## Project EDDIE Module Development Rubric

This rubric is designed to guide EDDIE module developers as they create materials to improve quantitative reasoning through use of authentic publicly accessible datasets. The rubric encodes the broad goals of Project EDDIE (Environmental Data-Driven Inquiry and Exploration).

## Background to Project EDDIE modules

Project EDDIE modules are scalable across different skill levels, both within and across different types of institutions. The modules are based on a relevant scientific question, a set of learning objectives, a plan for assessing student achievement, and a dataset that provides an opportunity to explore the scientific concept or environmental problem. *The common goal for all modules is to improve quantitative reasoning and skills associated with data manipulation and visualization*.

Project EDDIE modules use a flexible “A-B-C” structure that scaffolds learning from novice to more advanced levels. This structure allows for an instructor to choose how they want to use the materials in the classroom, where an instructor can adapt and adopt the module as needed for different contexts.

For example, one instructor might teach the whole module, while another instructor might teach just A and B, or start with B, or assign C for homework. The progressive format creates on-ramps for greater student independence and engagement with the chosen data sets.

**Part A** Introduces students to the scientific concepts, data types, technical skills, and basic analysis to be used throughout the module. The EDDIE format allows the instructor to give guidance and check work for accuracy.

**Part B** Builds on A with a new dataset, greater student independence from the instructor and increased opportunities for communication with peers. This section encourages students to explore the data and explain their results through problem-directed discovery. By the end of B, the students should have a sense of an answer to the overarching question posed by the module and be able to support a response with quantitative information they have determined themselves.

**Part C** Builds on A and B and requires the student to make choices based on what they’ve learned thus far, such as an appropriate 1) subset of data, 2) analysis, and/or 3) location to acquire data. By the end of C, students should have a more comprehensive understanding of the overarching research question. They should be able to support their responses with quantitative results from multiple sites and/or analyses and interpret their findings within the disciplinary context of the overarching question.

**Rubric**

# Module Characteristics

As students move through the A-B-C structure of the module they are given opportunities to work with data in ways that encourage:

1. **Exploration of a relevant scientific question.** The modules are anchored with an overarching relevant scientific question in an authentic context.
2. **Greater independence from instructor.** Module scaffolding is gradually removed, and students become progressively more independent. By the “C” portion students are making choices to explore the research question (e.g. about data subset/analysis/location to acquire data).
3. **Opportunities to explore and make increasingly sophisticated choices about data and analyses to address a scientific question or problem.** The module asks students to explore the data so they can decide and explain which analyses are appropriate.
4. **The development of sophistication in communicating reasoning and results.** Beginning with simpler communication strategies (e.g. explaining to a neighbor or formulation of a figure

caption), students should have the opportunity to explain and communicate their reasoning and results more thoroughly.

# Data Qualities

Using authentic and publicly accessible online datasets to address real-world questions reinforces the need and rationale for developing quantitative reasoning skills. Increasing availability of large online datasets provides unique opportunities to develop quantitative reasoning skills, particularly those associated with visualizing, analyzing, and interpreting quantitative data. The data used in EDDIE modules should be:

1. **Authentic and credible**. The data must be original data collected by scientists for a specific purpose. Manipulating authentic and “messy” data allows students to think deeply about data, including its limitations (Gould et al., 2014)
2. **Relevant and real**-**world**. Choosing datasets that are place-based or otherwise meaningful to students, such as spatially resolved or real-time data, allow students to see immediate relevance. Many of these large datasets are based on high-frequency sensor systems that collect hundreds to millions of data points each day, and introducing these methods is a useful tool for engaging students in today’s age of information technology as well as encouraging them in modern scientific understandings.
3. **Publicly available**. Ensuring that others can use the activity and find data.
4. **Sufficiently large to compel development of data management skills.** Working with large datasets requires that students build critical skills associated with data management and manipulation (Strasser and Hampton, 2012).

# Quantitative Reasoning

Quantitative reasoning (QR) refers to the ability to interpret data and to reason with numbers in real- world situations (Steen, 2004), and involves utilizing math skills and critical thinking in a disciplinary context (Elrod, 2014). Quantitative reasoning components of the modules:

### Engage students in using tools to perform a visualization, analysis and generate mathematical/statistical output (Quantitative skills)

1. **Compel students to make a claim/statement/conclusion, support it with evidence, and explain the coordination between the two** (Quantitative literacy)
2. **Promote conceptual development within a disciplinary context** (Disciplinary knowledge)

# Resources and Materials

### Learning objectives are clearly stated.

1. **All instructional materials are included and are sufficient for students to achieve the learning objectives**. Each EDDIE module should have a complete set of teaching materials that are complete and stand-alone, so that the instructor would not need to supplement with other resources. These could include introductory material (e.g. instructional slides), student handouts/guides, and instructor handouts/guides.
2. **Include pre-packaged version of the dataset**. Allows for offline use of the module, if needed.
3. **Materials are appropriately cited**. All learning materials, software and learning resources must conform to copyright law and proper citation protocols.

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| **Module Criterion** | **Strong** | **Satisfactory** | **Weak** | **Absent** |
| **Module characteristics.** The module has a flexible “A-B-C” structure. As students move through the “A-B-C” structure, they are given opportunities  to work with data in ways that encourage: |  |  |  |  |
| 1. Exploration of a relevant scientific question |  |  |  |  |
| 2. Greater independence from instructor |  |  |  |  |
| 3. Opportunities to explore and make increasingly sophisticated choices  about data and analyses |  |  |  |  |
| 4. Development of sophistication in communicating reasoning and results |  |  |  |  |
|  | **Present Absent** | |  | |
| **Data qualities.** The data used in the module should be … |  |  |
| 5. Authentic and credible |  |  |
| 6. Relevant and real-world |  |  |
| 7. Publicly available |  |  |
| 8. Sufficiently large to compel development of data management skills |  |  |
| **Quantitative reasoning.** The module should … |  |  |
| 9. Engage students in using tools to perform a visualization, analysis and generate mathematical/statistical output (Quantitative skills) |  |  |
| 10. Compel students to make a claim/statement/conclusion, support it with evidence, and explain the coordination between the two (Quantitative literacy) |  |  |
| 11. Promote conceptual development within a disciplinary context (Disciplinary knowledge) |  |  |
| **Resources and Materials.** |  |  |
| 12. Learning objectives are clearly stated |  |  |
| 13. All instructional materials are included and are sufficient for students to achieve the learning objectives |  |  |
| 14. Include pre-packaged version of the dataset |  |  |
| 15. Materials are appropriately cited |  |  |