Inquiry Project Design Plan

Teacher/Designer Names: Dr. Alecia Redway **School: PEARLS**	
Name of Project: Smoke from 2023 Canadian Wildfires Reaches Yonkers	**Grade Level: 7**
Est Launch Date: November 2023	**Est Duration (in weeks): 12 weeks**
Disciplines Involved: Science	
Problem Statement: Students develop a model that shows the mechanisms by which smoke from wildfires in Canada *travels* to Yonkers, NY	

STAGE 1: DESIRED RESULTS	
Big Idea: Systems, System Models	
Enduring Understandings: ● The rotation of Earth and the factors it influences are based on the **perspectives of observers** in the Northern and Southern Hemispheres ● Wind is caused by a difference in pressure (i.e. density) across an area ● Wind moves from higher density/pressure to lower density/pressure ● Coriolis force changes in latitude, direction of Earth's rotation, and speed of the moving object ● Wind direction is affected by the Coriolis force ● The Earth's systems (i.e., atmosphere, lithosphere/geosphere, and hydrosphere) experience uneven/unequal heating (i.e., thermal energy transfer) ● Thermal energy moves from areas of high temperatures to low temperatures through the movement of matter via conduction, radiation, and convection of heat from warm to cool objects ● Areas at higher elevations such as Yonkers have lower temperature than area at lower elevation ● Yonkers and Canada receive less solar energy than places closer to the	**Essential Question(s):** (MEANT TO BE SHARED WITH STUDENTS) ● Why did the sky change color? ● How is it possible for smoke from Wildfires in Canada to travel to Yonkers, NY?

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equator because of their latitude • Weather and climate of Yonkers and Canada are influenced by interactions involving sunlight, the ocean (Canada: the Atlantic Ocean on the east, the Pacific on the west, and the Artic Ocean to the north; for Yonkers: the Atlantic Ocean), the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect the oceanic and atmosphere flow patterns • The ocean closest to Yonkers and Canada exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents • For Yonkers and Canada, the general latitudinal pattern in climate (lower annual temperature at higher latitudes) is caused by less direct sunlight at the poles (less solar energy) • Air and water (fluids) flow from areas of high density to low density; density is affected by temperature and salinity of water; or temperature of air; differences in temperature can cause fluids to move vertically, and horizontally	

Established Goals (Standards, Performance Indicators, Learning Goals):
*choose relevant standards to unit/project plan timing and learning goals; do not need to use all disciplines below.
** unpack into SWK and SWBAT under identified standards as this will lead to aligned assessment design

Science Standards (list if using, unpack under each standard into SWK and SWBAT)**:**

MS-ESS2-6: Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmosphere and oceanic circulation that determine regional climates
SWK:

∉ What is a model?
∉ What is heat?
∉ What is thermal energy?
∉ How is thermal energy transferred between systems? Intra systems?
∉ What is unequal heating? How is it determined?
∉ What is a pattern?
∉ What patterns can be observed during atmosphere circulation?
∉ What patterns can be observed during oceanic circulation?
∉ How do atmospheric circulation patterns change with latitude, altitude, and geographic land distribution?
∉ What is climate? How is climate determined?
∉ What is the climate of Yonkers?
∉ What is the climate of Canada?
∉ How does the climate of Yonkers different from or similar to Canada?

SWBAT:

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- ∉ Develop a physical model of the Coriolis force
- ∉ Create and interpret a physical model of convection current
- ∉ Use a computer model of air pollution data to identify the air quality index
- ∉ Draw a static model (diagram) of methods of energy transfer
- ∉ Use models of isobars on weather maps to interpret pressure
- ∉ 3D print geographic land distribution of Canada to Yonkers
- ∉ Describe the data that would be collected from weather maps of Yonkers and Canada.
- ∉ Identify the tools and methods that were used to gather the data found on the weather
- ∉ maps.
- ∉ Collect data from weather maps for Yonkers or New York City.
- ∉ Predict how the movement and interaction of air masses will affect Yonkers' weather conditions.
- ∉ Describe the influence of latitude and altitude on Yonkers' weather conditions.
- ∉ Identify the relationships between weather variables using data from Yonkers weather maps.
- ∉ Synthesize information from different types of maps in order to draw conclusions.
- ∉ Explain why Yonkers' weather can only be predicted within probabilistic ranges.
- ∉ Describe the complex interaction between air masses at fronts.
- ∉ Describe how the movement and interaction of air masses causes changes in Yonkers' weather.
- ∉ conditions.
- ∉ Describe the influence of the Atlantic Ocean on air mass development and Yonkers' weather.
- ∉ Describe the relationships between:
    - large weather patterns (pressure systems) and associated weather conditions in Yonkers or New York City.
    - types of fronts and the interactions of air masses in Yonkers.
    - types of pressure systems and winds in Yonkers

Social Studies Standards (list if using, unpack under each standard into SWK and SWBAT)**:**

Geographic Reason (8th grade): Use location terms and geographic representations such as maps, photographs, satellite images, and models to describe where places are in relation to each other, to describe connections between places, and to evaluate the benefits of particular places for purposeful activities

SWK:
- ∉ What are geographic representations and how can we use them to show the path of smoke from Yonkers to Canada?
- ∉ Where is Yonkers in relation to Canada?

SWBAT:
- ∉ With respect to Earth's systems, how is Yonkers connected to Canada?
- ∉

Mathematics Standards (list if using, unpack under each standard into SWK and SWBAT)**:**

SWK:
- ∉ 7.SPC: Statistic and Probability
- ∉
- ∉

SWBAT:
- ∉
- ∉
- ∉

ELA Standards (list if using, unpack under each standard into SWK and SWBAT)**:**

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SWK:

- ∉
- ∉
- ∉

SWBAT:

- ∉
- ∉
- ∉

Technology Standards:

- **NYS Computer Science and Digital Fluency** (select at least 1 for Smart Start)**:7-8.CT.2:** Collect and use digital data in a computational artifact.
- **ISTE:**

Social Justice Standards:

Diversity 7: DI.6-8.7: I can accurately and respectfully describe ways that people (including myself) are similar to and different from each other and others in their identity groups.

Other (Art, SEL, etc):

Links to Standards/Reference Frameworks:
NYS NextGen ELA and Math, NGSS, NGSS by DCI Nat'l C3 SS Framework, NYS K-8 SS Standards, ISTE, Social Justice Standards, CASEL SEL Framework, NYS CS and Digital Fluency

Teaching/Learning Goal Notes for Stage 1:

See linked comments

STAGE 2: EVIDENCE & ASSESSMENTS:

Performance Task Narrative

Goal: *Provide a statement of the task. Establish the goal, problem, challenge, or obstacle in the task.*

The goal of this task is for 7th-grade science students at PEARLS to develop a series of models that explain the mechanism by which smoke from Wildfires in Yonkers traveled to Yonkers, New York.

Role: *Define the role of the students in the task. State the job of the students for the task.*

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Environmental Engineers

Audience: *Identify the target audience within the context of the scenario.* Students in the middle school autism class at PEARLS.

Situation: *Set the context of the scenario. Define the narrative.*
On June Thursday, June, 8, former Superintendent Dr. Quezada closed Yonkers Public Schools due to a Canadian wildfire blanketing the atmosphere in Yonkers. How is the possible for wildfires originating in Canada to affect the air quality in Yonkers?

Product(s): *Clarify what the students will create and why they will create it.*

- Initial static drawing that shows and explains the mechanisms responsible for the smoke transmission from Canada to Yonkers.
- A physical model of Coriolis force to explain why wind is deflected to the right in the Northern Hemisphere but to the left in the Southern Hemisphere.
- Video lab of the convection current physical model.
- Data table and graph of air quality index with static drawings showing the concentration of air particles.
- Constructing isobars on weather map activity and using the data to interpret pressure gradient.
- Static drawings of investigation of methods of heat transfer: conduction, radiation, and convection.
- Using simulation to write scientific arguments on heat transfer (via conduction) between 2 systems.
- Revised model that shows and explains the mechanism responsible for the smoke transmission from Canada to Yonkers.

Criteria for Success): *Provide students with a clear picture of success. Identify specific standards for success such as rubrics, checklists, quizzes, etc.*

- ❏ Checklist for Modeling: CAKESZ
- ❏ Rubric: Redway (2023) Theoretical Model of Interpreting Drawing Activities Proficiency

Other Evidence/Assessments:

Formative Assessments (Task Cards)

1. *Peer-to-peer assessment*: Students use MARK protocol to evaluate each other's model; Padlets/post it notes to share their responses.
2. *Self-assessments***:** Provide students with I can statements about knowledge and skills that they should acquire from the lesson. Students use the QFT framework to ask questions about the systems and system models under investigation.
3. *Teacher to students:* Plickers on knowledge and skills that students should have acquired in the lessons; whole class notes generation. Acrostic on terms (i.e., Coriolis force, thermal energy) from the unit. Frayer model of terms (i.e., heat, wind, air pressure, isobar) from the unit. Poll Everywhere on Systems and System Models; V chart of each investigation; HMH Assessments

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STAGE 3: THE LEARNING PLAN:

Learning Activities

Engineering Design Process to divide into stages such as Ask, Brainstorm, Create, Investigate, Improve)

Week 1: Kick-off and Asking Questions About the Phenomenon

Learning Goals:
SWBAT **ask questions** to figure out the mechanisms involved in th transmission of smoke from Canadian wildfires to Yonkers, NY

Learning Event: Ask Researchable Questions

1. Provide students with background scenario video: https://hudsonvalley.news12.com/yonkers-mayor-schools-closed-today-because-of-unhealthy-air-quality
2. Mini-lesson: Introduction to QFT
3. I will share driving questions, students' roles as environmental engineers/scientists, mediated resources: graphics of distance from Canada to Yonkers, video of air quality in Yonkers on June 7, 2023, and a picture of wildfires from Canada.
4. Using Poll Everywhere, students share 1 relevant question that is researchable either through literature search or empirical research (i.e., experimentation)
5. Students will ask questions by observing the multiple pieces of evidence about the phenomenon. Students will use the "I notice…, I wonder…" questioning prompt as a guide to ask open and closed questions.
6. Students view "Brain Games: In Living Color."
   a. Students explain the process that causes us to see color from light-emitting objects (Sun) and opaque objects (atmospheric particles and landforms)
7. Selecting from 2 of 5 exercises, based on a common reading, *The Fantastic Sky*, students, create visual models, and explanations, and respond to multiple choice questions to obtain knowledge about the causes of the color changes that were observed in the sky during the phenomenon.

Formative Assessments:
Homework: Students write a newspaper article/create a documentary: School closing due to air quality. Give the local and scientific perspective based on questions generated in class.
IXL: Describe the geosphere, biosphere, hydrosphere, and atmosphere
IXL: Transmission, reflection, absorption of waves

Notes/Resources:

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Week 2: Initial Model: Why the Sky Change Color

Learning Goals:
SWBAT construct an **initial model** that shows the mechanisms of how the smoke particles from Canadian wildfire change the color of the sky in Yonkers, NY

Learning Event: Brainstorm, Create a Static Drawing of the Phenomenon
1. Mini-lesson: Need for Models
2. Mini-lesson: Modeling Checklist
3. Mini-lesson: Introduce the initial modeling task
4. Mini-lesson: Brainstorming the inclusion-exclusion criteria of the phenomenon
5. Mini-lesson: Redway's static drawing model protocol: Planning the temporal changes to be displayed in the model
6. Creating the static drawing
7. Demo Physical model of scattering: Teacher or students bounce a pinpong ball of the edge of a Chromebook. The ping pong ball symbolizes the light ray bouncing off. The Chromebook represents the air molecule

Formative Assessments:
1. PollEverywhere: Given a picture of the sunrise for December 7, 2023 and the prompt "What is the cause of the colors in today's sunrise?", students generate a response.
2. Thought Experiment: Examine the ruler to see 1mm. In a thought experiment, divide the 1m into 1000 pieces to visualize the size of 1 micron (i.e. micrometer). Google the size of a smoke particle. Using Table 20.1 to predict the color of the sky based on the size of the smoke particle.
3. Quiz_12 Multiple choice question on the reading *Fantastic Sky*

Notes/Resources:
Reading: CK12_Scientific Models
Images for Modeling Checklist Generation
Matrix: Need for Models
Colored pencils
Pencil
Ruler
Tabloid paper (11 x 17)

Week 3: Experimentation: Air Pressure and Wind

Learning Goals:
SWABT plan and carry out experiments to learn about air pressure and wind and their role in the smoke transmission.

Learning Events: Air Pressure and Wind
1. Constructing and interpreting isobars.
2. Investigate the air pressure difference to generate wind using
3. Visualizing air pressure using mathematical and physical models
4. Visual Summary: Constructing diagrams for each section of HMH Exploration_2 reading
5. Forecasting New York City Weather for January 14-17, 2022
6. HMH_Exploration_Formation of Wind_Apply and Draw Activities

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Formative Assessments:

1. HW_As an environmental engineer, students develop a prototype of a barometer and collect weather data for 5 consecutive data. Students invent their own unit to show the subjectivity in naming units
2. Do Now: Give students maps of weather maps from NYS lab "Weather and Climate" to interpret air pressure to predict the probability of precipitation for New York City
3. Do Now: PollEverywhere: Students use knowledge of their current station on air pressure to describe the storm on December 18, 2023

Notes/Resources:

1. 5 recycled 1Liter plastic bottles
2. 2 bags of marshmallow
3. Globe Fearon: What is an isobar
4. Redway: Visualizing Air Pressure Using Mathematical and Physical Models
5. Period Table
6. HMH_Modeling the Formation of Wind

Week 4: Experimentation: Coriolis Force

Learning Goals:
SWABT plan and carry out experiments to learn about Coriolis Force in direction/path of wind

Learning Events:

1. Using a simulation activity, Coriolis Effect - Javalab, students observe the effect of Coriolis force from Northern and Southern Hemisphere perspectives. Students use the simulation, to construct a model of Earth's rotation and wind direction in the Northern and Southern Hemisphere.
2. Using PollEverywhere, students share their experiences with flying drones
3. Students view video segments, to learn about drone safety and drone care
4. Students use a game of catch while spinning to observe the effect of Coriolis force and record their responses using drones.
5. Students create a physical of Coriolis force using a rotating inflatable globe and food dye. Students record their responses in slow motion
6. Students use their primary data sources as evidence for writing a scientific argument for how the wind would blow smoke from Canada to Yonkers.
7. Students use their findings to update their static drawing models.

Formative Assessments:
Students complete Plickers questions on drone safety and care
DN_Perspective Thinking: Coriolis on a Merry-Go-Round (Traditional + MIT)
DN_Coriolis Force_Aircraft Path
DN_HMH_Model the Effects of Earth's Rotation in the Atmosphere
HW_Coriolis Force in Meteorology and Aviation: Students research and make a 1-minute about the cause and effect of Coriolis force and its impact on the 1 of 2 selected engineering field

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Notes/Resources:
1. Drones
2. Coriolis force simulation
3. Large foil tray
4. Blue food dye
5. Inflatable globe
6. Device for recording in slow motion
7. Pipette
8. Beaker
9. MIT Coriolis Force Demo: https://www.youtube.com/watch?v=dt_XJp77-mk
10. Coriolis Force on Merry Go Round (gif): The merry-go-round and the Coriolis component of acceleration | ME 274: Basic Mechanics II (purdue.edu)
11.

Week 5: Experimentation: Air Temperature

Learning Goals:
SWABT plan and carry out experiments to learn about factors that affect air temperature

Learning Events:
1. HMH_Explore Density Differences in Water
2. Station_Isotherms
3. Station_Convection Current
4. LAB_Heating and Cooling Rate of Land vs. Water

Formative Assessments:
1. Do Nows: Students select 5 points of do nows from 9 tasks addressing temperature. Some tasks require the use of 2 simulations
2. HW_As an environmental engineer, students develop a prototype of a thermometer and collect weather data for 5 consecutive data. Students invent their own unit to show the subjectivity in naming units

Notes/Resources:
1. LAB_Heating and Cooling Rate of Land vs. Water: sand, water, thermometer, heat lamp, 250 beakers
2. Station__Convection Current: blue and red dye, ice maker, Styrofoam cup, eye dropper, thermometer, clear tub, electric kettle
3. Simulation for the effect of altitude on air temperature: Atmosphere - JavaLab
4. Simulation for air temperature vs. air pressure: Sea and Land Breeze - JavaLab
5. Simulation for the effect of air temperature on density Sea and Land Breeze - JavaLab
6. Simulation for the effect of air temperature on air pressure Sea and Land Breeze - JavaLab

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