Essential Question: How do we define locations on a two-dimensional plane?

Overview:
Grid systems are used to make it easier to find locations on a map or on any type of coordinate plane. On a map, the standard grid system consists of latitude and longitude. In mathematics, the grid system is the coordinate plane. Understanding why a grid system is important as well as how it works gives a foundation for students to understand the value of the coordinate plane as well as how to locate and state locations of points. In this unit, students explore the need for a grid system, create a grid system for a map and apply this to identify and location objects in the coordinate plane.

Grade Range: 4 – 6   **Time Allocation**: 15 – 30 minutes per lesson

Objectives:
1. Students will identify the purpose of the coordinate plane.
2. Students will describe key vocabulary associated with the coordinate plane.
3. Students will identify locations on the coordinate plane.

Common Core Curriculum Standards

Grade 4 Mathematics - Measurement and Data
Understand that the unit length on a number line (interval from 0 to 1) can be divided into parts of equal fractional length. Draw number line representations of problem situations involving length, height, and distance including fractional or decimal units. *For example, show distances along a race course to tenths of a mile on a number line, by dividing the unit length into 10 equal parts to get parts of length 1/10; the endpoint of the segment of 1/10 length from 0 represents 1/10 of a mile from the starting point of the race. In Grade 4, all numbers lines begin with zero*

Grade 5 Mathematics – Geometry/Coordinates:
1. Understand that a pair of perpendicular number lines, called axes, defines a coordinate system.
    a. Their intersection is called the origin, usually arranged to coincide with the 0 on each line.
    b. A given point in the plane can be located by using an ordered pair of numbers, called its coordinates. The first number indicates how far to travel from the origin in the direction of one axis, the second number indicates how far to travel in the direction of the second axis.

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c. To avoid ambiguity, conventions dictate that the names of the two axes and the coordinates correspond (e.g., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate).
2. Graph points in the first quadrant of the coordinate plane, and identify the coordinates of graphed points. Where ordered pairs arise in a problem situation, interpret the coordinate values in the context of the situation.

Grade 6 Mathematics – The Number System
Graph points and identify coordinates of points on the coordinate plane in all four quadrants. Where ordered pairs arise in a problem situation, interpret the coordinate values in the context of the situation.

Procedure:

Lesson 1: Introduction

1. Hand out the map of the Boston Common and Public Garden. Also show the map on a projector. Have students respond to the following questions:
   ▪ What types of objects are shown on this map?
   ▪ What body of water is located approximately in the top center of the map?
   ▪ Suppose that you wanted to meet a friend at a specific location on the map. Choose a meeting place and write a few sentences describing how you would explain where the meeting place is to your friend.

2. Have students work in pairs to review their answers to the Do Now. Have each student share their descriptions of their meeting places while the other guesses the location. In the whole class format, have one student share their description while the class tries to figure out the location.

3. Debrief the activity by asking the following questions:
   a. Is it easy to find a location based on someone's description?
   b. What are ways to describe a location on a map that could be more precise?

Lesson 2: Grid Systems

1. Introduce the idea of a grid system. Have students cut out the maps out and then fold their maps into eighths both horizontally and vertically to form a grid system. They draw over their grid lines with a pencil and ruler. Label the grid lines with natural numbers as shown below.
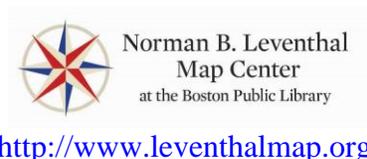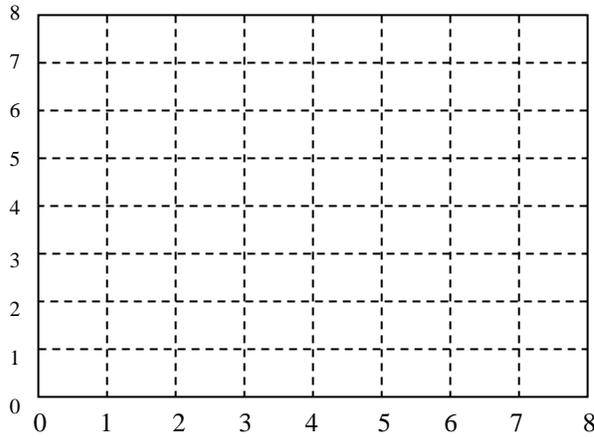
2. Explain that grid systems are used everywhere in life – streets, chess board, game of battle ship – and that are also used in mathematics. Use the grid system to introduce key vocabulary for a grid system: coordinate plane, origin, x-axis, y-axis, coordinate, coordinate point. Have students complete their notes sheet with the definitions.

3. Using the grid system for our map, have students find the meeting place at coordinates (6, 5). There may be some confusion about the difference between (6, 5) and (5, 6) – in fact, (5, 6) should be in the middle of the Frog Pond. Using the map on the projector, show the difference. Emphasize that for a grid system to work the rules for how to use it need to be consistent. State that we will always begin with the number on the horizontal axis and then move to the vertical axis. Show this using the example of (5, 6).

4. In the same pairs as from the Do Now, have students find the following locations:
    a. The meeting spot at (4, 3)
    b. The meeting spot at (1, 5)
    c. Using coordinate points, describe the location of an entrance to the Public Garden.

5. Review the findings of each pair. Discuss the following:
    a. How is our grid system better for location points than describing locations entirely in words?
    b. How could our grid system be improved?

Lesson 3: Enrichment - Fractions

1. To improve the grid system, for each axis, label the middle of each grid with quarters and halves. Then, have students find the following locations:
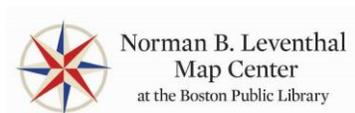
http://www.leventhalmap.org/
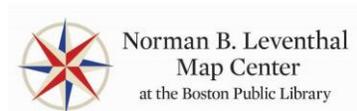
a. Which meeting place is at the point $(2\frac{1}{2}, 4\frac{1}{2})$?

b. Which meeting place is at the point $(5\frac{1}{2}, 2)$?

c. Using coordinate points, describe the location of the large statue near the bottom left of the Frog Pond.

2. Review findings as a class.

Lesson 4: Practice and Evaluation

1. Have students complete the assignment on locating points on the coordinate plane. Have students complete the assignment individually.

2. Collect the assignments to make sure student notes are complete and to evaluate student understanding of the coordinate plane.

Materials Needed:
- Maps Used:
  Boston Common and Public Garden, Walker and Company
  (http://maps.bpl.org/id/12570)
  (Note: Map is replicated at the end of the handout – it would be easier to use if printed in landscape form instead of portrait.)
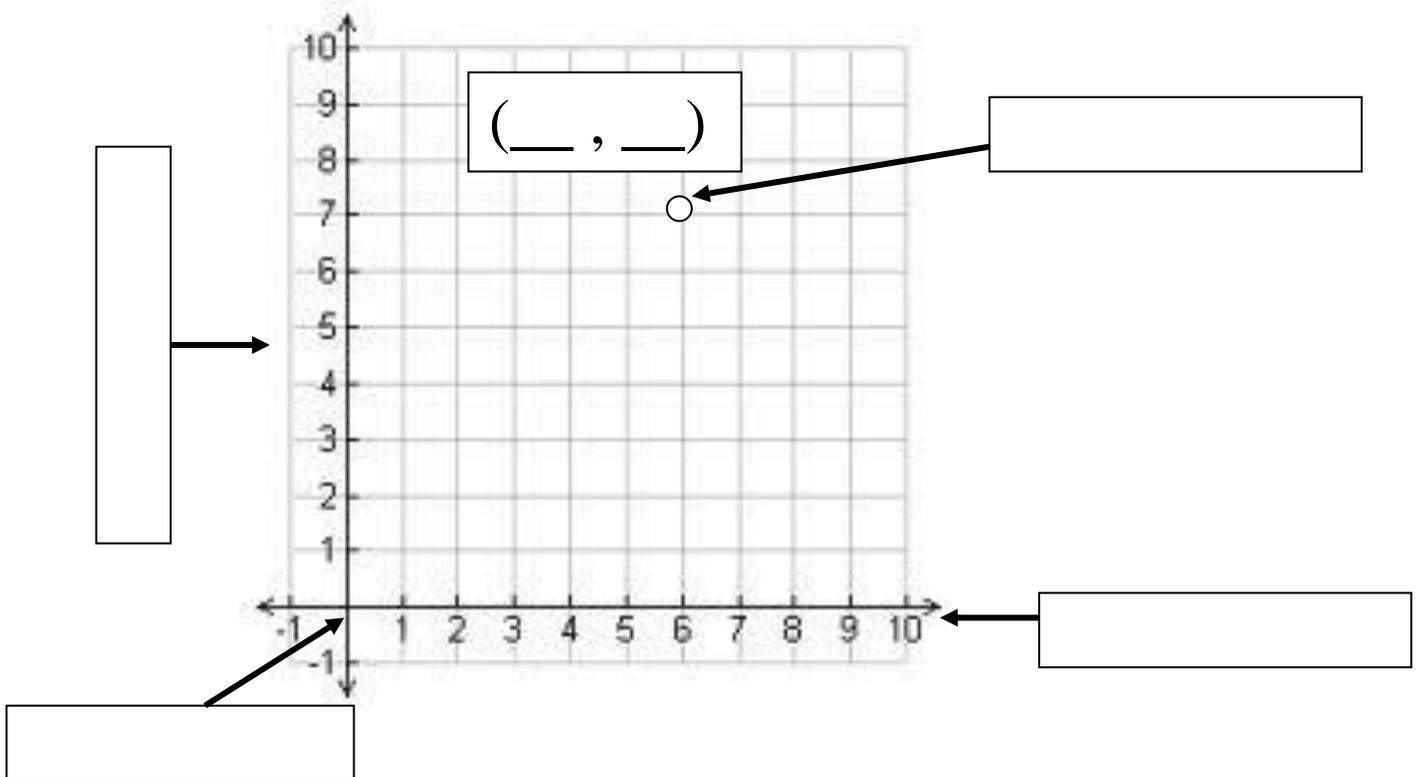- Scissors
- Rulers
- Pencils

Introduction to the Coordinate Plane

Name _____

Date _____

Lesson 1: Introduction

Review the map of the Boston Common and Public Garden.

1. What types of objects are shown on this map?

   _____

   _____

2. What body of water is located approximately in the top center of the map?

   _____

3. Suppose that you wanted to meet a friend at a specific location in the Boston Common or Public Garden. Choose a meeting place and write a few sentences describing how you would explain where the meeting place is to your friend.

   _____

   _____

   _____

   _____

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Lesson 2: Grid Systems

Notes: **The Coordinate Plane**

1. Using the map of the Boston Common and Public Garden with its new grid system, locate the following and mark the coordinate point on your map.
   a. The meeting spot at (4, 3)
   b. Then meeting spot at (1, 5)
   c. Using coordinate points, describe the location of an entrance to the Public Garden. _____

2. Think about the grid system we completed.

   a. How is our grid system better for location points than describing locations entirely in words? _____ _____

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_____

       b. How could our grid system be improved? _____

_____

Introduction to the Coordinate Plane

Name _____

Date _____

Lesson 3: Enrichment - Fractions

To improve the grid system, for each axis, label the middle of each grid on both the x and y-axes with halves. Then, locate the following meeting places. Label them on your map.

    a. $(2\frac{1}{2}, 4\frac{1}{2})$?

    b. $(5\frac{1}{2}, 2)$?

    c. Using coordinate points, describe the location of the large statue near the bottom left of the Frog Pond. _____

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Introduction to the Coordinate Plane

Name _____

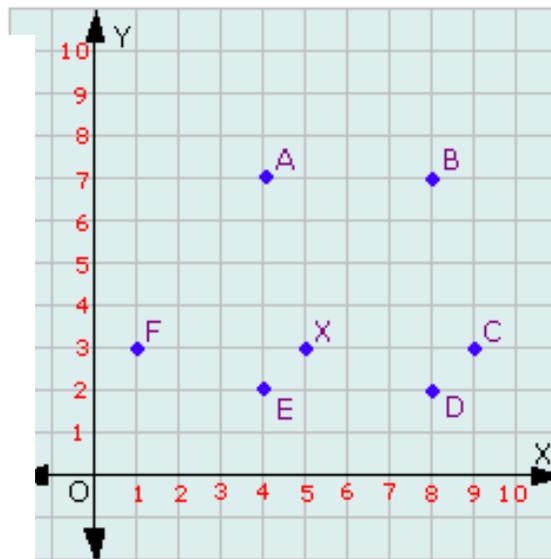Date _____

Lesson 4: Practice

1. State the coordinates of the following points:

A _____   E _____

B _____   F _____

C _____   X_____

D _____

2. Plot the following points on the graph at the right. Check them off as your complete them.

____ (2, 8)   ____ $\left(3, 5\frac{1}{2}\right)$

____ (10, 10)   ____ $\left(9\frac{1}{2}, 1\right)$

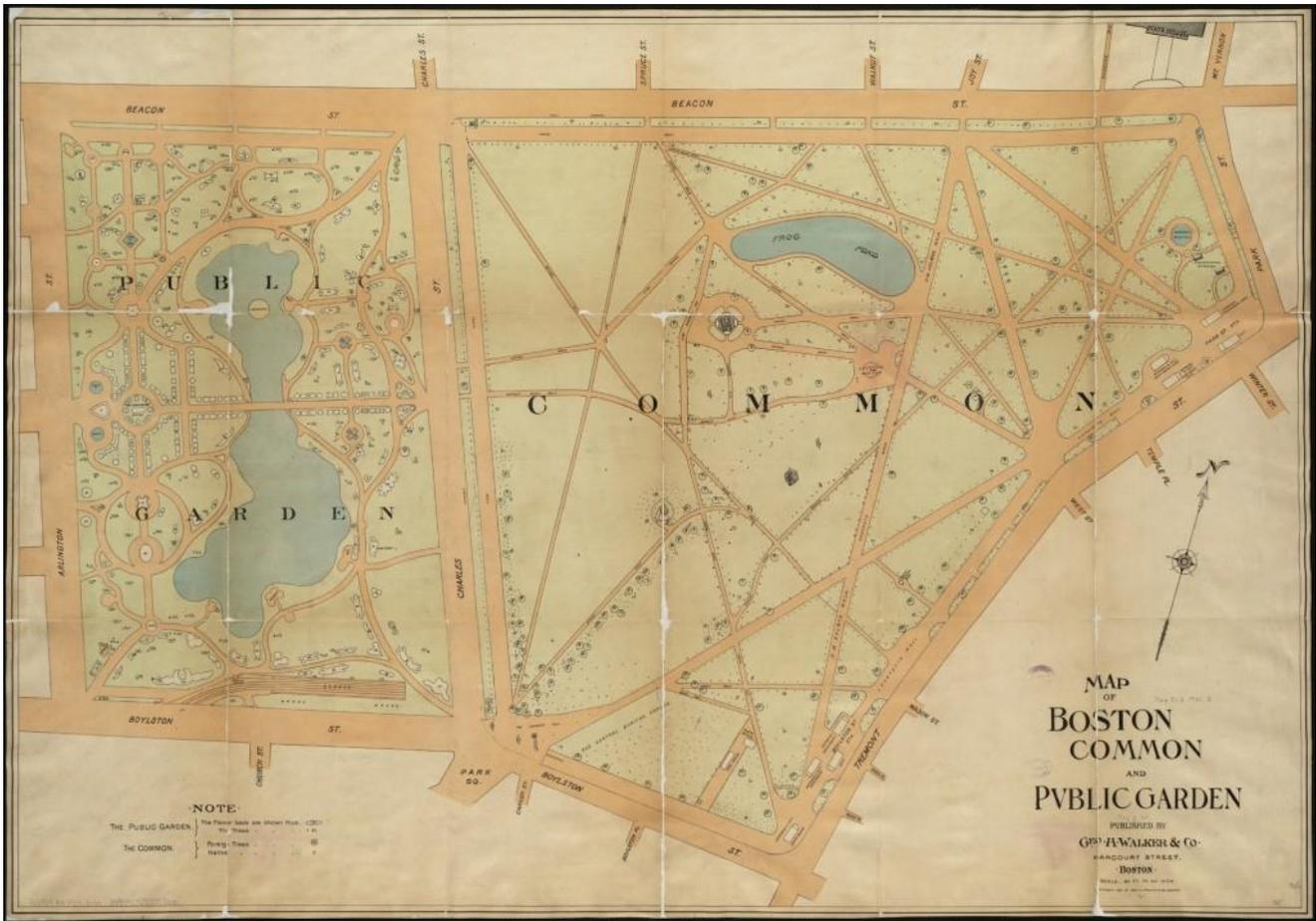____ (5, 7)   ____ $\left(0, 7\frac{1}{2}\right)$

____ (8, 0)   ____ (0, 0)

____ (0, 6)

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Map of Boston Common and Public Garden. Published by Geo. H. Walker & Co, Harcourt Street, Boston.

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