**STEM Middle and High School Lesson Template**

STEM lessons will take an interdisciplinary approach. This template is designed to aid in the development of an interdisciplinary STEM lesson.

**Title:** The Reasons for the Seasons

**Grade Level:** 9th grade

**Questions to ask before designing a lesson:**

1. **What is the essential question(s) for the lesson?**

* What are the reasons Earth experiences seasons?
* Does the entire Earth experience the same season at the same time?
* When is the Earth closest to the sun? Does this play a role in Earth’s seasons?
  1. **Why are these questions relevant?**
* According to the Washington County curriculum, students are expected to learn the reasons why the Earth has seasons. They are expected to be able to justify why the Earth’s distance from the Sun is not the reason we experience different seasons. These questions seek to tell the instructor if students have understood the concept of Earth’s seasons.
  1. **What are the connections to real life?**
* Students are affected by the seasons daily. They observe the various weather conditions that occur during each season. They observe the changes that occur in nature during each season. Students need to know how to prepare to survive the various seasons.

1. **What techniques are used to make the lesson:**
   1. **inquiry- based?**

* Determining the effect of angle of incidence on direct/indirect rays and interpolation of seasons
* “Sun” – Earth model
  1. **project- based?**

N/A

1. **What are the lesson outcomes?**

* SWBAT describe the 3 reasons why Earth has seasons.
* SWBAT justify their reasoning why Earth has seasons.
* SWBAT understand why the seasons for each hemisphere are reversed.

1. **How is participant discourse promoted?**

* Introduction: discussion protocol of engagement article
* Direct/indirect light: discussion during apparatus set up, discussion when determining which angle corresponds to direct or indirect light and which season it corresponds to
* “Sun” – Earth Model: discussion will naturally occur when students have to construct the model and arrive at consensus for the analysis questions

1. **How are science, technology, engineering, and mathematics addressed in the lesson?**

* Science: seasons, revolution of Earth on the ecliptic, tilt of Earth’s axis, direct/indirect light, angle of incidence
* Technology: use of protractor, use of calculators during direct/indirect light activity
* Engineering: construct direct/indirect light apparatus, constructing “Sun” – Earth Model
* Mathematics: determining angle in direct/indirect light activity, calculations of amount of “sunlight” energy/square in direct/indirect light activity, latitude ranges during “Sun” – Earth Model activity

1. Use the table below to match standards.

| **Standard** | **Standard Number (s)** | **Activity** |
| --- | --- | --- |
| **Common Core Standard for Mathematical Practice** | 5  6  3  6, 3 | Direct/Indirect Light Activity:   * Calculate light energy/km * Consistency in marking light ovals and counting number of squares * Determining season represented by angle of incidence in direct/indirect light activity   “Sun” – Earth Model Activity:   * Consistency in maintaining tilt of axis in model * Role of tilt of Earth’s axis in controlling seasons |
| **International Technology Education Association Standards for Technological Literacy** | 8, 10, 11, 20 | Construction of direct/indirect light lab apparatus  Develop “Sun” – Earth Model |
| **Common Core Reading Standards for Literacy in Science and Technical Subjects** | 2  3  4  6  7  9 | Introductory articles  Follow procedures for direct/indirect light activity  Interpret data, key terms, symbols (degrees)  Interpret analysis and conclusion questions  Translate data into words & vice versa found in data tables and drawings in both activities  Analyzing correctness of hypotheses, analysis of lab results during analysis and conclusion answers |
| **Common Core Writing Standards for Literacy in History/ Social Studies, Science and Technical Subjects** | 1a, 4  1b, 4  1c, 1e, 4  2a, 2b, 2d, 2f, 4  7, 8 | Predictions and hypotheses for each activity  Predictions and hypotheses, conducting activity to prove/disprove hypotheses for each activity  Cite specific data in conclusion questions for each activity  Write procedure, draw conclusions  Advanced groups researched questions on Seasonal effects on Earth and axis wobbles |
| **Maryland Science Skills and Processes Standards and Earth Science Standards** | 1.1.2, 1.2.2, 1.2.3, 1.2.4, 1.2.7, 1.3.1, 1.4.1, 1.4.2, 1.4.8, 1.5.1, 1.5.4, 1.5.9, 2.2.2.1 | Direct/Indirect Activity  “Sun” – Earth Model Activity   * Making predictions, hypothesis, set up lab apparatus, create a model, write a procedure, collect data, analyze data, draw conclusions |

1. 5E Model – STEM lessons will use the 5E Model

| **5E Lesson Components** | **Description of Activity** |
| --- | --- |
| **Engagement**  The activities in this section capture the participants’ attention, stimulate their thinking, and help them access prior knowledge. | * “rolling” power point slides of interdisciplinary comments about seasons * Introductory articles: Internal Clock of Mums, Stonehenge: Circles of the Seasons, Chaco’s Lost Sun Dagger, Why Leaves Change Color, Hummingbird Migration (a different one for each group, discuss, add conclusion to chart) |
| **Exploration**  In this section, participants are given time to think, plan, investigate, and organize collected information. | **Direct/Indirect Light Activity:**   * Foundational & Intermediate Knowledge Groups: * prediction, hypothesis, constructing apparatus, conducting activity, recording data, calculating light energy/square * Advanced Knowledge Groups: None   **“Sun” – Earth Model Activity:**   * Foundational & Intermediate Knowledge Groups: * prediction, hypothesis, constructing model, conducting activity, recording data * Advanced Knowledge Groups: None   **Seasonal Effects and Earth’s Axis Wobbles:**   * Foundational & Intermediate Knowledge Groups: * None * Advanced Knowledge Groups: use computers to answer questions |
| **Explanation**  Participants are now involved in an analysis of their exploration. Their understanding is clarified and modified because of reflective activities. | **Direct/Indirect Light Activity:**   * Foundational & Intermediate Knowledge Groups: * analysis questions and conclusion questions, prove hypothesis or not? * Advanced Knowledge Groups: description of the effect of direct/indirect sunlight on seasons   **“Sun” – Earth Model Activity:**   * Foundational & Intermediate Knowledge Groups: * analysis questions and conclusion questions, draw & label a model of position of earth around sun during each equinox and solstice * Advanced Knowledge Groups: draw & label a model of position of earth around sun during each equinox and solstice   **Seasonal Effects and Earth’s Axis Wobbles:**   * Foundational & Intermediate Knowledge Groups: * None   Advanced Knowledge Groups: use computers to answer questions |
| **Extension**  This section gives participants the opportunity to expand and solidify their understanding of the concept and/or apply it to a real world situation. | **Direct/Indirect Light Activity:**   * Foundational & Intermediate Knowledge Groups: * conclusion question # 2 * Advanced Knowledge Groups: None   **“Sun” – Earth Model Activity:**   * Foundational & Intermediate Knowledge Groups: * Conclusion question #s 1 and 2 * Advanced Knowledge Groups: None   **Seasonal Effects and Earth’s Axis Wobbles :**   * Foundational & Intermediate Knowledge Groups: * Observe questions/answers from advanced group during gallery walk * Advanced Knowledge Groups: * answer questions from both sections in activity   **The Reasons for the Seasons Analysis: answer question by group only**   * Foundational & Intermediate Knowledge Groups: * Answer question #s 1 – 12 (2 of the questions only) * Advanced Knowledge Groups: use computers to answer question #s 13 – 21 (3 of the questions only)   **Gallery Walk:** All Groups:   * students will observe the questions answered by other groups and will record the answers on their activity sheet   **The Reasons for the Seasons Analysis: answer all questions based on gallery walk**   * Foundational & Intermediate Knowledge Groups: Answer question #s 1 – 12 * Advanced Knowledge Groups: * use computers to answer question #s 13 - 21 |
| **Evaluation**  Evaluation occurs throughout the lesson. Scoring tools developed by teachers and participants target what participants must know and do. Consistent use of scoring tools improves learning. | * Formative - Analysis questions from Direct/Indirect Light, “Sun” – Earth Model, check ins throughout lesson, circulate throughout room listening to group conversations and clarifying questions * Summative - The Reasons for the Seasons Analysis – use last question as exit ticket for students |

**Adapted the following References:**

Teacher’s Domain

Data Streme Project, American Meteorological Society

Earth Science, MacMillian, for Direct/Indirect Rays activity

<http://www-istp.gsfc.nasa.gov/stargaze/Lseason.htm>

<http://daphne.palomar.edu/jthorngren/>

<http://gardens.si.edu/horticulture/res_ed/fctsht/mum.html>

<http://www.nationalgeographic.com/xpeditions/activities/07/popup/stonehenge.html>

<http://www.angelfire.com/indie/anna_jones1/lost_dagger.html>

<http://www.na.fs.fed.us/fhp/pubs/leaves/leaves.shtm>

<http://www.hummingbirds.net/migration.html>