

## Measuring with Foxes and Fishes

Jim Kreuger—Program Consultant, Kivalliq School Operations, Baker Lake

Here is a simple, but engaging, measurement activity that challenges student groups to work together, problem solve, and communicate their results and provides teachers with a wonderful opportunity to assess student success at all three. I have tested this activity with Sarah Morley's Grade 5 class at Alaittuq School, Maggie Manik's Grade 8B & 8C classes at Qitiqliq School, Richard Arcand's Grade 9 classroom at John Arnaladjuak School and Kerri Henry's and Sally Strutynski's Grade 9 classes at Jonah Amitnaaq School. In each case, students were engaged, challenged and went on to produce excellent work. This article describes how to develop, deliver, and assess this math activity that focuses on some Big Ideas in Mathematics.

### Grade Levels: Gr.4-9

**Materials** (for each group): marking rubric, chart paper, markers, 3 fox measure, 5 fox measure (the fox measures may be constructed from wood and should be accurately cut to 15 cm and 25 cm lengths and marked as 3 foxes and 5 foxes respectively)

3 Foxes

15 cm strip of wood

5 Foxes

25 cm strip of wood

### Big Ideas:

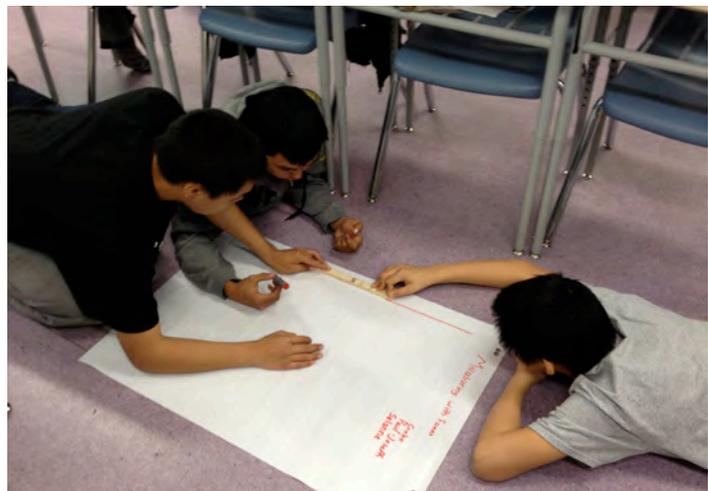
1. Measurement is an accurate direct comparison
2. Problem Solving requires:
  - persistence
  - organisation
  - creativity
3. Group Work requires
  - cooperation
  - leadership
4. Communication is
  - respectful
  - neat and clear (written)

### Overview:

Student groups are given two standard measures of lengths 3 and 5 foxes. Using only these measures students must accurately and neatly measure, draw and display lines of 1, 2, 3, 4, 5, 6, 7, 8, 9, & 10 foxes in length.

Students may not mark units on the wooden standards, but may mark lengths on their paper. A 10 Fox Ruler must also be drawn and divided into 1 fox units. An exemplar is provided to show students all of the elements in a poster format. Teachers should use the 3 & 5 fox standards to make an exemplar poster on chart paper. This can then be displayed in the room and used by students during the activity.

Students are assessed on three aspects of this activity: Group Work, Communication, and Problem Solving. Templates and an exemplar are provided to assist teachers and students with the assessment process.



## Preamble to the Activity (10-15 minutes)

This is presented as a script of a possible introduction to the activity.

Observation of Group Behaviours						
Group:						
Activity:						Date:
a)						
b)						
c)						
d)						
e)						
f)						
Key: 1 = Rarely 2 = Occasionally 3 = Frequently 4 = Consistently						
	A	B	C	D	E	F
Formless or lax						
Follows directions						
Exhibits leadership						
Respects the ideas of others						
Works cooperatively						
Communicates effectively						
Shares tasks equitably						
Works safely						
Handles equipment correctly						
Displays initiative/persistence						
Comments:						

Today you will be working in groups (of 2 or 3) to solve a problem and display your results on chart paper. You will be assessed on: group work, communication, and problem solving.

### Group Work

What does good group work look like and sound like? Today I will use an observation sheet to record your behaviours while you work together. Things that I will be looking for include: being on task, listening, sharing, helping each other, and getting the job done safely. You will also have an opportunity to assess your group work behaviours after the activity is completed.

### Communication

The end result of your work together will be a poster, like the one here on the wall. I will use a marking guide called a rubric to assess your poster when you are finished. To get an "A" your poster will need to be neatly labeled, well spaced, contain all of the lines straightly drawn, and have no spelling mistakes. Your group will get a rubric to refer to.



### Problem Solving

Measurement involves a direct comparison of something to a known standard. For example:

1. We measure a time interval like a class period by comparing it to minutes on a clock.
2. We measure the temperature in the classroom by comparing it to the degrees on a thermometer.
3. We measure the volume of gas that we put in our Honda or Skidoo by comparing it to the flowmeter on the gas pump at the tank farm.

Today we will be measuring length by drawing and comparing lines to standards of a known length.

The units used in measurement are often named after someone famous. For example:

1. Celsius, (temperature), named for Swedish astronomer Anders Celsius (1701– 1744).
2. Watt, (power--see light bulb), named for Scottish engineer, James Watt (1736–1819).
3. Volt, (electric potential—see batteries) Italian physicist, Alessandro Volta (1745–1827)

The unit of length that we will use today is the Fox, named after the Canadian hero, Terry Fox (1958-1981). You will be given two standards of 3 and 5 Fox lengths (hold up the standards to show the class).

3 Foxes

5 Foxes

Your challenge is to make a poster similar to the exemplar poster displayed on the wall. When you make your poster you should measure and draw all of the easy lines first. **Note you cannot transfer units from one place to another by marking the wooden pieces. Also, you are not allowed to take measurements from the exemplar poster or from other student groups.**

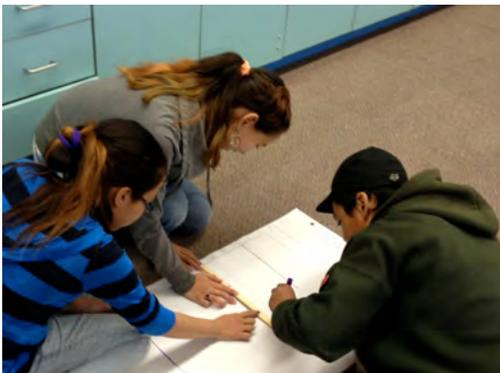
Which lines do you think would be easy to make? Explain how you would make them. (This discussion should quickly yield the 3 & 5 fox lines. The 8, 10, 6, & 9 Fox lines should come next. Placing the 3 fox standard over the 5 fox standard helps students to see what 2 foxes looks like. The class now has discussed how to solve roughly 70% of this problem. They have more than enough to keep them busy exploring for 30 minutes. Depending on the grade level you may wish to decrease the amount of help provided above. You can also increase the number of wooden pieces to scaffold this activity.)

I think you have enough ideas to get together with your group and do the activity. Remember, if you are not sure what to do, ask! When you are finished I will assess your problem solving by inspecting your lines for accurate measurement (not estimation!) and asking you, or a member of your group, to explain how you measured specific lines.

You will now work in your groups to produce a poster with measured lines. Remember, today you will be assessed on group work, problem solving and communication.

**Activity** (30 minutes--timed)

Groups can finish this activity in 30 minutes if teachers frequently monitor and announce the time remaining. Additional time is required if students are to self-assess their group work. Assessing posters can wait for another class.



**Follow-up**

When students are finished and at their desks, you can extend the activity by challenging groups to determine how they would measure lines of great lengths like: 11, 31, 83, or 99 foxes for example. Interviewing each group is the best way to determine their success at problem solving. Groups should work together to ensure that each member understands how to measure and draw each line. Teachers can ask individual members to demonstrate how the group



measured and drew each line. This interview can be done at the end of the activity or at a later time. If done at a later time, allow groups to meet and revisit the strategies and methods used to measure the lines before they are interviewed.

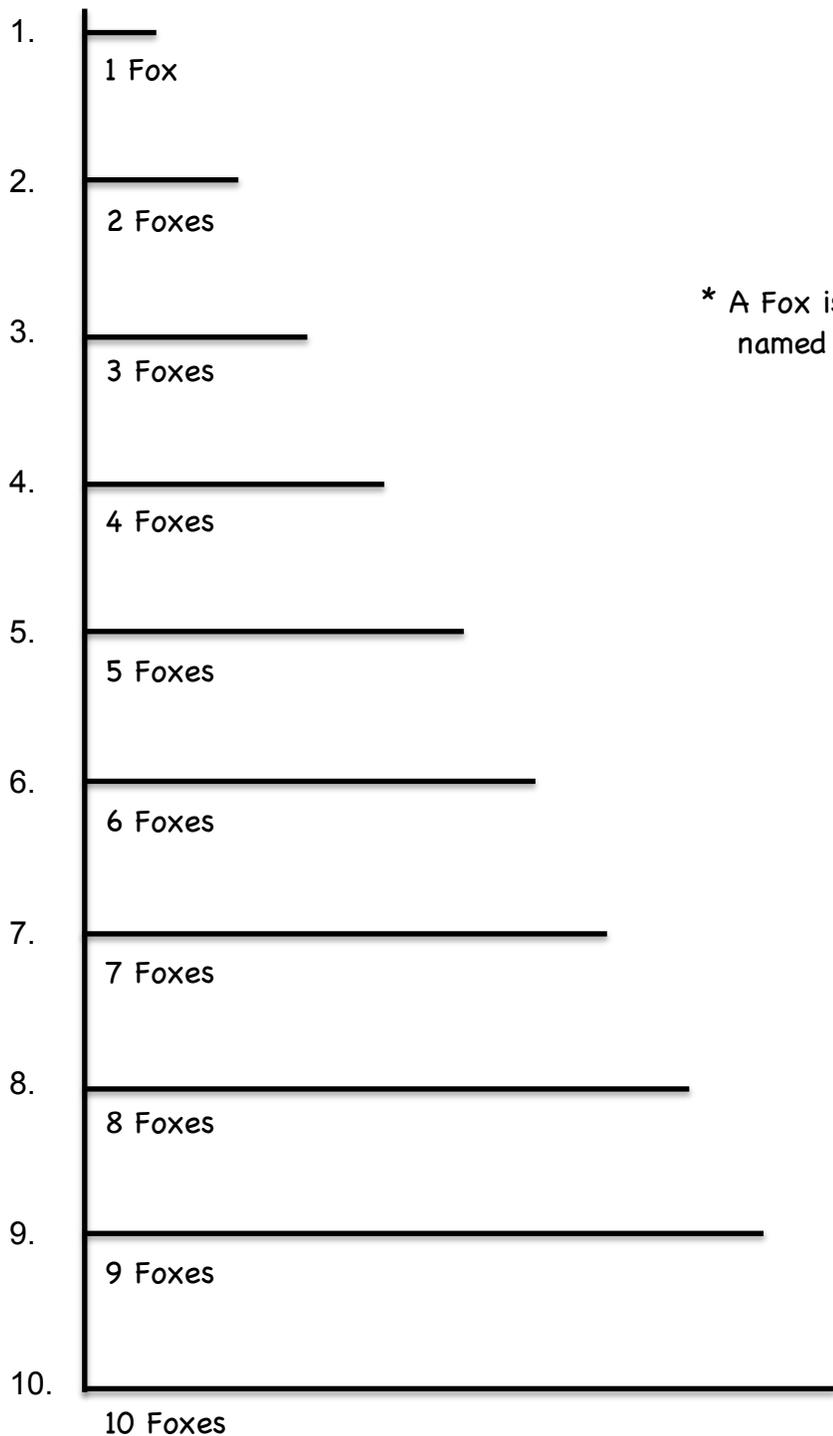
**Conclusion**

This activity works well because most students in Grades 4-9 have the necessary competencies to succeed. Sharing assessment process and criteria with students clarifies what is expected of the student. This helps students to focus on success. Solving problems is exhilarating which creates a sense of accomplishment and fun. Assessment of problem solving can be done at a later time with each group individually. Having students review their poster, discuss, and then demonstrate with the manipulatives how they solved the problem gives them the opportunity to practice metacognition (think about their thinking). Group work is an important cross-curricular skill and assessing it not only values this behavior, it communicates behavioral expectations to the students thereby increasing the success at displaying them. Many teachers have found this to be a great classroom management tool.

Extension activities and sample assessment templates are included in the following pages.

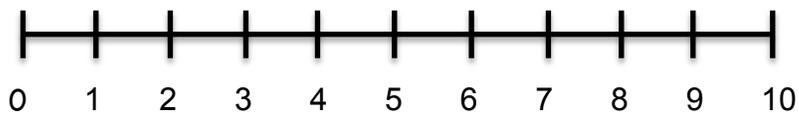
# Exemplar Measuring with Foxes\*

Student names



\* A Fox is a unit of length named after Terry Fox.

A Fox Ruler



## Sample Observation Scale

<b>Observation of Group Behaviours</b>						
<b>Group:</b>						
<b>Activity:</b>					<b>Date:</b>	
a)						
b)						
c)						
d)						
e)						
f)						
<b>Key: 1 = Rarely    2 = Occasionally    3 = Frequently    4 = Consistently</b>						
	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>		
Remains on task						
Follows directions						
Exhibits leadership						
Respects the ideas of others						
Works cooperatively						
Communicates effectively						
Shares tasks equally						
Works safely						
Handles equipment properly						
Displays initiative/persistence						
<b>Comments:</b>						

## Sample Self-Assessment Scale

<b>Group Work — Student Self-Assessment</b>			
<b>Name:</b>	<b>Date:</b>		
<b>Group Members:</b>	<b>Topic:</b>		
<b>Answer each question by checking the most appropriate response.</b>			
	Seldom	Sometimes	Often
1. I encouraged others.			
2. I shared ideas and information.			
3. I checked to make sure others in my group understood.			
4. I was willing to help others.			
5. I was willing to listen to others in the group.			
6. Others in my group encouraged and helped me			
7. We checked with the teacher to make sure we knew what we were supposed to be doing.			
8. We did the work properly and on time.			
9. We worked well together and cooperated.			
10. We had fun and enjoyed the activity.			
<b>Answer the following questions about working in a group.</b>			
11. What did you like about working in your group?			
12. What would you do differently next time?			
13. How is working in a group different from working by yourself?			

**Sample Observation Scale**  
**Teacher's Observation Rating Scale for Group Performance**  
 (Use this form to give feedback on the performance of student groups.)

Activity: \_\_\_\_\_ Date: \_\_\_\_\_

Members of Group:

\_\_\_\_\_

\_\_\_\_\_

**RATING SCALE**

0 = Major Difficulty    1 = Needs Improvement    2 = Okay    3 = Very Good    4 = Excellent

Circle the appropriate number after each statement.

- |    |   |   |   |   |   |   |
|----|---|---|---|---|---|---|
| 1. | All members participated well in this group activity. | 0 | 1 | 2 | 3 | 4 |
| 2. | Members listened to each other in the group.          | 0 | 1 | 2 | 3 | 4 |
| 3. | Members helped & encouraged each other in the group.  | 0 | 1 | 2 | 3 | 4 |
| 4. | Group members stayed on the task that was assigned.   | 0 | 1 | 2 | 3 | 4 |
| 5. | Group members worked well together.                   | 0 | 1 | 2 | 3 | 4 |
| 6. | No one member of the group dominated this activity.   | 0 | 1 | 2 | 3 | 4 |

Total \_\_\_\_\_

7. a) Things that the group did well:

b) Things that the group could improve:

## Sample Rubric

### Measuring with Foxes--Communication

<b>A</b>	<ul style="list-style-type: none"><li>• Poster contains all of the elements in the example, is neat and well spaced out.</li><li>•Text contains no spelling mistakes and is easy to read.</li><li>• Lines are straight and accurately measured.</li></ul>
<b>B</b>	<ul style="list-style-type: none"><li>• Poster contains almost all of the elements of the example, is neat and well spaced.</li><li>•Text contains few spelling mistakes and is easy to read.</li><li>• Lines are neat and accurately measured.</li></ul>
<b>C</b>	<ul style="list-style-type: none"><li>• Poster contains almost all of the elements of the example, and is well spaced out.</li><li>•Text contains some spelling mistakes and/or is hard to read.</li><li>• Lines are untidy and carelessly measured.</li></ul>
<b>D</b>	<ul style="list-style-type: none"><li>• Poster contains almost all of the elements of the example, and is disorganized.</li><li>•Text contains many spelling mistakes and/or is messy and hard to read.</li><li>• Lines are untidy and/or not measured.</li></ul>
<b>F</b>	<ul style="list-style-type: none"><li>• Poster is missing many of the elements of the example, and is disorganized</li><li>•Text is illegible.</li><li>• Lines are crooked and/or not measured.</li></ul>
Insufficient Response	

## Further Activities

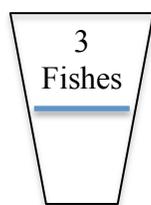
### Measuring with Fishes?!

The same problem can be presented to a class as a volume measurement challenge. Students are given cups with designated volumes of 3 fishes and 5 fishes. Students must use the cups to measure the specific volumes of 1, 2, 3, 4, 5, 6, 7, 8, 9, & 10 fishes. This is a little more messy but just as engaging and includes the possibility for some additional solutions (no pun intended)!

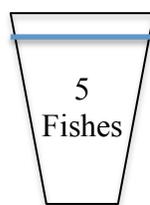
**Materials** (for each group): masking tape, wash tub, sharpie marker, 1-3 fish measure, 1-5 fish measure (the fish measures may be made from plastic glasses), 1 measure bottle (clear plastic litre water bottle or the like).

### How to make the cups

Use a measuring cylinder (from the science lab) to accurately measure 500mls into a large plastic drinking glass. With a permanent sharpie, mark the glass where the water level is and label the glass "5 Fishes". Now accurately measure 300mls into a second glass, mark the level and label it "3 Fishes".



300 mls



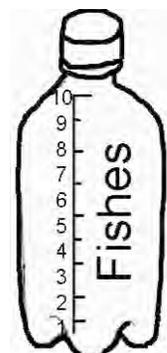
500 mls

### Overview:

This activity is completely analogous to *Measuring with Foxes*, but is more difficult. Most students discover the relationships between the foxes (length) faster than the fishes (volume), probably because they are more familiar with length than volume. At any rate the activity is a good follow-up to *Measuring with Foxes* or could be used to differentiate the lesson for stronger students.

Student groups are given two standard measures of volumes 3 and 5 fishes. Using only these measures students must accurately measure and mark volumes from 1 to 10 fishes on an empty water bottle provided. When finished each group should have a measuring bottle that is neatly marked off in increments of 1 fish, from 1 to 10 fishes (if the bottle is bigger, you can extend it to 15 or 20 fishes). Note if you put a strip of masking tape down the side of the measuring bottle, students can write their increments on the tape and the bottles can be reused with another class.

The finished measuring bottle becomes the product created by the group that results from this task. Teachers can check for accuracy by pouring measured amounts of water into the bottle and checking to see if the marked increments are in the right place. (Remember: 1 fish = 100 mls, 2 fishes = 200 mls, 3 fishes = 300 mls, etc.)



A rubric for marking the bottle could be co-developed with the students by asking them what makes a good measuring bottle. Items for consideration in this rubric might include: process used to determine the increment, accuracy of the measuring bottle, and communication elements. The group work rubric used for *Measuring with Foxes* could also be used for this activity as well.

### **Math Problems**

The following problems could be used as a closing activity for both *Measuring with Foxes* and *Measuring with Fishes*.

Using only 3s and 5s, explain how you could make the following numbers (show your work in the form of a number sentence):

8

2

6

4

1

9

20

30

18

250

297

### **Further Reading**

Davies, Anne. (2011). *Making classroom assessment work*. (3<sup>rd</sup> ed.). Courtney (BC): Connections Publishing.

Charles, Randall I. (2005). Big ideas and understandings as the foundation for elementary & middle school mathematics. *Journal of Mathematics Education Leadership*. 7 (3), 9-24.