Get in Line! Lessons 1 A & B: Linear data experiments

Lesson Overview

In this series of lessons, students will complete hands-on experiments to collect data in the form of x- and y- coordinates. They will use technology to graph and look for patterns to establish solid connections to the concepts of slope, x- and y-intercepts, and how such graphs are connected to time-distance graphs.

This series of lessons should be part of a larger unit that includes student practice problems, quizzes, tests, and materials for reteaching if needed.

Alignment

Science Standards

No Science content standards in the Get in Line! lessons.

Science and Engineering Practices

SEP 4: Analyze and interpret data.
SEP 5: Use mathematical and computational thinking.
SEP 6: Construct explanations.

Crosscutting Concepts (from the SDE instructional unit resources document)

2. **Cause and effect**: The National Research Council states "events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts"

Math Standards

SCCCR Math 8.F.1 Explore the concept of functions.

a. Understand that a function assigns to each input exactly one output.
b. Relate inputs (x-values or domain) to outputs (y-values or range) to independent and dependent variables.
c. Translate among the multiple representations of a function, including mappings, tables, graphs, equations, and verbal descriptions.
d. Determine if a relation is a function using multiple representations, including mappings, tables, graphs, equations, and verbal descriptions.
e. Graph a function from a table of values. Understand that the graph and table both represent a set of ordered pairs of that function.

SCCCR Math 8.F.3 Investigate the differences between linear and nonlinear functions using multiple representations (i.e., tables, graphs, equations, and verbal descriptions).

a. Define an equation in slope-intercept form $(y=mx+b)$ as being a linear function.
b. Recognize that the graph of a linear function has a constant rate of change.
c. Provide examples of nonlinear functions.

(Note: The focus in this series of lessons is on linear functions, as highlighted above. The rest of this standard is addressed in a different series of lessons in this unit.)

Standards for Mathematical Practice

Standard 1: Make sense of problems and persevere in solving them.
Standard 3: Use critical thinking skills to justify mathematical reasoning and critique the reasoning of others.
Standard 5: Use a variety of mathematical tools effectively and strategically.
Standard 7: Identify and utilize structure and patterns.

ELA Inquiry Standards

Standard 3: Construct knowledge, applying disciplinary concepts and tools, to build deeper understanding of the world through exploration.

3.1 Develop a plan of action by using discipline-specific strategies.

3.4 Organize and categorize important information, revise ideas, and report relevant findings.

ELA Writing Standards

Standard 6: Write independently, legibly, and routinely for a variety of tasks, purposes, and audiences over short and extended time frames.

6.1 Write routinely and persevere in writing tasks over short and extended time frames, for a range of domain-specific tasks, and for a variety of purposes and audiences.

ELA Communication

Standard 1 Interact with others to explore ideas and concepts, communicate meaning, and develop logical interpretation through collaborative conversations; build upon the ideas of others to clearly express one's own views while respecting diverse perspectives.

1.2 Initiate and participate effectively in a range of collaborative discussions with diverse partners; build on the ideas of others and express own ideas clearly and persuasively.

1.4 Engage in dialogue with peers and adults to explore meaning and interaction of ideas, concepts, and elements of text, reflecting, constructing, and articulating new understandings.

1.5 Synthesize areas of agreement and disagreement including justification for personal perspective; revise conclusions based on new evidence.

Connections

Content Area Connections

- Science
- Math

Content Connections

Graphing, understanding, and being able to interpret linear functions includes foundational big ideas that are essential to success in eighth grade, as well as providing a bridge to high school mathematics. These concepts are also very easily applied to the distance-time graphs that are part of eighth grade Science. This series of lessons offers students opportunities to explore

graphing linear and non-linear functions and looking for patterns, as well as applying those ideas to distance-time graphs.

Active Learning Strategies (for Purposeful Reading, Meaningful Writing, and Productive Dialogue)

Lessons 1 A & B

- Anchor chart
- Mingle, Mingle
- Graphic Organizer
- Making Thinking Visible (Modified)
- Gallery Walk
- Table Talk
- Exit Ticket

NOTE: Lessons 2 A & B (*Get in Line! Slope, intercepts, and lines of best fit*) continue the work that begins in Lessons 1 A & B.

Computational Thinking

This series of lessons addresses computational thinking by having students use technology to connect to the big ideas of slope and intercepts in mathematics, as well as considering how those concepts are transferred to Science. Students must work together and persist in identifying and analyzing patterns that empower them to generalize those concepts.

*Computational thinking (CT) is a problem-solving process that includes (but is not limited to) the following **characteristics**:*

- Logically organizing and analyzing data
- Confidence in dealing with complexity
- Persistence in working with difficult problems
- The ability to communicate and work with others to achieve a common goal or solution
- Generalizing and transferring this problem-solving process to a wide variety of problems.

*These skills are supported and enhanced by a number of dispositions or attitudes that are essential dimensions of CT. These **dispositions or attitudes** include:*

- Confidence in dealing with complexity
- Persistence in working with difficult problems
- Tolerance for ambiguity
- The ability to deal with open ended problems
- The ability to communicate and work with others to achieve a common goal or solution

Lesson Plans

Note: There are two complete lessons in this series. Each lesson has two parts.

- Lesson 1A: Linear Data Experiments (collecting data)
- Lesson 1B: Linear Data Experiments (analyzing and interpreting data)
- Lesson 2A: $y = mx$
- Lesson 2B : $y = mx + b$

Lesson 1, Part A: Linear Data Experiments

Experiments adapted from:

Algebra Experiments I: Exploring Linear Functions
May Jean Winter & Ronald J. Carlson (Dale Seymour Publications, 1993)

Time Required – 60 minutes

Disciplinary Vocabulary – equation, coefficient, multiple representations, function, x-intercept, y-intercept, slope, linear function, slope-intercept form, and constant rate of change

Materials Needed:

Standard materials:

- Student Math notebooks

Linear Data Experiments:

Rebound	The Raven and the Jug	Spilled Ink
• Chart marked in increments of 10 cm from 50 cm – 170 cm • Racquet ball (Engage) • Rubber bouncy ball (Explore)	• Metric ruler (clear or opaque if possible) • Tall clear or opaque plastic cup (one that is about the same circumference from bottom to top) • Rocks or large marbles • Water • Paper towels for spills	• Eye Dropper • Roll of paper towels • Small container of water (travel sized bottle works well) • Metric ruler (clear or opaque if possible)

Walking the Plank A & B	Stretching Spring A & B
• 2" x 6" board that is at least 6 feet long • **Dial** bathroom scale (metric) ○ "Cheap" digital scales often require the weight to be equally distributed on the surface of the scale. That WILL NOT work for this experiment. • Metric measuring tape • Textbook (to hold up one end of the board	• Stiff ruler or paint stick • Blue tape • Plastic cup • Narrow zip tie • Length of slinky • Meter stick • Marbles • Desk or table

Handouts:

- Each Linear Data Experiment has a two-page (or front/back) handout (details included in lesson)

Linear Data Experiments:

Formative Assessment Strategies: student dialogue, assorted handouts, Making Thinking Visible posters of Linear Data Experiments

Misconceptions:

- Students may:
    - Incorrectly plot ordered pairs.

- Assume that the graph of a linear function always “looks like” a perfect line.
- Assume that the graph of a function of any sort always results in a line.

Safety Note(s): None noted.

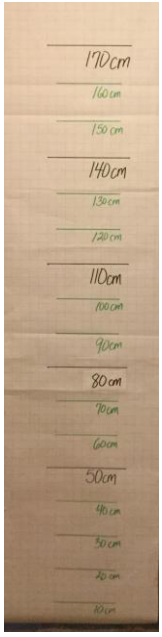
Note: The goal for this day is to complete the **Engage** and **Explore** sections of the lesson. You need to plan for *at least 30 minutes* for the linear data experiment stations that make up the **Explore** portion. You also need to do each of the experiments you plan to use with your students yourself before trying them in the classroom. Grab a friend and have some fun.

Engage

Rebound

NOTE: Do this activity before using it with your students. You will likely need to get someone to help you. A racquet ball works well for this experiment.

You will need a chart like the one shown at right. Before class begins, put it up in an area of the room that’s large enough for you and at least one student to stand in and that can be clearly seen by the rest of the class. You may also choose to have a student be the ball dropper.



- Have students sketch a t-chart in their Math notebooks.

DROP	REBOUND
170 cm	
140 cm	
110 cm	
80 cm	
50 cm	

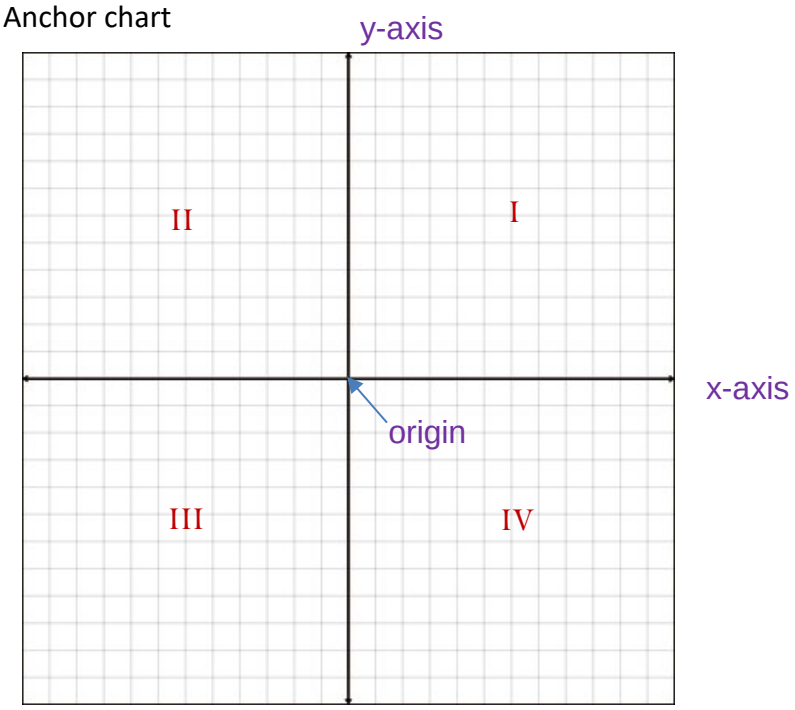
- Say: "Watch and record the height of the rebound when dropped from 170 cm". Hold the ball about a foot in front of the chart and then drop the ball. Try to hold the ball a steady distance from the chart for each drop. Have a student volunteer keep their eye on the ball and mark the height of the rebound by placing a finger on the chart. Students come to consensus regarding the estimate of the height of the rebound and record it in their t-charts.

Ask: "What do you think the height of the rebound might be when the ball is dropped from 140 cm?" Drop the ball. Again, students come to consensus regarding the estimate of the height of the rebound and record it in their t-charts.

- Repeat the steps for drops from 110 cm, 80 cm, and 50 cm.
- Use the data collected from the experiment to review some basic vocabulary: x-axis, y-axis, origin, quadrants, ordered pairs, independent and dependent variables.

NOTE: You may create an anchor chart as part of the review.

Anchor chart



- Give students a piece of graph paper and have them plot the data from their t-charts. Use this as an opportunity to review setting the scale for graphs. There is a handout with mini-graphs on it that you can run and cut apart to save paper.
- Say: "Do NOT connect the points on your graph!"
- Write these prompts on the board for students to respond to in their Math notebooks:
  - Describe why all the points are in the first quadrant.
  - Describe what is true for points in each of the other quadrants.
  - Describe what the graph from the experiment tells you about the data.

- Use the strategy *Mingle, Mingle* to have students compare their responses with their peers.

- Go over the responses to the prompts.
- The graph and responses to the prompts should be added to their Math notebooks.

Explore

Linear Data Experiments Stations

- Students work in small groups of three to four each to complete the experiments. You need to set up enough of each station to accommodate the number of groups of students.
- Plan to spend at least 30 minutes on this part.
- Plan for students to complete at least 3 experiments.
- Each experiment has handouts with detailed instructions for students to follow.
- The goal is for students to collect data that will be used in the **Explain** section of the lesson in Part B.

Experiment set-ups and descriptions.

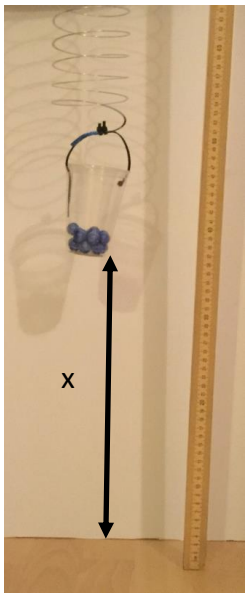
Stretching Spring A & B

Materials:

- Stiff ruler or paint stick
- Blue tape
- Plastic cup
- Narrow zip tie
- Length of slinky
- Meter stick
- Marbles
- Desk or table

Directions for set up:

- Poke two holes in a plastic up (one on each side across from each other)
- Use the zip tie to make a handle
- Use blue tape to attach the zip tie to one end of the slinky
- Tape the stiff ruler or paint stick to the edge of a table or desk so that about 6 inches is sticking out
- Tape the other end of the slinky to the ruler



Stretching Spring A

Stretching Spring B

Description of experiment:

This experiment can result in either a positive or negative relationship. In Stretching Spring A, x is the number of marbles in the cup and y is the distance from the bottom of the cup to the floor. The relationship is negative. In Stretching Spring B, x remains the number of marbles in the cup and y is the distance from the end of the ruler / paint stick to the top of the bucket. The relationship is positive. Students need to measure to the nearest mm, and the measurements should be written in cm and mm. For example, 57 mm is 5.7 cm. This will make it easier to set the scale for the graphs.

There are handouts with detailed instructions for the students to follow.

Handouts for Stretching Spring A

STRETCHING SPRINGS, A

Basic Instructions/Set Up:

x = the number of marbles in the cup

y = distance from bottom of cup to the floor

Start with 0 marbles. Measure the distance from the bottom of the cup to the floor to the nearest cm.

Add 2 to 4 marbles at a time, each time measuring from the bottom of the bucket to the floor to the nearest cm.

Repeat until you run out of weights or the cup reaches the floor.

The number of marbles in the bucket is the dependent / independent variable. (Circle one.)

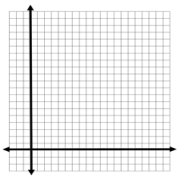
The distance the cup is from the floor is the dependent / independent variable. (Circle one.)

Data table

Number of marbles x	Distance from bottom of cup to the floor (nearest mm) y
0	___ mm (__. __ cm)

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.



Handouts for Stretching Spring B

STRETCHING SPRINGS B

Basic Instructions/Set Up:

x = the number of marbles in the bucket

y = distance from edge of the table to the top of bucket

Start with 0 weights. Measure the distance from the edged of the table to the top of the bucket to the nearest cm.

Add 2 to 4 "weights" at a time, each time measuring from the bottom of the bucket to the floor to the nearest cm.

Repeat until you run out of weights or the bucket reaches the floor.

The number of weights in the bucket is the dependent / independent variable. (Circle one.)

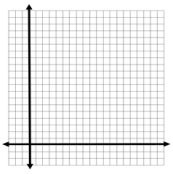
The distance the bucket is from the edge of the table is the dependent / independent variable. (Circle one.)

Data table

Number of marbles x	Distance from edge of table to top of bucket (nearest mm) y
0	___ mm (__. __ cm)

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.



The Raven and the Jug

Materials:

- Metric ruler (clear or opaque if possible)
- Tall clear or opaque plastic cup (one that is about the same circumference from bottom to top)
- Rocks or large marbles
- water
- paper towels for spills

Directions for set up:

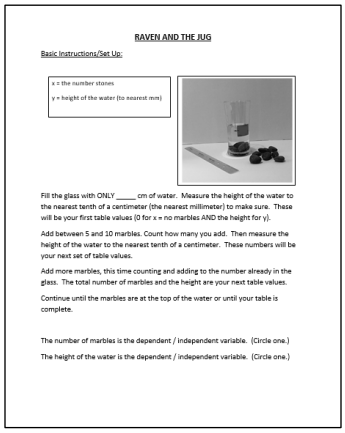
- Choose rocks or marbles that are large enough to raise the water level with only one or two added to the cup each time. The rocks in the picture came from the home décor section of Wal Mart.
- Prior to setting up for students, make a mark on each cup to designate the starting water level. To decide where you want that mark, put 5 cm of water to start. Then add 2 rocks and see how much the water level rises. You're looking for an increase of at least 5 mm AND you want to be able to collect at least 5 pieces of data. Label the starting water level measurement on the cup.

Description of experiment:

In this experiment, x is the number of rocks/marbles added each time and y is the water level in the cup. The relationship is positive. Students need to measure to the nearest mm, and the measurements should be written in cm and mm. For example, 57 mm is 5.7 cm. This will make it easier to set the scale for the graphs.

There are handouts with detailed directions for students to follow.

Handouts for Raven and the Jug



RAVEN AND THE JUG

Basic Instructions/Set Up:

x = the number stones

y = height of the water (to nearest mm)

Fill the glass with ONLY _____ cm of water. Measure the height of the water to the nearest tenth of a centimeter (the nearest millimeter) to make sure. These will be your first table values (0 for x = no marbles AND the height for y).

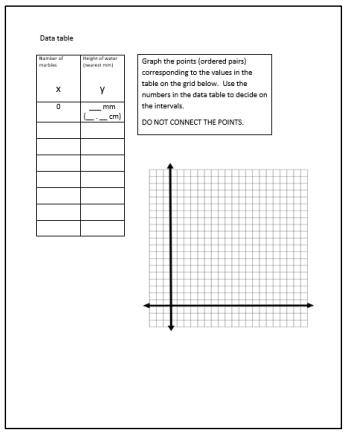
Add between 5 and 10 marbles. Count how many you add. Then measure the height of the water to the nearest tenth of a centimeter. These numbers will be your next set of table values.

Add more marbles, this time counting and adding to the number already in the glass. The total number of marbles and the height are your next table values.

Continue until the marbles are at the top of the water or until your table is complete.

The number of marblas is the dependent / independent variable. (Circle one.)

The height of the water is the dependent / independent variable. (Circle one.)



Data table

Number of marbles x	Height of water (nearest mm) y
0	____ mm (___.___ cm)

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.

Spilled Ink

Materials:

- Eye dropper
- Roll of paper towels
- Small container of water
- Metric ruler (clear or opaque if possible)

Directions for set up

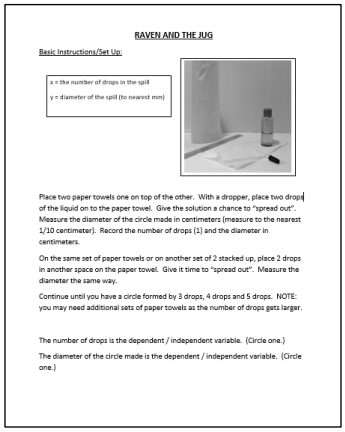
- Put enough water in the container to make it easy to fill the eyedropper. The container in the picture is a travel sized plastic bottle.
- A clear or opaque metric ruler makes it easier to find the edges of the “spills” to measure the diameters.
- Regular paper towels work better than the kind that are usually in business or school restrooms.

Description of experiment:

In this experiment, x is the number of drops of water and y is the diameter of the “spill.” The relationship is positive. Students should make a new spill for each trial rather than continuing to add drops to a single spill. They need to measure to the nearest mm across the widest part of the spill. The measurements should be written in cm and mm. For example, 57 mm is 5.7 cm. This will make it easier to set the scale for the graphs.

There are handouts with detailed directions for the students to follow.

Handouts for Spilled Ink



RAVEN AND THE JUG

Basic Instructions/Set Up:

x = the number of drops in the spill

y = diameter of the spill (to nearest mm)

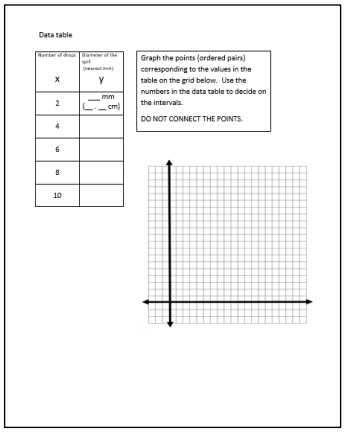
Place two paper towels one on top of the other. With a dropper, place two drops of the liquid on to the paper towel. Give the solution a chance to "spread out". Measure the diameter of the circle made in centimeters (measure to the nearest 1/10 centimeter). Record the number of drops (1) and the diameter in centimeters.

On the same set of paper towels or on another set of 2 stacked up, place 2 drops in another space on the paper towel. Give it time to "spread out". Measure the diameter the same way.

Continue until you have a circle formed by 3 drops, 4 drops and 5 drops. NOTE: you may need additional sets of paper towels as the number of drops gets larger.

The number of drops is the dependent / independent variable. (Circle one.)

The diameter of the circle made is the dependent / independent variable. (Circle one.)



Data table

Number of drops x	Diameter of the spill y (nearest mm)
2	___ mm (__ . __ cm)
4	
6	
8	
10	

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.

Walking the Plank

Materials:

- 2" x 6" board that is at least 6 feet long
- Dial bathroom scale (metric)
    - "Cheap" digital scales often require the weight to be equally distributed on the surface of the scale. That WILL NOT work for this experiment.
- Metric measuring tape
- Textbook (to hold up one end of the board

Directions for set up:

For BOTH Walking the Plank A & B

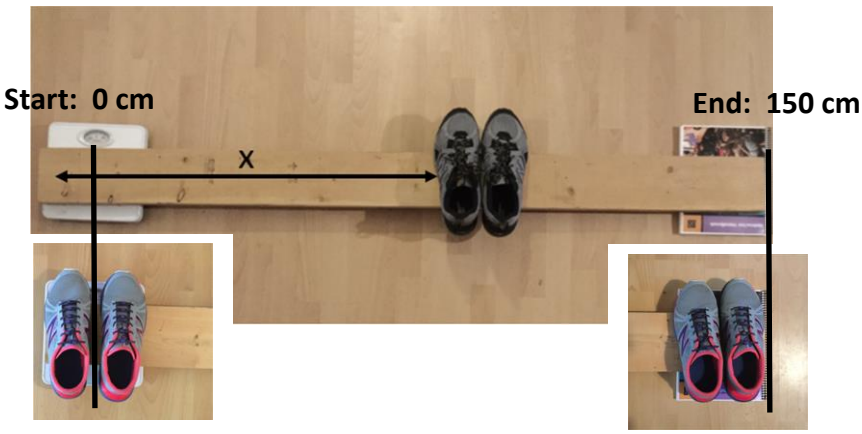
- Mark 30 cm increments on the board. You may need to adjust this based on the length of your board. The goal is for learners to collect at least 5 data points for their graphs.
- Put one end of the board on the scale. Put the textbook under the opposite end. The thickness of the textbook should be close to the thickness of the scale.

Walking the Plank A

- For Walking the Plank A, the walker begins with the outside of their right foot at the book end of the board and ends with the window of the scale between their feet.

Walking the Plank B

- For Walking the Plank B, the walker begins with the window of the scale between their feet and ends with the outside of their right foot at the book end of the board.



Description of experiment:

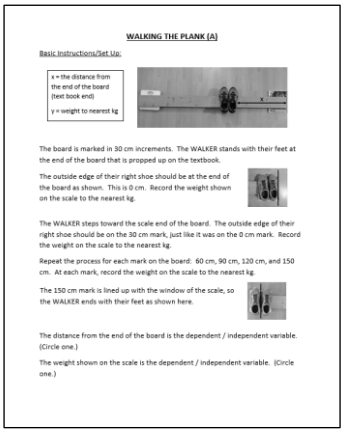
This experiment can result in either a positive or negative relationship. In Walking the Plank A, x is the distance the walker is from the book end of the board and y is weight in kg. This relationship is positive. In Walking the Plank B, x is the distance the walker is from the scale and y is weight in kg. This relationship is negative. You will need a standard dial scale that

measures kg. “Cheap” digital scales require the weight to be evenly distributed on the surface of the scale and will not work with this experiment.

Note: You may choose to have a bag filled with books or some other kind of weight to use in lieu of having students stand on the board. The bag will need to be heavy enough for the weight to register at the end of the board farthest from the scale, as well as result in measurable changes at all points along the board.

There are handouts with detailed directions for the students to follow.

Handouts for Walking the Plank A



WALKING THE PLANK (A)

Basic Instructions/Set Up:

x = the distance from the end of the board (text book end)

y = weight to nearest kg

The board is marked in 30 cm increments. The WALKER stands with their feet at the end of the board that is propped up on the textbook.

The outside edge of their right shoe should be at the end of the board as shown. This is 0 cm. Record the weight shown on the scale to the nearest kg.

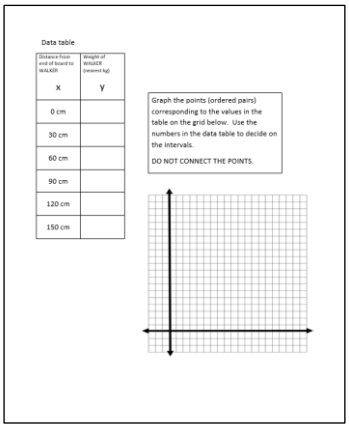
The WALKER steps toward the scale end of the board. The outside edge of their right shoe should be on the 30 cm mark, just like it was on the 0 cm mark. Record the weight on the scale to the nearest kg.

Repeat the process for each mark on the board: 60 cm, 90 cm, 120 cm, and 150 cm. At each mark, record the weight on the scale to the nearest kg.

The 150 cm mark is lined up with the window of the scale, so the WALKER ends with their feet as shown here.

The distance from the end of the board is the dependent / independent variable. (Circle one.)

The weight shown on the scale is the dependent / independent variable. (Circle one.)



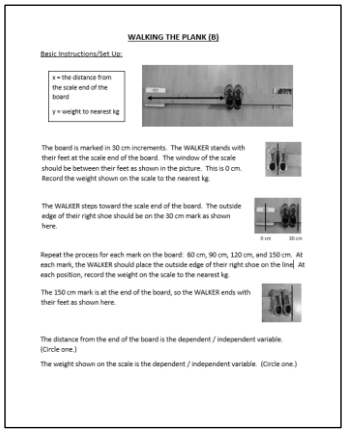
Data table

Distance from end of board to WALKER x	Weight of WALKER (nearest kg) y
0 cm	
30 cm	
60 cm	
90 cm	
120 cm	
150 cm	

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.

Handouts for Walking the Plank B



WALKING THE PLANK (B)

Basic Instructions/Set Up:

x = the distance from the scale end of the board

y = weight to nearest kg

The board is marked in 30 cm increments. The WALKER stands with their feet at the scale end of the board. The window of the scale should be between their feet as shown in the picture. This is 0 cm. Record the weight shown on the scale to the nearest kg.

The WALKER steps toward the scale end of the board. The outside edge of their right shoe should be on the 30 cm mark as shown here.

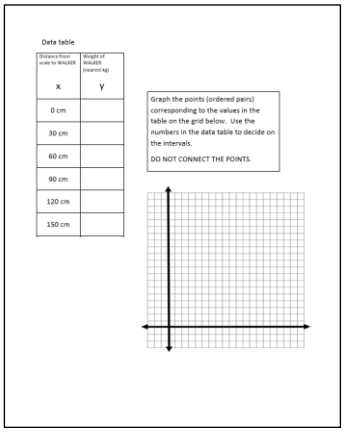
0 cm 30 cm

Repeat the process for each mark on the board: 60 cm, 90 cm, 120 cm, and 150 cm. At each mark, the WALKER should place the outside edge of their right shoe on the line. At each position, record the weight on the scale to the nearest kg.

The 150 cm mark is at the end of the board, so the WALKER ends with their feet as shown here.

The distance from the end of the board is the dependent / independent variable. (Circle one.)

The weight shown on the scale is the dependent / independent variable. (Circle one.)



Data table

Distance from scale to WALKER x	Weight of WALKER (nearest kg) y
0 cm	
30 cm	
60 cm	
90 cm	
120 cm	
150 cm	

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

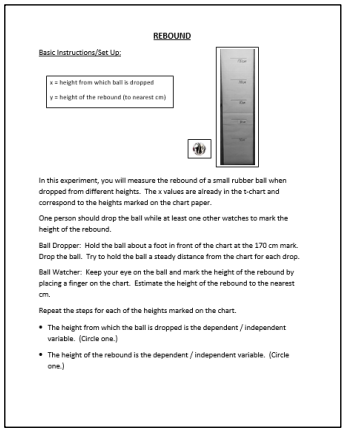
DO NOT CONNECT THE POINTS.

Rebound

Students may repeat the experiment from the **Engage** section of the lesson. Replace the racquet ball with a small rubber bouncy ball.

There are handouts with detailed directions for the students to follow.

Handouts for Rebound



REBOUND

Basic Instructions/Set Up:

x = height from which ball is dropped

y = height of the rebound (to nearest cm)

In this experiment, you will measure the rebound of a small rubber ball when dropped from different heights. The x values are already in the t-chart and correspond to the heights marked on the chart paper.

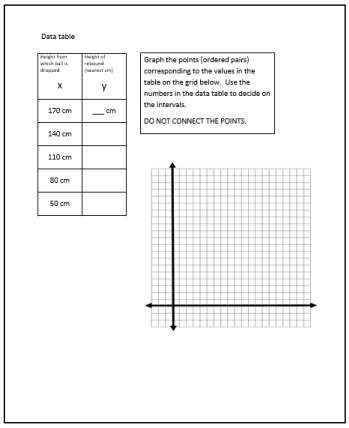
One person should drop the ball while at least one other watches to mark the height of the rebound.

Ball Dropper: Hold the ball about a foot in front of the chart at the 170 cm mark. Drop the ball. Try to hold the ball a steady distance from the chart for each drop.

Ball Watcher: Keep your eye on the ball and mark the height of the rebound by placing a finger on the chart. Estimate the height of the rebound to the nearest cm.

Repeat the steps for each of the heights marked on the chart.

- The height from which the ball is dropped is the dependent / independent variable. (Circle one.)
- The height of the rebound is the dependent / independent variable. (Circle one.)



Data table

Height from which ball is dropped x	Height of rebound (nearest cm) y
170 cm	___ cm
140 cm	
110 cm	
80 cm	
50 cm	

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

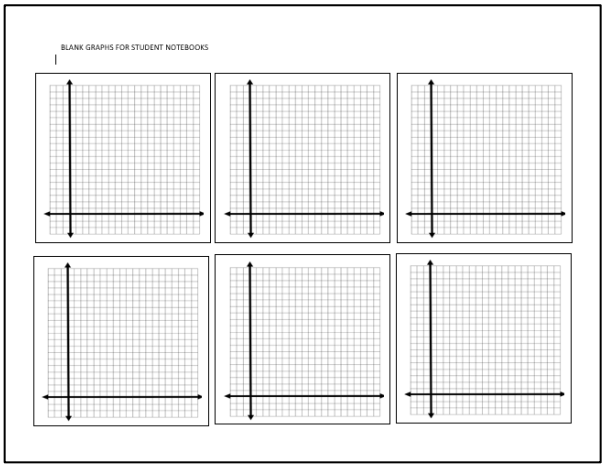
DO NOT CONNECT THE POINTS.

Organizing the experiments:

- Students should work in trios or groups of four. Decide how many stations you need based on the number of students in your classes.
    - You don't have to do all the stations. However, you need a good combination of experiments that result in positive linear relationships and negative linear relationships.
        - Positive relationships: Stretching Spring B, Raven and the Jug, Walking the Plank A, Spilled Ink
        - Negative relationships: Stretching Spring A, Walking the Plank B, Rebound
    - Every student doesn't have to complete every station. A mixture of experiments across the class is good.
    - You must decide which groups will complete which experiments so that you have a good representation of posters for the Explain section of the lesson, which will be completed on Day 2.
    - Walking the Plank takes up the most room.
    - Each group should have a designated Group Recorder.
- Place handouts at each station for students to pick up and use for that station. You may decide to run only 1 set for each group to save paper. The Group Recorder uses the station copies to make notes for the whole group and makes sure that everyone's name

is on that set of handouts. The rest of the students in the group should copy the data table into their Math notebooks. Group members may take turns as Group Recorder if they like.

- There is a handout that has blank graphs on it. Cut the graphs apart and put a stack at each station. Students can tape them into their Math notebooks.



- Students should be able to complete an experiment, record data, and sketch the graph in 10 minutes. That means they can hit three stations if you keep them moving.
- Collect the handouts. Use them to check for student understanding and to assign posters for groups to create in the **Explain** part of the lesson. Prepare index cards or slips of paper with the names of the experiments to hand out at the beginning of class on Day 2.
- Let students know they'll be working in the same groups on Day 2.

End of Lesson 1, Part A

Lesson 1, Part B

Lesson 1 B

Time Required – 60 minutes

Disciplinary Vocabulary – equation, coefficient, multiple representations, function, x-intercept, y-intercept, slope, linear function, slope-intercept form, and constant rate of change

Materials Needed:

Standard materials:

- Chart paper
- 11 x 14 or 11 x 17 paper if chart paper is not available
- Markers or colored pencils
- Straight edges
- Student Math notebooks

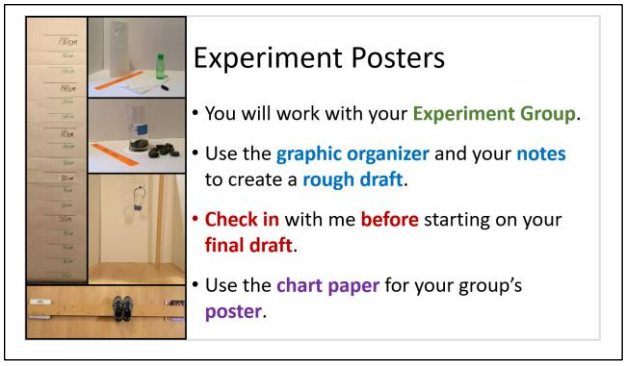
Handouts:

- Experiment poster organizer
- Completed handouts from Lesson 1A

Note: There are also PowerPoint slides included in the lesson resources.

Explain

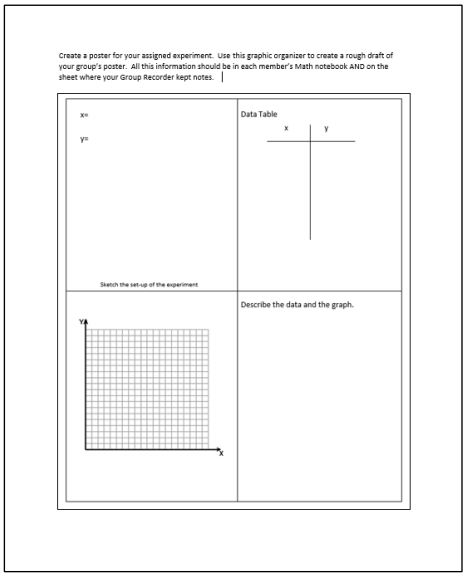
- Display instructions for group work as students enter the room.



- Distribute handouts collected at end of Day One
- Assign a poster to each group and give them a copy of the graphic organizer.
- Students will use the notes taken by their Group Recorder as well as any personal notes to work on the rough draft.

- Circulate as students work to monitor progress and check for understanding.
- Each group should check in with you and make any corrections or adjustments needed before beginning their final draft on the chart paper.
- Each student should copy the information on the graphic organizer and poster into their individual Math notebooks.

Graphic organizer handout


Create a poster for your assigned experiment. Use this graphic organizer to create a rough draft of your group's poster. All this information should be in each member's Math notebook AND on the sheet where your Group Recorder kept notes.

x=

y=

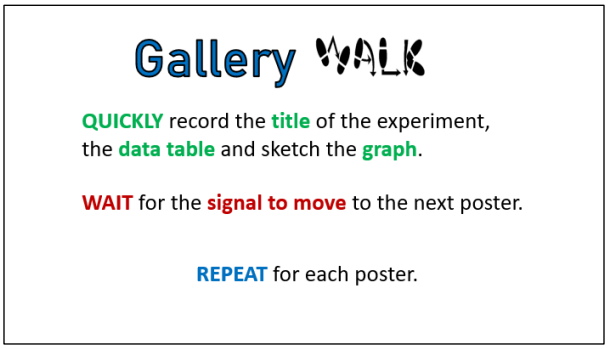
Sketch the set-up of the experiment

Data Table

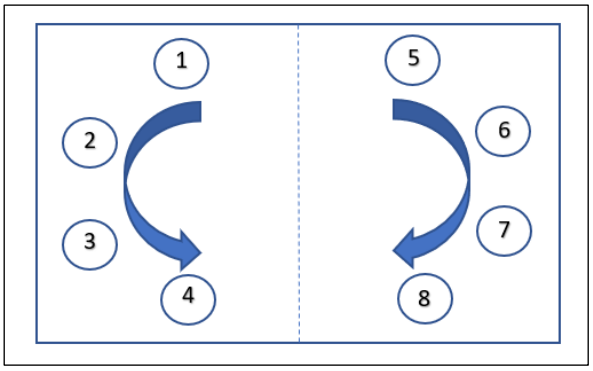
x	y

Describe the data and the graph.

- Students complete a Gallery Walk to study each group's poster.

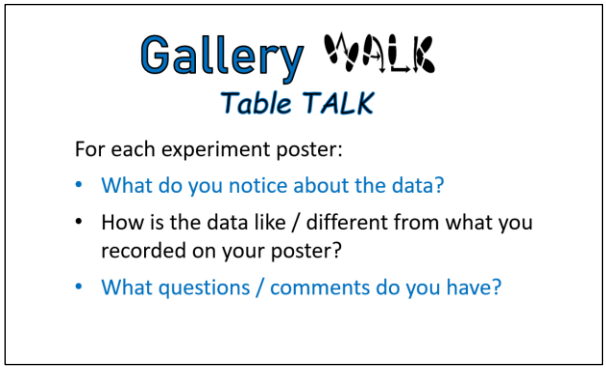


- You may set up the Gallery Walk in two parts. For example, if you have a total of eight groups of students, run two rotations.



- Students begin at the poster they created with their group. Once everyone is in place, groups rotate as shown above, spending about 4 minutes at each poster. Establish a signal that lets students know they need to move to the next poster. When groups get back to their group's poster, they return to their seats for Table Talk.

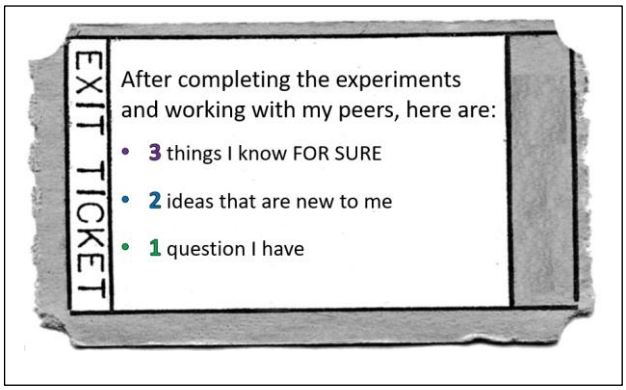
- Use the questions on the slide to guide dialogue within groups. Circulate as groups talk about the posters to monitor progress and check for understanding.



- Lead whole group discussion of the experiments. Points to bring out include:
  - Independent and dependent variables
  - That x is the independent variable and y is the dependent variable
  - Factors that may have influenced collecting data
  - Positive relationships
  - Negative relationships
  - Shape of the graphs (line-like or linear but not perfectly so)
  - What students think might happen if more data were collected for each experiment
  - What the coordinate (0, 0) means for that experiment

- Exit Ticket

  Students complete the exit ticket on index cards or small slips of paper. Collect to check for understanding and see if there are questions that need to be addressed at the start of the next class.



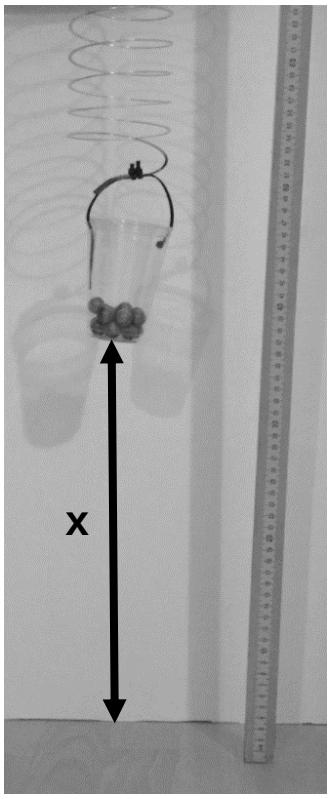
NOTE: The data from these experiments will be used later in the series of lessons to provide students opportunity to explore best fit lines using desmos.com. Each group should have completed at least three experiments on Day One. Students will use the information they recorded in their individual Math notebooks to do this.

End of Lesson 1, Part B

HANDOUTS FOR LESSON 1A BEGIN ON THE FOLLOWING PAGE

STRETCHING SPRING (A)

Basic Instructions/Set Up:



x = the number of marbles in the cup

y = distance from bottom of cup to the floor

Start with 0 marbles. Measure the distance from the bottom of the cup to the floor to the nearest cm.

Add 2 to 4 marbles at a time, each time measuring from the bottom of the bucket to the floor to the nearest cm.

Repeat until you run out of weights or the cup reaches the floor.

The number of marbles in the bucket is the dependent / independent variable. (Circle one.)

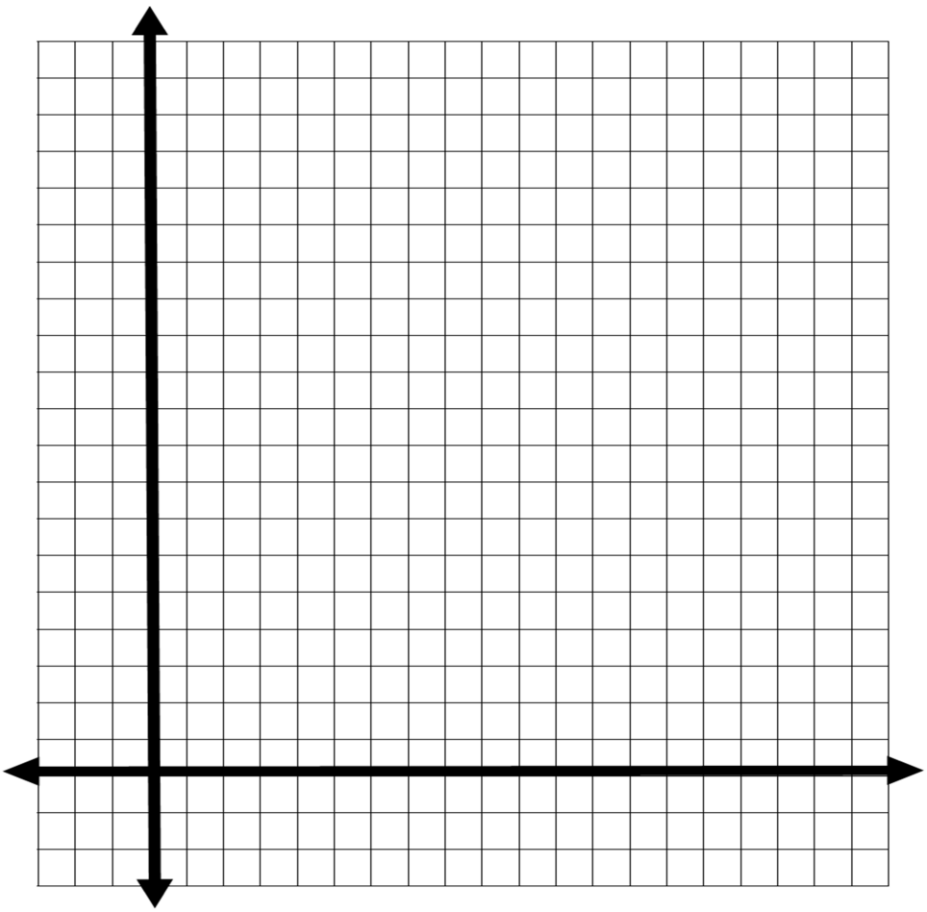
The distance the cup is from the floor is the dependent / independent variable. (Circle one.)

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.

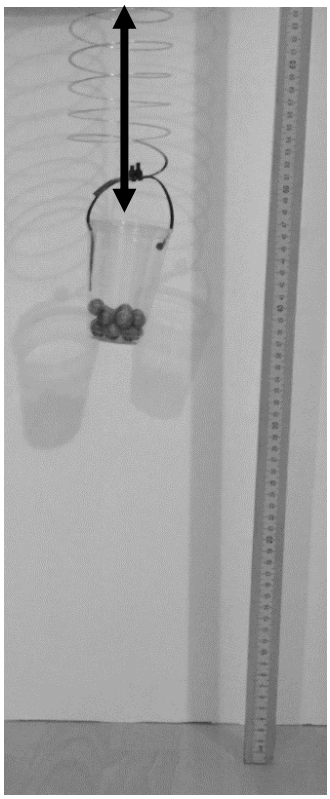
Data table

Number of marbles **x**							
Bottom of cup to floor (nearest cm) **y**							



STRETCHING SPRING B

Basic Instructions/Set Up:



x = the number of marbles in the bucket

y = distance from edge of the table to the top of bucket

Start with 0 weights. Measure the distance from the edged of the table to the top of the bucket to the nearest cm.

Add 2 to 4 “weights” at a time, each time measuring from the bottom of the bucket to the floor to the nearest cm.

Repeat until you run out of weights or the bucket reaches the floor.

The number of weights in the bucket is the dependent / independent variable. (Circle one.)

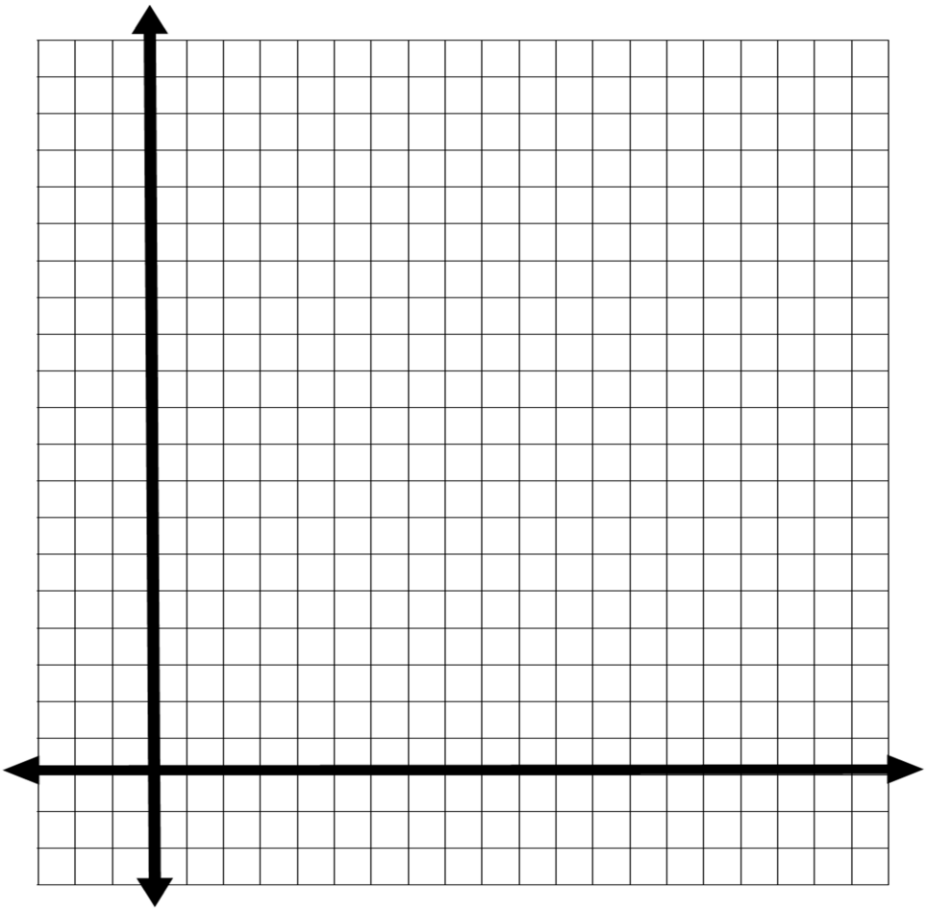
The distance the bucket is from the edge of the table is the dependent / independent variable. (Circle one.)

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.

Data table

Number of marbles **x**							
Edge of desk to top of cup (nearest cm) **y**							

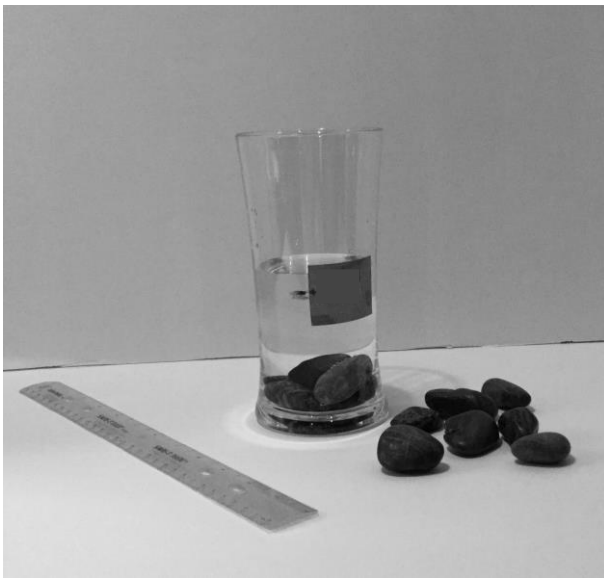


RAVEN AND THE JUG

Basic Instructions/Set Up:

x = the number stones

y = height of the water (to nearest mm)



Fill the glass with ONLY _____ cm of water. Measure the height of the water to the nearest tenth of a centimeter (the nearest millimeter) to make sure. These will be your first table values (0 for x = no marbles AND the height for y).

Add between 5 and 10 marbles. Count how many you add. Then measure the height of the water to the nearest tenth of a centimeter. These numbers will be your next set of table values.

Add more marbles, this time counting and adding to the number already in the glass. The total number of marbles and the height are your next table values.

Continue until the marbles are at the top of the water or until your table is complete.

The number of marbles is the dependent / independent variable. (Circle one.)

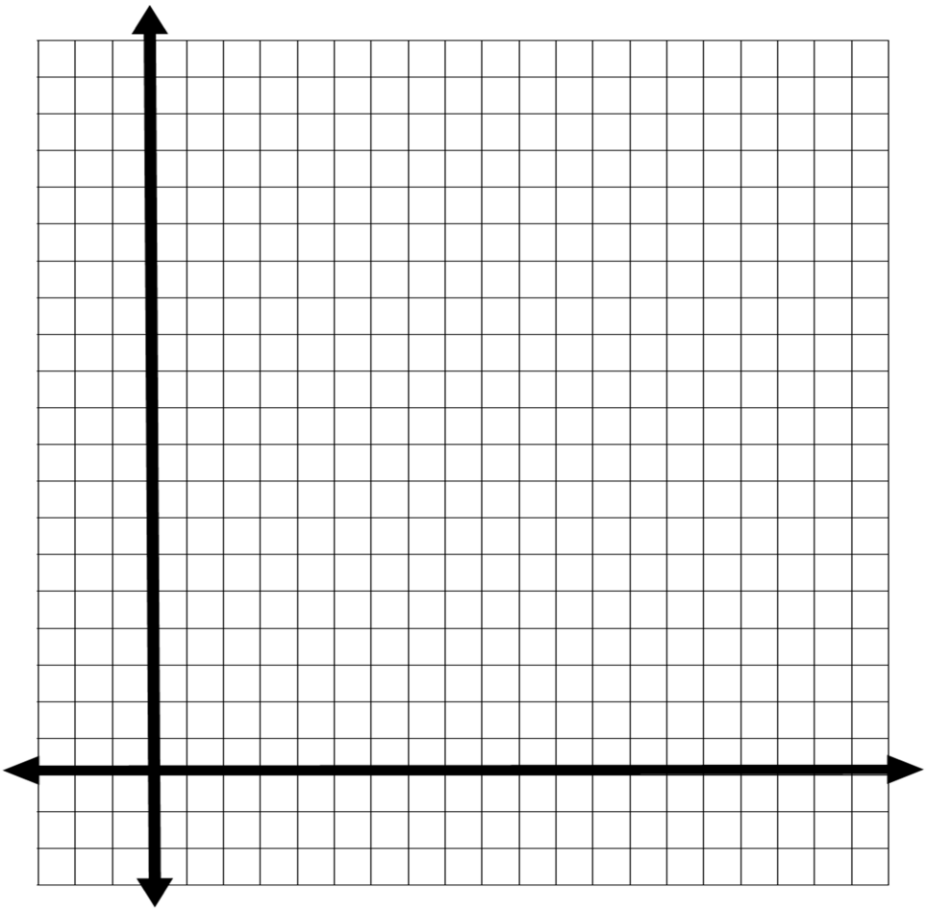
The height of the water is the dependent / independent variable. (Circle one.)

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.

Data table

Number of stones **x**							
Height of the water (nearest cm) **y**							



SPILLED INK

Basic Instructions/Set Up:

x = the number of drops in the spill

y = diameter of the spill (to nearest mm)

Place two paper towels one on top of the other. With a dropper, place two drops of the liquid on to the paper towel. Give the solution a chance to "spread out". Measure the diameter of the circle made in centimeters (measure to the nearest 1/10 centimeter). Record the number of drops (1) and the diameter in centimeters.

On the same set of paper towels or on another set of 2 stacked up, place 2 drops in another space on the paper towel. Give it time to "spread out". Measure the diameter the same way.

Continue until you have a circle formed by 3 drops, 4 drops and 5 drops. NOTE: you may need additional sets of paper towels as the number of drops gets larger.

The number of drops is the dependent / independent variable. (Circle one.)

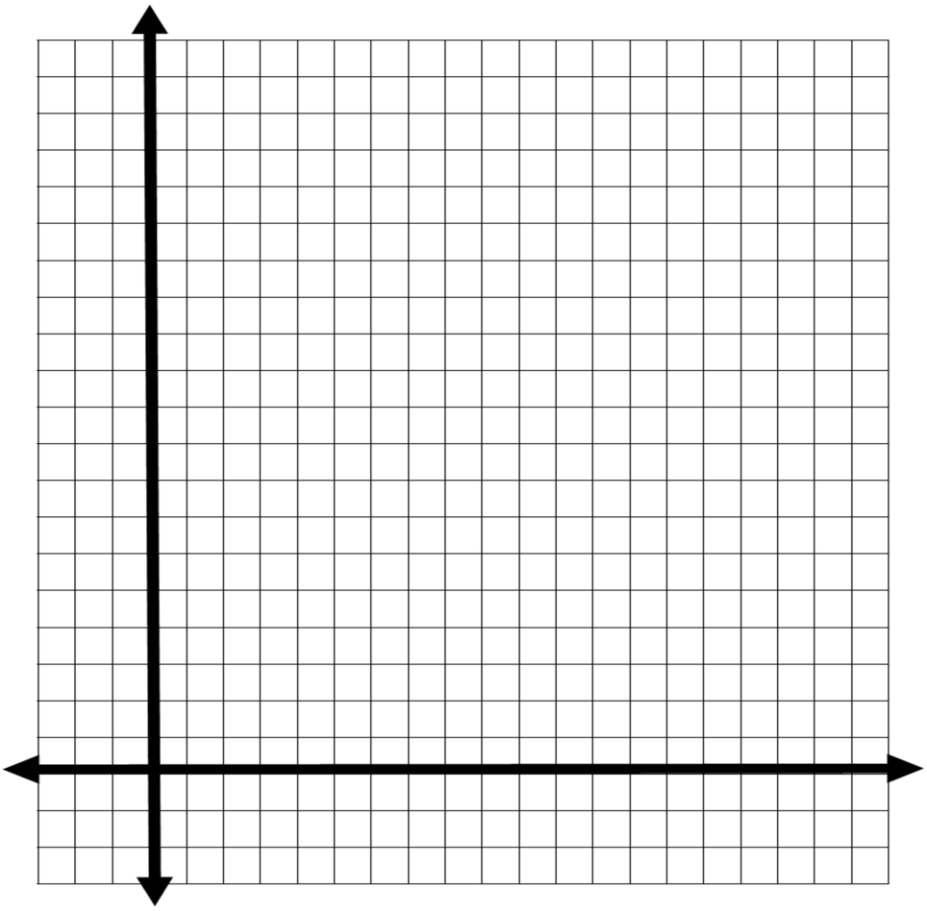
The diameter of the circle made is the dependent / independent variable. (Circle one.)

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.

Data table

Number of drops **x**							
Diameter of the spill (nearest cm) **y**							

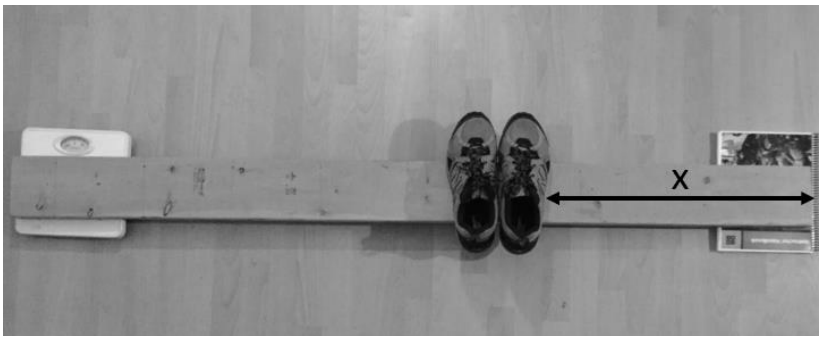


WALKING THE PLANK (A)

Basic Instructions/Set Up:

x = the distance from the end of the board (text book end)

y = weight to nearest kg



The board is marked in 30 cm increments. The WALKER stands with their feet at the end of the board that is propped up on the textbook.

The outside edge of their right shoe should be at the end of the board as shown. This is 0 cm. Record the weight shown on the scale to the nearest kg.

The WALKER steps toward the scale end of the board. The outside edge of their right shoe should be on the 30 cm mark, just like it was on the 0 cm mark. Record the weight on the scale to the nearest kg.

Repeat the process for each mark on the board: 60 cm, 90 cm, 120 cm, and 150 cm. At each mark, record the weight on the scale to the nearest kg.

The 150 cm mark is lined up with the window of the scale, so the WALKER ends with their feet as shown here.

The distance from the end of the board is the dependent / independent variable. (Circle one.)

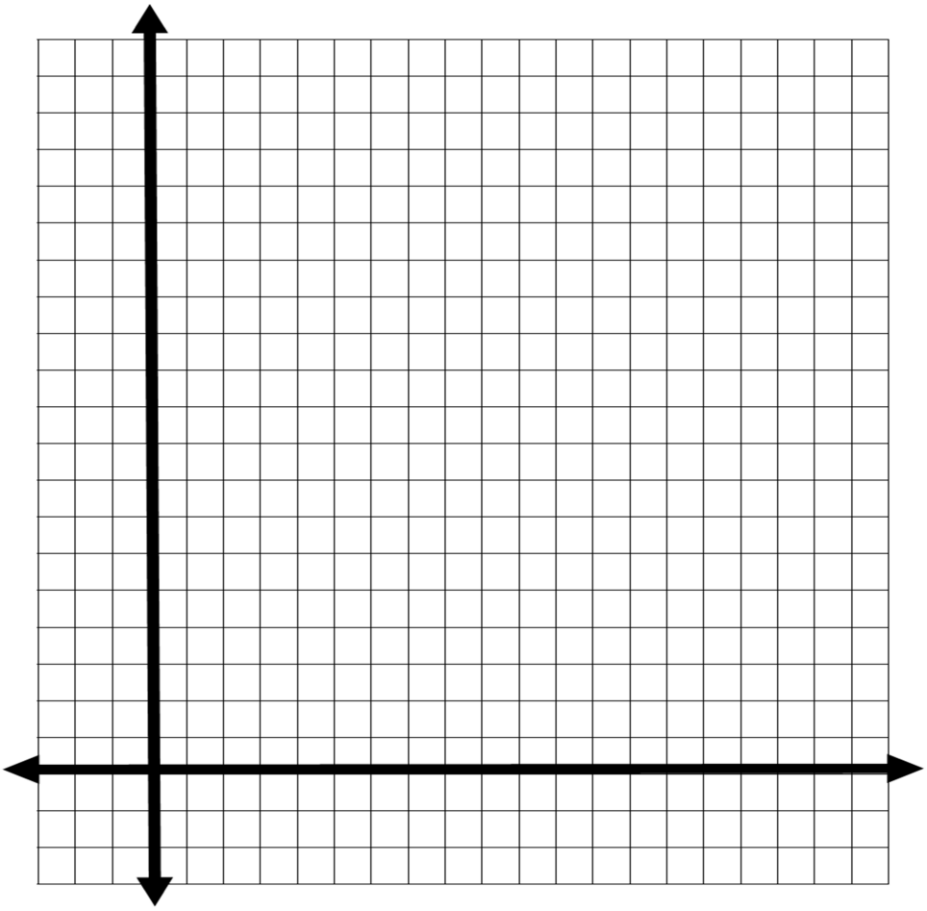
The weight shown on the scale is the dependent / independent variable. (Circle one.)

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.

Data table

Distance from text book end **x**							
Weight of walker (nearest kg) **y**							

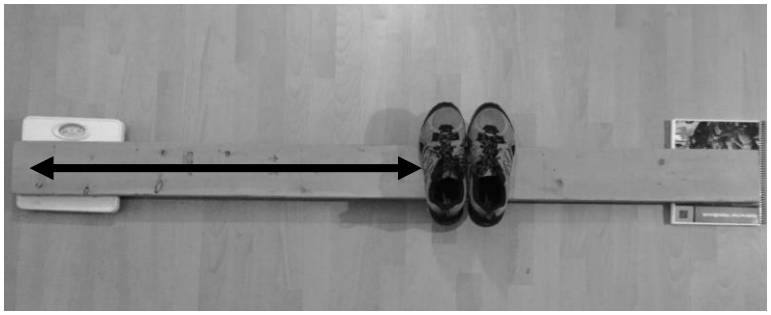


WALKING THE PLANK (B)

Basic Instructions/Set Up:

x = the distance from the scale end of the board

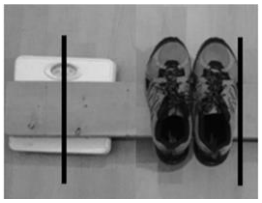
y = weight to nearest kg



The board is marked in 30 cm increments. The WALKER stands with their feet at the scale end of the board. The window of the scale should be between their feet as shown in the picture. This is 0 cm. Record the weight shown on the scale to the nearest kg.

The WALKER steps toward the scale end of the board. The outside edge of their right shoe should be on the 30 cm mark as shown here.

Record the weight on the scale to the nearest kg.



0 cm 30 cm

Repeat the process for each mark on the board: 60 cm, 90 cm, 120 cm, and 150 cm. At each mark, the WALKER should place the outside edge of their right shoe on the line. At each position, record the weight on the scale to the nearest kg.

The 150 cm mark is at the end of the board, so the WALKER ends with their feet as shown here.

The distance from the end of the board is the dependent / independent variable. (Circle one.)

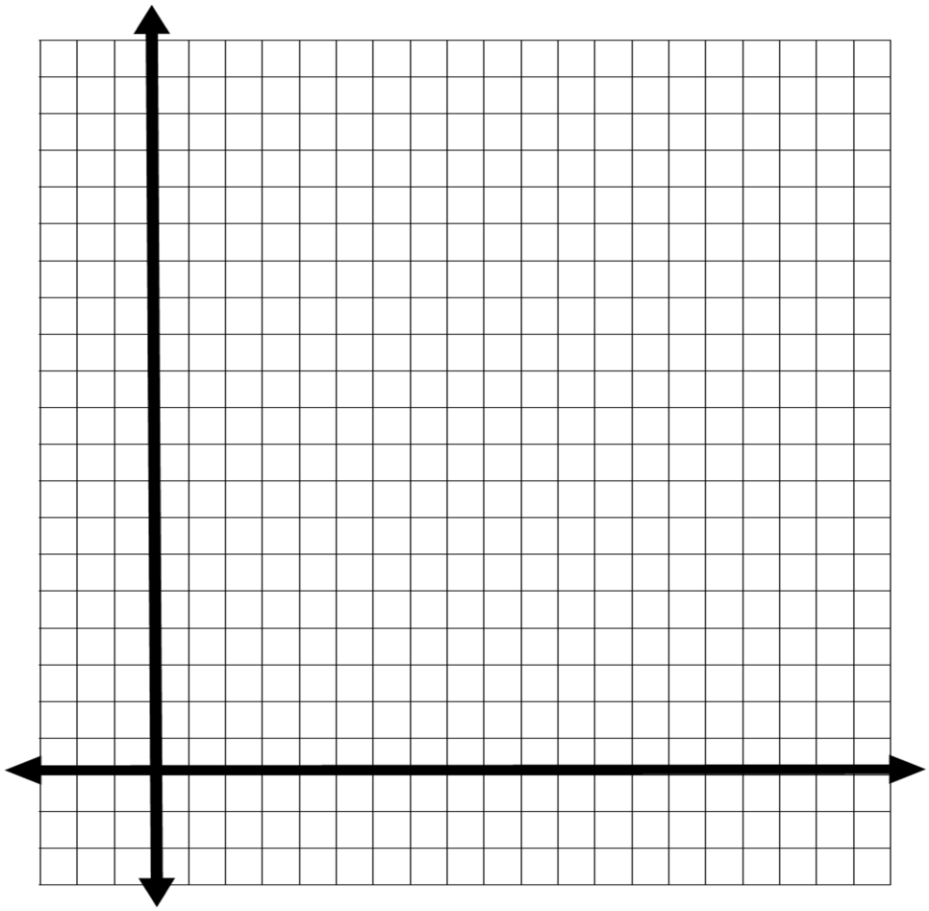
The weight shown on the scale is the dependent / independent variable. (Circle one.)

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.

Data table

Distance from scale end **x**								
Weight of walker (nearest kg) **y**								

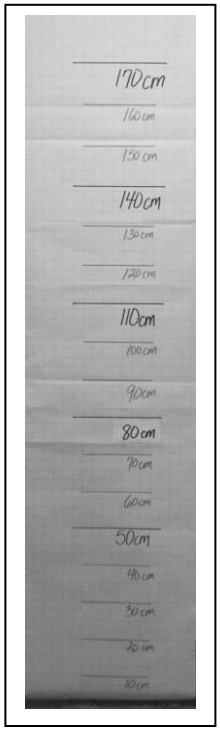


REBOUND

Basic Instructions/Set Up:

x = height from which ball is dropped

y = height of the rebound (to nearest cm)



In this experiment, you will measure the rebound of a small rubber ball when dropped from different heights. The x values are already in the t-chart and correspond to the heights marked on the chart paper.

One person should drop the ball while at least one other watches to mark the height of the rebound.

Ball Dropper: Hold the ball about a foot in front of the chart at the 170 cm mark. Drop the ball. Try to hold the ball a steady distance from the chart for each drop.

Ball Watcher: Keep your eye on the ball and mark the height of the rebound by placing a finger on the chart. Estimate the height of the rebound to the nearest cm.

Repeat the steps for each of the heights marked on the chart.

The height from which the ball is dropped is the dependent / independent variable. (Circle one.)

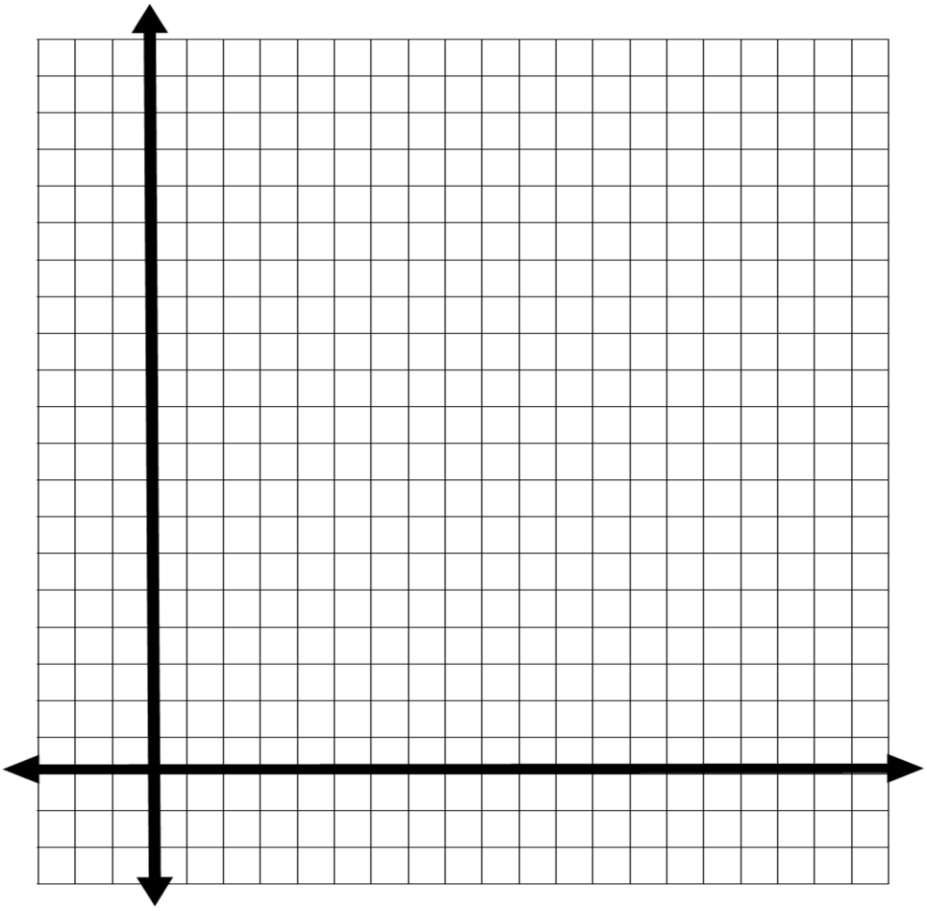
The height of the rebound is the dependent / independent variable. (Circle one.)

Graph the points (ordered pairs) corresponding to the values in the table on the grid below. Use the numbers in the data table to decide on the intervals.

DO NOT CONNECT THE POINTS.

Data table

Ball drop height (nearest cm) **x**								
Height of rebound (nearest cm) **y**								



HANDOUTS FOR LESSON 1 B BEGIN ON THE FOLLOWING PAGE

Create a poster for your assigned experiment. Use this graphic organizer to sketch a rough draft of your group's poster. All this information should be in each member's Math notebook AND on the sheet where your Group Recorder kept notes.

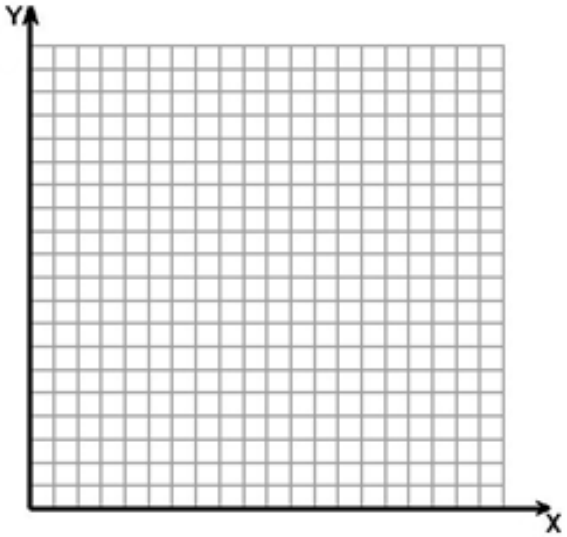
x=

y=

Sketch the set-up of the experiment

Data Table

x	y



Describe the data and the graph.

BLANK GRAPHS FOR STUDENT NOTEBOOKS