Developing Mathematical Proficiency

The potential of different types of tasks for student learning

### Handouts

### Contents

Handout 1: The Five Strands of Mathematical Proficiency 2

Handout 2: Task A 3

Handout 3: Task B 4

Handout 4: Task C 5

Handout 5: Task D 6

Handout 6: Reflection 7

### Copying

*Except where noted/credited otherwise, these materials are Copyright © 2015-2017 Mathematics Assessment Resource Service, University of Nottingham. They are published under the* [*Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International*](https://creativecommons.org/licenses/by-nc-sa/4.0/) *license, so they may be copied and adapted for non-commercial use under certain conditions and with appropriate attribution. Please see the license for details, or contact us via* [*http://mathnic.mathshell.org/contact.html*](http://mathnic.mathshell.org/contact.html) *if in doubt.*

*All MathNIC materials can be freely downloaded from our website* [*http://mathnic.mathshell.org/*](http://mathnic.mathshell.org/)

Handout 1: The Five Strands of Mathematical Proficiency

|  |  |  |
| --- | --- | --- |
| **Conceptual Understanding** | The comprehension of mathematical concepts, operations, and relations. | * Enables students to connect ideas to what they already know * Supports retention and prevents common errors |
| **Procedural Fluency** | Skill in carrying out procedures flexibly, accurately, efficiently, and appropriately. | * Learning procedures can strengthen and develop mathematical understanding, while understanding makes it easier to learn skills |
| **Strategic Competence** | The ability to formulate, represent, and solve mathematical problems. | To come up with answer to a problem, students must:   * follow a solution method and adapt as necessary * understand the quantities in the problem and their relationships * represent the relationships mathematically * have the mathematical skills required to solve the mathematical problem |
| **Adaptive Reasoning** | The capacity for logical thought, reflection, explanation, and justification. | As students reason about a problem they can:   * build their understanding * carry out the needed computations * apply their knowledge * explain their reasoning to others |
| **Productive Disposition** | The habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one’s own efficacy. | Requires frequent opportunities to:   * make sense of mathematics * recognize the benefits of perseverance * experience the rewards of sense making in mathematics |

Adapted from: <https://mathequality.wordpress.com/2012/06/25/nrcs-five-strands-of-mathematical-proficiency/>

Handout 2: Task A

### Percent Change Game

Use these 12 numbers to fill in the gaps below.

**10, 20, 25, 35, 40, 50, 60, 70, 75, 80, 90, 100**

$\_\_\_\_ increased by \_\_\_\_% = $\_\_\_\_  
  
$\_\_\_\_ increased by \_\_\_\_% = $\_\_\_\_  
  
$\_\_\_\_ decreased by \_\_\_\_% = $\_\_\_\_  
  
$\_\_\_\_ decreased by \_\_\_\_% = $\_\_\_\_

You score a point for each number **used only once** – and in a correct expression.

Try to get the highest score you can.

(Maximum score: 12 points)

Adapted from <http://www.foster77.co.uk/Percentage%20Change%20TASK%20SHEET.pdf>

Handout 3: Task B

### Describing and Defining a Square

Four equal sides

Diagonals meet at right angles

Four lines of symmetry

Two pairs of parallel sides

Four right angles

Rotational symmetry of order 4

Two equal diagonals

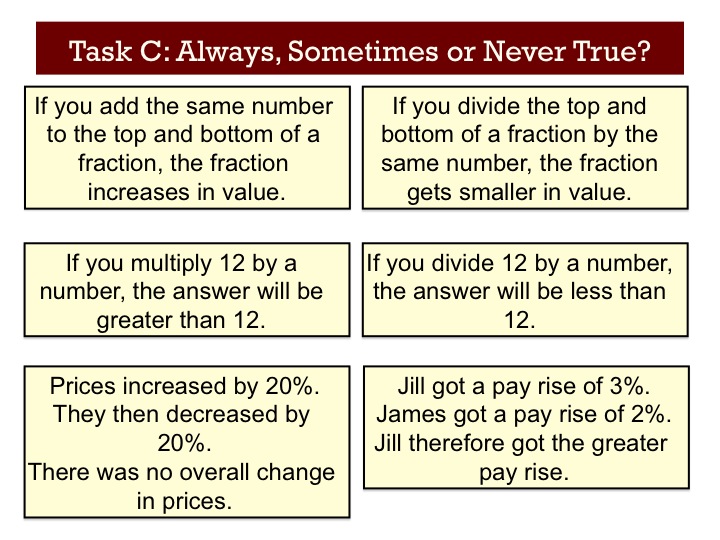
Which *pairs* of statements *define* a square? Which do not?

A lesson called ‘[Describing and Defining Quadrilaterals](http://map.mathshell.org/lessons.php?unit=7325&collection=8)’ based on this task, can be found on the Mathematics Assessment Project website (http://map.mathshell.org/)

Handout 4: Task C

### Always, Sometimes or Never True?

Here is a collection of mathematical statements or conjectures:



Consider each statement in turn and decide whether it is always, sometimes or never true.

* If it is always true, show some examples, and then try to provide an explanation as to why it is always true.
* If it is never true, explain why.
* If it is sometimes true, give examples and define precisely when it is true and when it is not true.

Handout 5: Task D

### Schoolteachers and Dentists

There are about 320 million people in the US.



* About how many school

teachers are there?



* About how many dentists are there?

Estimate some other facts and check them out.

Adapted from <http://www.bowlandmaths.org.uk/pd/pd_01.html>

Handout 6: Reflection

Think about tasks that are already in use (either by you or well known tasks) and categorise them under the five strands of mathematical proficiency:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Description of Task** | **Conceptual Understanding** | **Procedural Fluency** | **Strategic Competence** | **Adaptive Reasoning** | **Productive Disposition** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

Which of the five strands of mathematical proficiency do students currently have the most opportunity to develop in your classroom?

|  |
| --- |
|  |

Describe how you plan to include a balance of the mathematical proficiency strands in your curriculum over the coming weeks.

|  |
| --- |
|  |