the various stations?*
- ☑ *How do you think (fill in the blank) would move if you (fill in the blank)?*
- ☑ *What evidence do you have to support your prediction(s)?*
- ☑ *How does this evidence support your predictions?*
- ☑ *Why would it be helpful to observe motion patterns and make predictions about future motion of objects?*
- ☑ *What is an example?*

Resources:
http://www.physicsclassroom.com/Class/newtlaws/u2l2a.cfm#category

Activity: Magnet Cars

3-PS2-3 Motion and Stability: Forces and Interactions
Ask questions to determine the cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

3-PS2-4 Motion and Stability: Forces and Interactions
Define a simple problem that can be solved by applying scientific ideas about magnets.

Objectives:

- Students will learn that magnets can apply both pushing and pulling forces on other magnets depending on orientation.
- Students will explore the idea that magnets can apply pulling forces on some metals but not others.
- Students will investigate magnetic forces diminish with distance.
- Students will learn that magnetic forces can be used as a tool to regulate the motions of certain objects.

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Materials:

For the class

- 1 or more hand-held circular hole punches
- Coloring supplies if students are to decorate cars

For each group (of 2 or 3 students)

- 1 car template printed on card stock
- 4 wheels
- 2 aluminum axles
- 1 roll of tape
- 1 large paperclip
- 5 small magnets

Suggested Approach:

Magnetic Cars Part 1:

Begin with some questions to stimulate memories of prior experiences.

- ☆ *How many objects can you name that make use of magnets?*
- ☆ *How are the magnets used in each of those objects?*
- ☆ *Can magnets effect something without touching it? Give an example.*
- ☆ *Can magnets change the way something moves? Give an example.*

Help students form groups of two or three. Pass out student pages.

Explain the procedure for assembling the cars, then pass out materials.

1. Cut along the dotted lines.
2. Fold along the solid lines to make an open rectangular box.
3. If students will be decorating their cars, now would be the best time to do that.
4. Tape the corners to keep the box rigid.
5. Use a hand-held hole puncher to make a circular hole at the four locations marked with a circle.
6. Axles go through the circular holes.
7. Carefully push wheels onto the axles.
8. Test the car to see if it rolls freely and adjust wheels and axles as necessary.
9. Tape a paperclip to the center of one bumper.
10. Tape one magnet to the center of the opposite bumper.

Magnetic Cars Part 2:

Challenge students to use magnets to make their car move, without allowing anything to touch the car. Have them do this as many different ways as they

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can. As they play, students are to record observations and questions about the behavior of their magnet car.

Have students put their cars out-of-reach, perhaps on your desk, for the following class discussion. Students share their observations and questions. On the board, or on chart paper, record:

- ✰ *Any question which might possibly be answered by allowing students to do an experiment*
- ✰ *Any observation which could be tested in a controlled way to see if it can be repeated*

Once you have about five statements recorded, allow the class to select one statement for which they will design an experiment that could answer the question or confirm the observation.

After conducting their experiments, have students share results and discuss any discrepancies between their results.

If time and student interest allow, conduct further experiments.

Magnetic Cars Part 3:

Ask students to think of the various problems that cars might encounter on a road. Could magnetic forces be able to prevent or solve any of those problems?

Have each group select one potential problem or danger faced by driving on the road in a car. Students may use their magnets to modify the car or the road in some way to solve the problem. Allow them to be creative.

Have students put their cars out-of-reach, perhaps on your desk, for the following class discussion.

Debrief:

- ☑ *Allow each group to present their work.*
- ☑ *What problem did you want to solve? Explain your solution.*
- ☑ *Did it work?*

<u>Activity: Weather and Climate</u>

3-ESS2-1 Earth's Systems

Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

3-ESS2-2 Earth's Systems

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Obtain and combine information to describe climates in different regions of the world.

Advanced Preparation:

- ◻ Gather resources for research.
- ◻ Determine size of passport and how each will be bound.
- ◻ Obtain materials to be used in building structures.

Objectives:

- ➢ Students will graphically represent, analyze, and interpret data.
- ➢ Students will use data to identify climate zones.

Materials:

- Multiple Sheets – Drawing Paper
- Coloring Materials
- Binding Materials
- World Map
- Computer with Internet Access
- Computer with Projector
- Power Point
- Books for Research
- Latitude and Longitude Map
- Passport Template
- Average Temp and Precip Tables

Weather and Climate Part 1:
Suggested Approach:
Place students in groups of four to begin the activity. Have the groups describe each of the four seasons to one another. Suggest the following to lead the groups' conversations:

- ☆ *Compare the seasons: winter, spring, summer, and fall.*
- ☆ *What traits were used to discuss the seasons?*
- ☆ *How could these traits be classified?*

Display the power point slide that shows the weather map. Open a class discussion for the following ideas:

- ☆ *What do you know weather maps?*
- ☆ *Share observations about the map.*
- ☆ *What information is on the map?*
- ☆ *What are the numbers on the map?*
- ☆ *How many days does this map represent?*

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Pictographs and/or bar graphs are the expectations.

Have students continue to work in groups of four. Share the power point slides showing the type of data that will be used. Review latitude and longitude as needed. Distribute the city/location information to each group. Share with them a scenario, such as they are meteorologists, and that their tasks are to organize the information.

1. Seasonal precipitation and seasonal temperature into a graph. The following website is suggested for making online graphs. https://nces.ed.gov/nceskids/graphing/Classic/
2. Locate and label each group's city (ies) on the map. Students may need a world map to locate their city/location.

Assist students as needed. After allowing sufficient time for groups to complete their tasks, combine two groups together. These new groups should:

- ☆ *Explain and share their work from the above steps, as well as discuss similarities and differences between the locations.*
- ☆ *Mark the new locations on their maps.*

Continue this process by having groups pair with different groups each time until all groups have been able to meet with each other.

The class should return to their original working groups. Students then examine their maps. Through discussion within groups, students decide which cities have the most in common in regards to weather and determine which cities can be paired. Ask the class questions such as:

- ☆ *How did you pair the cities?*
- ☆ *Why did you pair them in this way?*
- ☆ *What do you notice about the locations of the cities you paired?*

Share the power point slide Locations. (Note: Locations are based on climate zones.) Ask students to think about and share their ideas about locations of the pairs of cities/locations that are on the slide.

- ☆ *Anchorage, Alaska and Boden, Sweden*
- ☆ *Scott Base and Falkland Islands*
- ☆ *Los Angeles, California and Vienna, Austria*
- ☆ *Cape Town, South Africa and Melbourne, Australia*
- ☆ *Punta Cana, Dominican Republic and Manila, Philippines*
- ☆ *Rio de Janerio, Brazil and Jakarta, Indonesia*

Ask students why there are lines across and up and down the map and what we call these lines. Follow this with a discussion about what they notice regarding location of the city/location points that are indicated on the map. Coach students to the concept that latitude "bands" have similar conditions. Use the latitude slide if needed. Display the climate zone map slide. Have students

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make observations about the map. Make sure they notice the climate zone labels. Students label and color the climate zones.

Debrief:
Ask students questions such as:

- ☑ *What categories were you and your group organizing and graphing?*
- ☑ *What do think are the characteristics that are used to identify the climate zones?*
- ☑ *What do you notice about these climate zones and where their cities are located?*
- ☑ *How would you describe the difference(s) between climate and weather?*

Weather and Climate Part 2:
Suggested Approach:
Host a discussion using questions such as the following:

- ☆ *What is a passport?*
- ☆ *When would you use a passport?*

Share that they will now make a climate zone passport. (Decide how students will bind the passports.) The passport will contain items such as the following:

- ☆ *Cover*
- ☆ *Drawing of world with climate zones labeled*
  - *Short explanation of how climate zones are identified*
- ☆ *_____ cities/locations from each climate zone.*
  - *Name of city/location*
  - *Latitude*
  - *Picture to represent the area*
  - *Time of year to visit based on data from graphs*
  - *What to pack using data from graphs*
- ☆ *Written summary of what they have discovered about climate zones*

Debrief:

- ☑ *What climate zone(s) did you decide to visit?*
- ☑ *Share some of the characteristics of the climate zone.*
- ☑ *Why did you select your destination(s)?*
- ☑ *How does the climate of where you visited compare to Illinois's climate?*

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Activity: Protecting from the Hazard

3-ESS3-1 Earth and Human Activity
Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard

3-5-ETS1-3 Engineering Design
Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Objectives:
- ➢ Students will design and build a structure to survive a weather hazard.
- ➢ Students will design a test to use in determining the quality of the structure.
- ➢ Students will use data to redesign and retest the structure.

Advanced Preparation:
- □ Decide what materials will be available for construction and testing.
- □ Decide if you want to have any size constraints on the structures.
- □ Determine how and what will be needed for testing of structures.
- □ Obtain resources for research of climate zones.

Materials:
- Resources for Research
- Student Pages
- Possible Building Materials
  - Paper, Note Cards, Cardstock, Construction Paper
  - Clay
  - Craft Sticks
  - Various types of cloth
  - Tape/glue/other binding material
- Possible Items for Testing
  - Fan
  - Sandpaper
  - Squirt bottle
  - Hair dryer
  - Centimeter cubes or other weights

Suggested Approach:
Place students into groups of 3-4. Either allow groups to select or assign a climate zone for the lesson. Groups will then research the climate zone. Allow

ample time for groups to consider, discuss, and come to consensus about the following:

- ☆ *What are the seasons like in the climate zone?*
- ☆ *What problems could the weather possibly cause in the climate zone?*
- ☆ *Select a weather hazard from your climate zone that your group like to use for the rest of the lesson?*
- ☆ *What concerns are there about this hazard?*
- ☆ *What would you need to think about if you were building a house (insert structure) in the climate zone?*

Reconvene the class. Share that they will now discuss and plan a house that would be appropriate for the climate zone and weather hazard. Once designs are complete, have groups examine building materials to determine what and how they will be used. Another option is to display materials prior to the design phase. Groups now build their house.

Next, groups decide how the hazard will be simulated during testing of the house. Share the materials available for the testing phase. As groups complete the testing plans, they should carry out the tests. Data regarding test results should be recorded.

Repeat the design and testing process. Decisions as to prototype changes must be based on data from the initial testing.

Groups share the climate zone, hazard, structure, rationale for design, and results of the testing.

Debrief:

- ☑ *How did your group's testing model the hazard?*
- ☑ *What data did your group record?*
- ☑ *What went well with the group design?*
- ☑ *What would need to be changed? Explain your thoughts.*
- ☑ *Will any design be able to hold up in every storm (hazard) for its location?*

Resources:

1. https://www.weather.gov/timeline
2. http://www.weather.gov/ (current U.S. weather conditions)
3. https://en.wikipedia.org/wiki/National_Weather_Service
4. http://climate.ncsu.edu/edu/k12/.Tilt