Unit 6.3 CS: Why does a lot of hail, rain, or snow fall at some times and in some places and not others?

(Weather, Climate, and Water Cycling + Computer Science)

Changes between Public Release and Computer Science field test unit

Modifications to individual lessons are summarized in the table below:

Revision Lesson	Field Test Lesson and changes made
Lesson 1	Exploration of the hail dissection images and the hail frequency map from the old lesson 2 have been moved into this lesson. These happen before building the driving question board, to help broaden the range of questions students raise about this phenomenon.
Lesson 2	This is lesson 2 of the Public Release version, but shorter. The hail swatch maps and weather data table have been separated from each other to help support comparing patterns across hail case sites. A new idea is made explicit. A video has been added that shows a playback of radar images for two hail fall events. An engineering task has been added - creating an initial sketch of a design for measuring how the air higher up compares to the air near the surface.
Lesson 3	This is a new lesson. It includes a short station-based exploration of 3 different weather-related sensors connected to micro:bits. The lesson introduces some constraints for reusing these sensors for the design ideas from the prior lesson, which students use as they revise their design ideas one additional time. This lesson introduces input-process-output thinking, a recurring lens that students use to model information flow in software/ hardware systems in all subsequent CS-infused middle school units.
Lesson 4	This is lesson 3 of the Public Release version, but shorter. It spends less time having students analyze data tables data of temp. vs. altitude from weather balloons. We removed the progress tracker entry at the end of the lesson. We added the use of a computer visualization program (TUVA) to help students compare patterns of temp. vs. altitude more readily. This help build literacy in TUVA use, which is a tool students encounter in subsequent middle school units.
Lesson 5	This is lesson 4 of the Public Release version, but shorter. It no longer has a focus on planning the investigation for using sensors to collect schoolyard data. Instead students are provided a structured protocol for doing this data collect with the micro:bit sensor system and then practice using the protocol and sensors inside before going outside to collect data. The structured protocol is in the form of a flow chart - which will serve as as a useful example/reference later in lesson 12, when students start create CS-oriented models for a storm simulation revision, one of which can be a flow chart.
Lesson 6	This lesson merges lesson 5 and 7 of the Public Release version into a single two-day lesson. It combines the soap bubble, balloon, and humidity investigations into a single day three-station lab. Micro:bit based sensors replace the old humidity sensors, to enable display data collected from these it in real-time in a graph. The related particle-level modeling activities for each investigation all occur back to back on day 2 of the lesson. We moved the discussion about energy transfers that used to be at the end of old lesson 5 to the start of the next lesson.
Lesson 7	This is lesson 6 of the Public Release version. We shifted the energy transfer class model that used to be developed at the end of this lesson to the start of this lesson, before the transfer task. The transfer task is the similar to the Public Release version, but shorter. It still focuses on explaining hail cloud growth and seasonal differences between the N. and S. hemispheres.

Lesson 8	This is lesson 8 of the Public Release version. We shifted the magnetic marble model to be a teacher demonstration with interactive discussion, instead of a small group activity. We added a small group activity with a particle-based phase change simulation.
Lesson 9	This is Lesson 9 of the Public Release version.
Lesson 10	This is Lesson 10 of the Public Release version. We added a second storm simulation for students to evaluate, that contains more visualizations of energy transfer and matter flow. Students now record the values they tested for input variables and corresponding output that were produced in both simulations. We added a whole class activity where the teacher introduces IF/TEN conditionals, as a way to represent input/out put relationships. We added a new progress tracker to support collecting ideas for simulation revisions to related to input/variables, interactions/mechanisms, and outputs/visualizations. We added an introduction to tradeoffs to consider when naming variables for use in a computer program.
Lesson 11	This lesson merges lesson 11 and 12 of the Public Release version into a single three-day lesson. We removed the paper-blowing activity and homemade barometer build. We shifted how we use water tubs and colored dye. It no longer is a small group designed investigation. It now is an interactive demo/discussion followed up with analysis of time-lapse videos and still images from four different tub conditions. We added two progress tracker entries to support collecting ideas for simulation revisions related to input/variables, interactions/mechanisms, and outputs/visualizations.
Lesson 12	This is the first two days of lesson 13 of the Public Release version. We structured the modeling activities differently for putting the pieces together. Instead of referring to and revising gotta-have it checklists, students now draw on the ideas they captured in their progress trackers over the past two lessons. We added a short activity to have students actually start modifying the storm simulation by adding user interface elements to it that represent additional input variables and values they think are important to include. We introduce three computer science variable types to students (number, string, and Boolean) and the tradeoffs associated with using each type. We shifted the modeling focus on day two of the lesson to be on one of two possible sub-questions related to hail formation and hail fall and we know have students develop two models for their sub-question. One of these models is a CS-oriented representation of relationships in the system (IF/THEN conditional relationships or flow charts).
Lesson 13	This replaces is the last day of lesson 13 of the Public Release version, with one additional day added to it. We added an industry profile video of a meteorologist, which also summarizes aspects of hurricane detection related to storm simulation/modeling and additional sensor technologies. We added a reflection on the use/applications of CS ideas/technologies beyond weather related ones. We added an exploration of a sensor system that measures air pressure and data on hurricane winds, surface air pressure, and damage. The transfer task (hurricanes) is the same as in the Public Release version.

- The length of the unit up to this point is two days less than the Public Release version.
- The full version of the revised CS-infused unit has been planned out. It will continue after lesson 13, to address the same phenomena and science ideas as lessons 12-22 of the Public Release version. It will most likely be 6-7 days shorter overall though. And it will have provide to implementation options:
    - continue teaching the remainder of the unit as a third lesson set OR
    - save it to use as a stand-alone unit at a later point in the year or in a later grade