Teachers Explanatory Notes
TI-15 Explorer™: A Tap on the Shoulder

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1. Review the concept of continuing number patterns, in general, and specifically number patterns that are generated via constant addition or subtraction.

   Review the idea of describing patterns by relating a value within a pattern to the step number. For example, the number pattern in the table below:

Step	1	2	3	4	5
Value	3	6	9	12	15

   can be described in words as *Value equals three times the step number*
   or in symbols as $v = 3 \times s$

   A more challenging number might include two operations on the Step number.
   For example:

Step	1	2	3	4	5
Value	4	7	10	13	16

   Value equals three times the step number plus one
   $v = 3 \times s + 1$.

   Further examples and direction are provided in the PowerPoint include with this activity.

   PPT

   Pay particular attention to the language associated with number pattern (see Key Vocabulary items above).

   Provide examples of a range of different number patterns, represented as tables of number pattern pairs. Focus, in particular, on number patterns that are generated via constant addition or subtraction – **constant addition patterns** (see examples above in 1). Include a small number of sets of number pattern pairs where there is no apparent pattern as counter examples e.g.

Step	1	2	3	4	5
Value	4	7	8	12	6

2. Select (or ask for volunteers) five students to stand side by side with their left hands on the shoulders of the person beside them (the last in the line will have no one to put their hand on a shoulder).

   Have a stopwatch handy to record how long it takes for the following event. Tell the left-most student in the line, on a given signal, to tap the shoulder of the person to the left of them, and ask the other students in the line to pass on the tap as soon as they receive it. Tell the students at the end of the line to indicate when they have received the tap.

After three or four of practices, record the number of students in the line and the time it takes to pass the tap through the line in a table (as in Worksheet 1) so that students can copy a record of the results at the end of the activity.

W1

3. Select (or ask for volunteers) another five students to join the existing line and repeat step 2 above.

4. Continue adding students to the end of the line and repeating the activity until the whole class is involved. It is fine for the last set of students joining the line to be less or more than five as long as the correct number of students is recorded against the time.

5. Students should record the data for the activity in the table on Worksheet 1.

W1

6. Ask students to find a pattern in the data set that relates the time it takes to pass the tap along a line to the number of students in the line. This should be very close to linear i.e., a pattern generated through constant addition (**constant addition pattern**).

   Some students may need some assistance in seeing a pattern in authentic (real life) data as the differences between entries may not be exactly the same.

   Similarly, some students may need assistance in finding a consistent pattern if the last group of students who joined the line were not five in number.

   The aim is to work out the amount of time per person it takes to pass the signal on and to express this in words, and hopefully symbols, in order to make a prediction.

   A word in rules, at this stage, might look something like:

   The time it takes for a tap on the shoulder to be passed on is 0.5 times the number of persons.

   In symbols:
   $t = 0.5 \times n$

7. Show how the formula operations Op1 on the TI-15 Explorer™ can be defined to perform a calculation based on their rule and have them check their rule against the results they obtained in the tap on the shoulder activity (see Worksheet 2).

W2

To define an operation (formula) first press the Op1 (or Op2) key then type the steps of the operation and then press Op1 (or Op2) to set the operation

For example, to set the formula
t = 0.5 × n

Press Op1 × 0.5 Op1

Students should notice that their rule does not make an accurate prediction and needs some adjustment. With some gentle direction students should discover that their rule is 'out' by about the same amount each time.

8. Ask students to make an adjustment to their rule – this should require the addition of a small quantity which is due to the extra time it takes for the initial starting signal to reach the student at the beginning of the line and for the time it takes the person recording the time to halt the stopwatch once they hear the signal that the tap on the shoulder has reached the end of the line. The reason for this 'extra' time should be discussed with students.

9. Ask students to adapt their formula in the *Stored Operations* facility of the calculator to accommodate the 'extra' time.

   A word in rules, at this stage, should look something like:
   The time it takes for a tap on the shoulder to be passed on is 0.5 times the number of persons plus 0.4.

   In symbols:
   $t = 0.5 \times n + 0.4$

   Students should now check their calculators against the data they obtained in the *Tap on the Shoulder* activity.

   Discuss how well their new rule fits the original data. Explore reasons the calculations do not match the data exactly.

10. Students should make use of this rule to predict how long it would take to pass a tap on the shoulder through 100 people. They should compare the results from their rule with results obtained from a graph of the data and discuss how close these are and reasons for any differences.

11. An assessment task is included with this activity. AT

12. **Extension 1**: How long would it take for a tap on the shoulder to pass through 50 people.

    Discuss with students how they could test their prediction in an authentic (real life) way (perhaps by combining two classes).

    Carry out their plan and discuss with them the accuracy of their prediction and reasons for any variations that might occur.

    Ask students to recommend both improvements to their method of testing their prediction and to their rule.

13. **Extension 2**: Perform the same activity, as outlined above, by asking students to hold hands and pass on a squeeze of the hand.