Printables for “Problem Strings”

KNPIG ID # A 3340.6 – ORANGE

This file contains printables for a small group of students.

- Directions & Examples for Problem strings in the range of 100.

Teacher Note: Problem strings are a powerful tool for supporting math talk in the classroom. After posing problems, give plenty of wait time. Prompt students to explain their thinking and invite them to find and use a variety of strategies. Use questions such as "Can you use this problem to solve the next problem?", "Can you solve it another way?" and "Do you see a pattern?" to foster reflections, sense making and the development of more advanced strategies. If students need the support of materials, problems can be presented on a 100 bead rack, such as the virtual bead accessible through the interactive website link, and then screened. For more information about strings, see the print link.

MENTAL MATH PROBLEM STRINGS

What is a *Mental Math Problem String*?
A problem string is a *sequence of related arithmetic tasks* (typically 5-10 problems presented horizontally) that are designed to call attention to a particular mathematical feature. They can be posed with materials, such as showing an addition problem on a double bead rack, or posed with just numerals. The tasks are presented one at a time. Often, the previous tasks and their solutions remain visible as each successive task is presented.

Problem strings create opportunities for students to discover and strengthen composite arithmetical strategies and foster number sense. The types of tasks and the way successive tasks build on preceding tasks will influence which strategies students will discover and use. Teacher questioning, student think time and student discussions are critical to the process.

Some examples of problem strings are listed here:

Using a related known fact	**Using 5 and 10 structures**	**Part – Whole Relationships**
12+3 =	15+4 =	18-2 =
12+4 =	19-4 =	18-16 =
12+5 =	16-6 =	14-2 =
12+7 =	5+12 =	14-12 =
13+7 =	13-5 =	17-15=

Fostering student thinking
Use open-ended questions to prompt student thinking, such as

- How did you work that out?
- Why does that work?
- Does anyone have another way to work that out?
- What did you know that helped you work that out?
- Do you see a pattern? What is it?
- What is a new problem that is similar to these?
- Can you use the previous problem(s) to help with this problem?

Allow think time before students respond. A "thumbs up" or other hand single can be used by students to indicate their readiness to answer. Foster an expectation that students listen to each other and may ask questions about each other's strategies. Students might show agreement through a waggling "hang ten" gesture or other agreed upon signal. At times, ask one student to paraphrase another student's explanation or use another student's method. Invite multiple strategies for a single task.

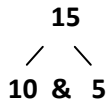
Modeling Student Strategies

When leading activities involving mental problem strings, the teacher can support student thinking and student discussion by acting out and/or recording the students' explanations. For example, a setting such as a bead rack, a double 10 frame or snap cubes can be used to act out a student's strategy.

Written methods like those shown below can be used to record student thinking. Match the recording model to the strategy used. As students become more familiar with investigating and discussing strings, transition from teacher modeling to the students recording their own thinking and sharing those recordings with the class. (A class document camera is very helpful for these kinds of discussions!)

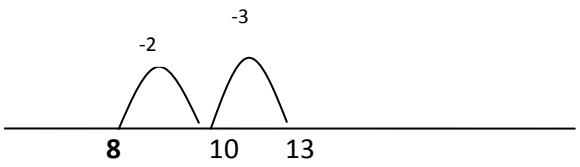
The teacher's role is to keep the mathematical discussion focused, help student express and record their own thinking and support the students in listening to and understanding each other. Be careful not to show a "teacher" way of solving or thinking - this will discourage students from pursuing their own ideas and listening to peers. Be open - students may come up with ideas you did not anticipate but contain wonderful mathematics!

SPLIT MODEL **15 + 3 =**



5 + 3 = 8
10 + 8 = 18

JUMP MODEL **13 - 5 =**
(Empty Number Line)



Teacher Resources

The above models are discussed in more detail in Teaching Number in the Classroom with 4-8 year olds (see reference). For more information about Split Strategies, see Chapter 9. For more information about Jump strategies, see Chapter 8.

The following two teacher resources use a series of problem strings over the course of a year to develop addition and subtraction ideas. Copy the URL below the title for ordering information and for more information.

- Minilessons for Early Addition and Subtraction; *A Yearlong Resource*
  http://www.heinemann.com/products/E01013.aspx
- Minilessons for Extending Addition and Subtraction; *A Yearlong Resource*
  http://www.heinemann.com/products/E01102.aspx
  http://www.contextsforlearning.com/samples/RGK3ExtendAddSubConSum.pdf

References

Fosnot, C., & Dolk, M. (2001). *Young mathematicians at work: Constructing number sense, addition and subtraction*. Portsmouth: Heinemann.

Fosnot, C. T. & Uittenbogaard, W. (2007). *Minilessons for Early Addition and Subtraction.* Portsomouth, NH: Heinemann.

Fosnot, C. T. & Uittenbogaard, W. (2007). *Minilessons for Extending Addition and Subtraction.* Portsomouth, NH: Heinemann.
Wright, R.J., Martland, J., Stafford, A.K., & Stanger, G.S. (2002). Teaching *Number in the Classroom with 4-8 year-olds*

Examples of Mental Math Problem Strings within 20

Doubles and near doubles

6 + 6 =

6 + 7 =

7 + 8 =

14 - 7 =

16 - 8 =

17 - 8 =

Bridging through 10

10 + 6 =

9 + 6 =

9 + 4 =

8 + 5 =

5 + 7 =

Transformation

7 + 7 =

8 + 6 =

6 + 6 =

7 + 5 =

8 + 4 =

Bridging through 10

9 + 4 = 10 + ___

9 + 7 = 10 + ___

8 + 5 = 10 + ___

11 + 4 = 10 + ___

11 + 6 = 10 + ___

Commutative Property

8 + 3 =

3 + 8 =

17 + 2 =

2 + 17 =

3 + 14 =

Adding 5

5 + 3 =

5 + 8 =

5 + 4 =

5 + 9 =

5 + 6 =

Examples of Mental Math Problem Strings within 100

addition within a decade

3 + 5 =

43 + 5 =

73 + 5 =

24 + 4 =

64 + 4 =

subtracting within a decade

9 - 6 =

29 - 6 =

59 - 6 =

47 - 5 =

67 - 5 =

Across the decade

8 + 3 =

28 + 3 =

58 + 3 =

58 + 6 =

38 + 6 =

78 + 6 =