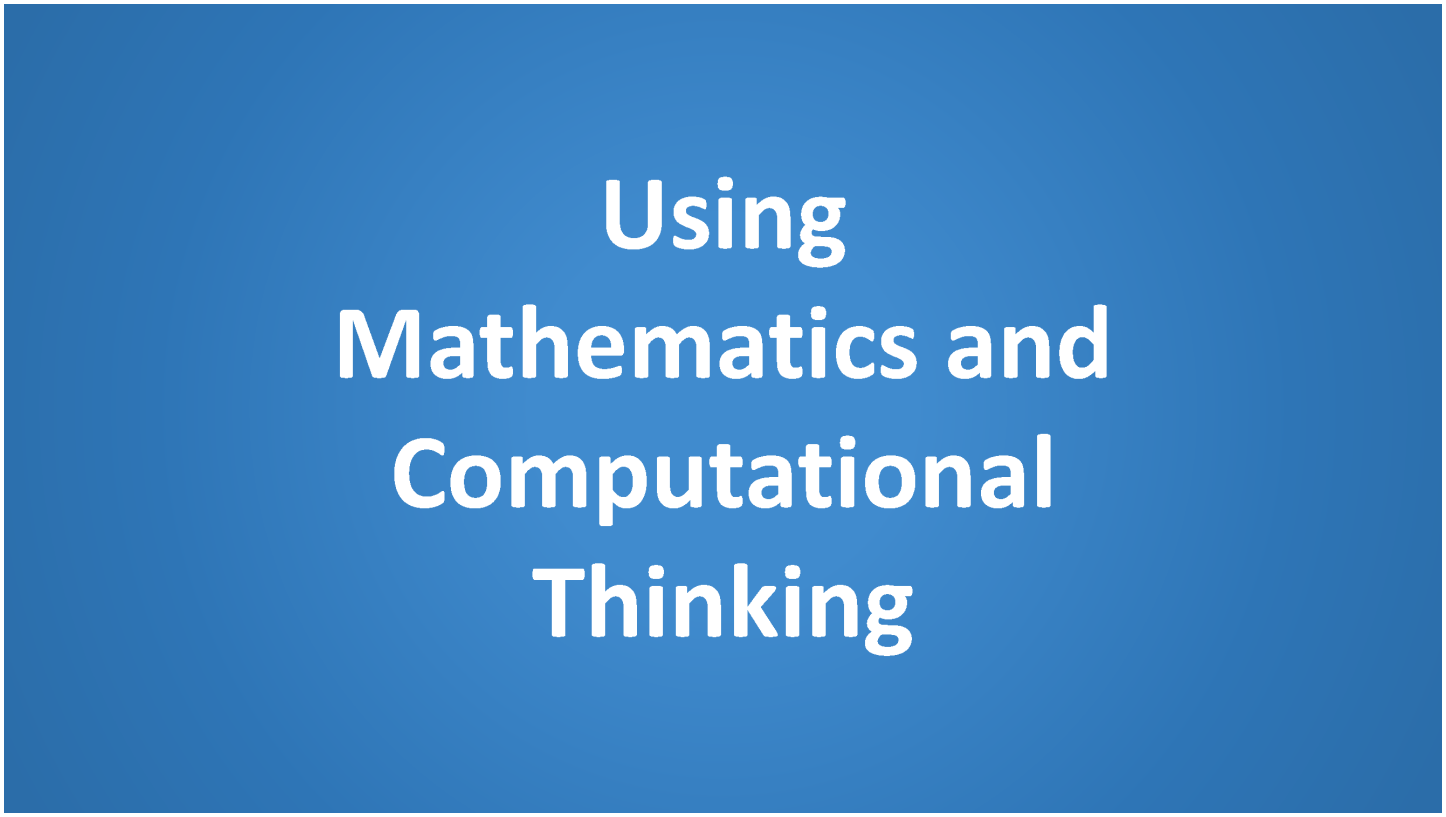
Using Mathematics and Computational Thinking with MND



Scientists and engineers use mathematics and quantitative thinking to representing variables, behaviors, and their relationships. Mathematics is used to create models and simulations; statistically analyze data; and recognize, communicate, and look for relationships with other variables.

> *Although there are differences in how mathematics and computational thinking are applied in science and in engineering, mathematics often brings these two fields together by enabling engineers to apply the mathematical form of scientific theories and by enabling scientists to use powerful information technologies designed by engineers. Both kinds of professionals can thereby accomplish investigations and analyses and build complex models, which might otherwise be out of the question.* (NRC Framework, 2012, p 65)

K-2: Mathematical and computational thinking in K-2 builds on prior experiences and progresses to recognizing that mathematics can be used to describe the natural and designed world(s).

- Use counting and numbers to identify and describe patterns in the natural and designed world(s).
- Describe, measure, and/or compare the quantitative attributes of different objects and display the data using simple graphs.

3-5: Mathematical and computational thinking in 3-5 builds on K-2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Organize simple data sets to reveal patterns that suggest relationships.

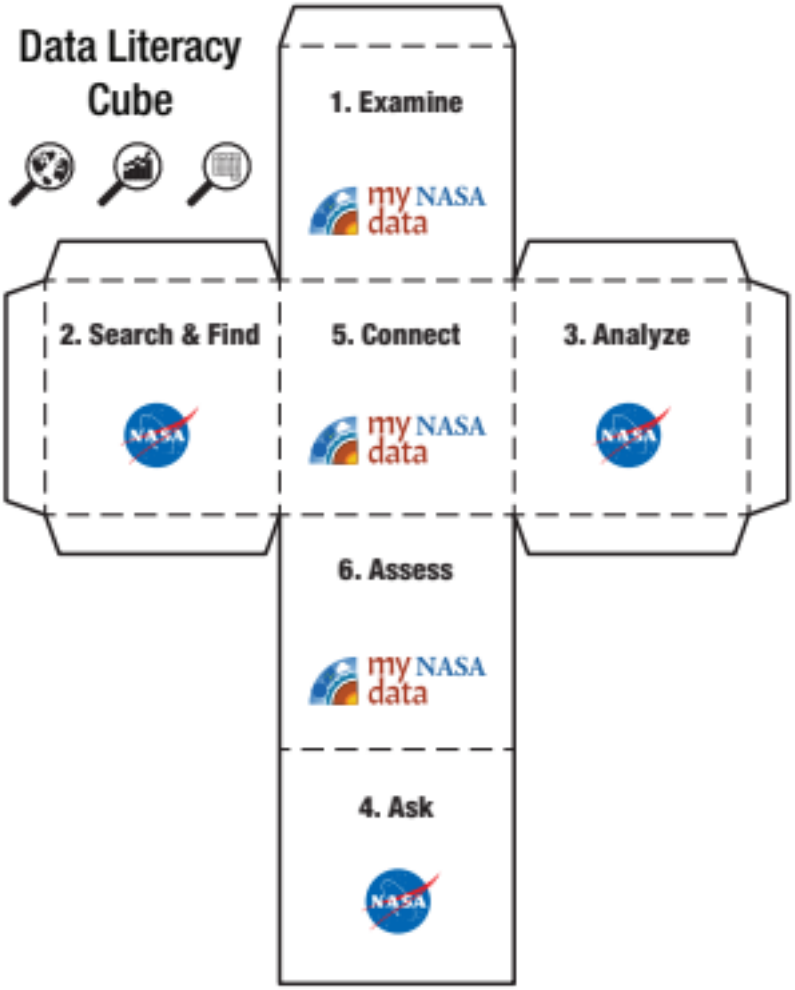
6-8: Mathematical and computational thinking in 6-8 builds on K-5 experiences and progresses to identifying patterns in large datasets and using mathematical concepts to support explanations and arguments.

9-12: Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use digital tools (e.g., computers) to analyze very large datasets for patterns and trends.
    - Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1- 4)(HS-ESS3- 6)
    - Create a computational model or simulation of phenomena, designed device, process, or system. (HS-ESS3- 3)

Data Literacy Cube

The Data Literacy Cube can be used to foster mathematics and computational thinking. The Cube is available for analyzing maps, graphs and data. The cube has differentiated questions to scaffold learners in their analysis.


Data Literacy Cube
1. Examine
my NASA data
2. Search & Find
5. Connect
3. Analyze
6. Assess
4. Ask

National Aeronautics and Space Administration

Name: Date:

Data Cube Questions

Keywords (add more words):

collect/collected data highest value instrument
lowest value measure

1. Examine- What are the data (information) about?

a. The **data** (information) are about _____ .
Example: air temperature, precipitation, plants, etc.

b. By looking at the **data** I see _____ .

2. Search and Find- How were the data **measured**?

a. The **data** were **collected** by _____ .
Example: me, scientist, satellite, etc.

b. The **instrument** used to **measure** this **data** was a/an _____ .
Example: thermometer, ruler, etc.

3. Analyze- What do the **data** show?

a. The place on Earth where the **data** were **collected** is _____.
Example: city, state, latitude/longitude, global, etc.

b. I observe that the time when the **data** were **collected** is _____
Example: month, year, day, etc.

4. Ask- Write your own questions using the **data**.

a. Why _____?

b. How _____ ?

5. Connect- How can we use this information to help us?

a. These **data** help us understand _____ .

b. These **data** can help scientists by _____ .

6. Assess- What does the information tell you? Calculate or estimate using the **data**.

a. The **highest value** is _____ . The **lowest value** is _____ .

b. Graph the **data** (use graph paper or create your own graph to show your information).

National Aeronautics and Space Administration

Name: Date:

Data Cube Questions

Keywords (add more words):

collect/collected data geographic area highest value
lowest value time range unit

1. Examine- What are the **data** (information) about?

a. The **unit** used for the **data** is _____ .
Example: °C, cm, kg, etc.

b. The **data** represent (are about) _____ .
Example: temperature, distance, mass, etc.

2. Search and Find- How were the data measured?

a. The data were **collected** every _____ .
Example: day, week, month, year, etc.

b. The data were **collected** by _____ .
Example: me, scientist, satellite, etc.

3. Analyze- What does the information tell you? Calculate or estimate the numbers using the **data**.

a. The **highest value** is _____ and represents _____ .

b. The **lowest value** is _____ and represents _____ .

c. The pattern/s I see _____ in the **data** is/are _____.
Example: the most, the least, etc.

4. Ask- Write your own questions using the **data**.

a. Why does _____ ?

b. How can _____ ?

5. Connect- How can we use this information to help us?

a. These **data** help us understand _____ .

b. These **data** help explain why _____ .

c. These **data** can help scientists understand _____ .

6. Assess- What do the **data** show?

a. The **geographic area** of Earth where the data were **collected** is _____.
Example: city, state, latitude/longitude, global, etc.

b. The **time range** (when did it happen?) is from _____ to _____.
Example: Monday, October, 12:00, etc.

c. Graph the **data.** (Use graph paper or create your own graph to show your information.)

National Aeronautics and Space Administration

Name: Date:

Data Cube Questions

Keywords (add more words):

central tendency data Earth System mean median mode
phenomenon sphere time range variable unit

1. Examine- What are the **data** about?

a. The **variable** is _____ . It represents _____ .

b. The independent **variable** is _____ .

c. The dependent **variable** is _____ .

2. Search and Find- How were the **data** measured?

a. The _____ instrument collected these data.

b. The **data** are collected every _____ .
Example: day, week, month, quarter, year, etc.

c. The **unit** used to describe the data is _____ .
Example: °C, cm, kg, etc.

3. Analyze- What does the **data** show?

a. The geographic area of Earth that is represented is _____ .

b. The **time range** is from _____ to _____ .

c. This **variable** belongs in the _____ **sphere** of the **Earth System**.
Example: Hydrosphere, Atmosphere, etc.

4. Ask- Write your own questions using the **data**.

a. How do..., Why..., What is... _____ .

b. I would like to compare _____ with these **data** because _____ .

c. How do these **data** affect another **sphere** in the **Earth System**?

5. Connect- How can we use this information to help us?

a. These **data** help us understand _____ .

b. These **data** can explain the **phenomenon** of _____ because _____ .

6. Assess- What does the information tell you? Calculate or estimate the numbers using the **data**.

a. The range of the **data** is _____ .

b. The data's **mean** is equal to _____; **median** _____; **mode** _____.

c. The measure of **central tendency** that best represents the data is the _____ . This is because _____ .
mean, median or mode

d. Graph the **data** (use graph paper or create your own graph to show your information).

National Aeronautics and Space Administration

Name: Date:

Data Cube Questions

1. **Examine-** What are the data about?
   a. What does the variable represent?
   b. What is the range of the data?
   c. In which sphere of the Earth System does this variable belong?
2. **Search and Find-** How were the data measured?
   a. What instrument/s collected these data?
   b. How frequently were the data collected?
   c. What unit describes the data?
3. **Analyze-** What does the data show?
   a. What geographic area on Earth do the data represent?
   b. What time range do these data represent?
   c. What area and time data would you like to collect to help you analyze these data?
4. **Ask-** Write your own questions using the data.
   a. Identify a question related to these data that you could research.
   b. Identify another scientific variable that you could evaluate with these data.
   c. How do you think this area compares to other geographic provinces in your region?_____
   (i.e., coastal plain, highlands, etc.)
5. **Connect-** How can we use this information to help us?
   a. What kinds of research questions could we use these data for?
   b. Describe how you may use these data to explain a naturally occurring event.
   c. How is technology connected to these data?
6. **Assess-** What information do you see on the graph?
   a. Are there any outliers? If so, what are they?
   b. Do the outliers meet your expectations? Why/Why not?
   c. Graph the data (use graph paper or create your own graph to show your information).