Mathematics at ISUtrecht

The Role Play phase can span from kindergarten to grade 2. A student is in the Role play phase when the student displays any of these indicators:

- distinguish tallness, heaviness, opposites and how much things hold
- describe two or three obvious measurement attributes of the same thing
- describe something as having more or less of an attribute than something else, e.g. as being taller than or as being fatter than.
- look at displays of familiar data and say which is most or has more
- sort and arrange data they have collected into familiar groupings
- count when asked to say how many in each group in a data display
- use 'bigger', 'smaller' and 'the same' to describe differences between small collections
- anticipate whether an indicated change to a collection or quantity will make it bigger, smaller or leave it the same
- distinguish spoken numbers from other spoken words
- distinguish numerals from other written symbols
- see at a glance how many are in small collections and attach correct number names to such collections
- connect the differences they see between collections of one, two and three with the number string: 'one, two, three, …'
- understand a request to share in a social sense and distribute items or portions.
- recall the sequence of number names at least into double digits
- know how to count a collection, respecting most of the principles of counting
- understand that it is the last number said which gives the count
- understand that building two collections by matching one to one leads to collections of equal size, and can 'fix' one collection to make it match another in size
- compare two collections one to one
- solve small number story problems which require them to add some, take some away, or combine two amounts by imagining or role playing the situation and counting the resulting quantity
- share by dealing out an equal number of items
- distinguish shape from other attributes that relate to how things 'look'
- use informal language that indicates they are responding to shape; e.g. 'the pointy one'
- carry out matching tasks by selecting a matching shape from a collection and either posting shapes in boxes or fitting shapes into cut outs

- reproduce simple geometric configurations if only encoding is required; that is, build a matching shape or arrangement to one that is constantly in sight
- draw simple figures by imitating how they have seen them drawn (including letters and numbers)
- give directions from one landmark to the next when retelling a journey or places in a story; e.g. 'go to the pond, go on the bridge, go home'.

The Experimental phase can span from kindergarten to grade 3. In the Experimental phase for mathematics, the student demonstrates all the following indicators:

- know that several things may be in different orders when compared by different attributes
- line up the base of two sticks when comparing their lengths and fit regions on top of each other to compare area
- use the everyday notion of 'how many fit' and count how many repeats of an object fit into or match another; e.g. How many pens fit along the table?
- count units and call it 'measuring'; e.g. I measured and found the jar holds a bit more than 7 scoops.
- use 'between' to describe measurements quantities (length, mass, capacity, time); e.g. It weighs between 7 and 8 marbles.
- understand expressions such as "will happen," "won't happen," and "might happen"
- distinguish impossible events from events that are possible but unlikely
- suggest counting as a way of answering data questions that focus on comparing collections
- use skip counting to say how many in a tally
- use counting to help construct their data display, e.g., construct a block graph by counting how many in each group, then counting how many squares to colour in
- understand the need for a baseline and space blocks regularly to allow comparisons to be made
- place direct measurement data in sensible sequences using a baseline, e.g., cut paper strips to fit around their heads and make a bar (column) graph by lining up the bottom of strips
- choose to count to compare the sizes of groups, without prompting
- look at a bar graph and say which bar has more based on its length
- describe figures and objects using terms that are evocative of shape, such as 'corner', 'pointy', 'lopsided', 'slanty'
- describe conventional figures and objects by reference to prototypes they 'look like'; e.g. 'It's a door shape'.

- select ready-made materials that 'look right' to make recognisable models of parts of their environment
- remember what some families of shapes look like and produce recognisable versions
- remember key aspects of the way things look and try to reproduce them in their drawings; e.g. drawing circles for wheels, putting two eyes, a nose and a mouth on a face
- relate the position of objects to each other in familiar settings using terms such as 'behind', 'near'
- draw or make simple 'route' maps and models that show a sense of spatial relationships and order, although only for local settings that they have freely explored.

The Early phase can span from grade 1 to grade 5. In the Early phase for mathematics, the student demonstrates all the following indicators:

- directly compare and order events from more to less likely and are able to justify their decision with relevant reasons.
- understand what it means for simple events to be equally likely
- see that, when organising data, the categories can be reorganised without changing the overall total
- produce and read pictographs or block graphs where each unit represents more than one piece of data
- produce simple two-way tables and Venn diagrams, partitioning totals between the cells or sections for straightforward data
- represent whole-number data in different ways
- use column and row headings to interpret what the numbers in simple two-way tables represent
- connect the repetition of a 'unit' with the numbers on a whole-number calibrated scale
- make things to a specified length in uniform units (including centimetres and metres)
- use provided measurements to make a decision about comparative size
- count units as a strategy to solve comparison problems such as: Whose frog is heavier?
- say which is longer (heavier) based on information about the number of units matching each object
- select counting as a strategy to solve problems such as: Are there enough cups? Who has more? Will it fit?
- use materials or visualise to decompose small numbers into parts empirically; e.g. 8 is the same as 5 with 3
- make sense of the notion that there are basic facts
- select either counting on or counting back for subtraction problems depending on which strategy best matches the situation

- think of addition and subtraction situations in terms of the whole and the two parts and which is missing
- write number sentences that match how they think about the story line for small number addition and subtraction problems
- respond to a request to 'tell me about the shape of this …' using language such as 'flat', 'curved', 'side', 'round', 'face', 'edge', 'square', 'angle', 'base'
- compare and contrast geometric figures
- identify the faces, edges and vertices of a geometric object and hence select component parts to make it in various forms (skeletal, hollow)
- match the 2D shapes with the faces of standard 3D shapes
- select nets that have the right component parts to match a simple object
- recognise repetitions of the same shape embedded within arrangements and patterns
- identify component parts to show that a shape or arrangement is symmetrical
- describe one thing being between others and put key features in order on a map

The <u>Transitional</u> phase can span from grade 3 to secondary. In the Transitional phase for mathematics, the student demonstrates all the following indicators:

- draw on numerical information alone to decide whether two simple events are or are not equally likely to occur
- systematically list all possibilities, unprompted, to work out numerical probabilities for one-stage actions
- use experimental results and data about past events to determine a range of possible outcomes and informally use relative frequency to estimate
  probabilities
- create axes that show discrete or continuous quantities, including time scales
- use simple proportional comparisons when interpreting data in tables and graphs, e.g., half as many people prefer pizzas to hamburgers
- use part-whole reasoning without needing to see or visualise physical collections.
- compose 'part-units' into wholes, understanding, for example, that a narrow garden bed may have an area of 5 or 6 square metres even though no whole 'metre squares' fit into the bed

- compare whole numbers using their knowledge of the patterns in the number sequence, and think of movements between numbers without actually or mentally representing the numbers as physical quantities
- partition at least two- and three-digit numbers into standard component parts (e.g. 326 = 300 + 20 + 6) without reference to actual quantities
- write suitable number sentences for the range of addition and subtraction situations
- use the inverse relationship between addition and subtraction to make a direct calculation possible
- double count in multiplicative situations by representing one group and counting repetitions of that same group, simultaneously keeping track of the number of groups and the number in each group
- use successive splits to show that one half is equivalent to 2 parts in 4, 4 parts in 8, etc. and expect that if the number of portions is doubled, they halve the size of each portion
- give a detailed list of properties in their descriptions of shapes
- know from the properties of a rectangle that a slanted parallelogram cannot be a rectangle even though it is what a rectangular face on a block 'looks like' from 'the side'
- use mathematical conventions to represent objects in different types of drawings
- produce their own nets for geometric shapes that they can see and handle
- describe characteristic features of mirror symmetry
- identify the particular rotations, reflections and translations that relate the component parts of simple arrangements and patterns

The <u>Conventional</u> phase can span from grade 4 to secondary. In the Conventional phase for mathematics, the student demonstrates all the following indicators:

- develop coordinated mental representations of spatial configurations
- understand why the area of a rectangle and the volume of a rectangular prism can be found by multiplying its length dimensions and can use this for fractional side lengths
- think of the part-units themselves as units; e.g. a particular unit can be divided into one hundred parts and each part is then a centi-unit
- subdivide units to make measurements more accurate
- choose units that are sufficiently small (that is, accurate) to make the needed comparisons
- use their understanding of the multiplicative structure built into the metric system to move flexibly between related standard units; e.g. they interpret the 0.2 kilogram mark on a scale as 200 grams

- use relationships between measurements to find measures indirectly; e.g. knowing that 1 mL = 1 cm3 they can find the volume of an irregular solid in cubic centimetres by finding how many millilitres of water it displaces using
  a capacity cylinder
- use a range of information sources to put things in order from least likely to most likely, e.g., use research data or experimental data to form conclusions
- interpret the 0 to 1 scale in general usage and understand why the probability that a toss of a fair die will produce 5 is one-sixth
- use their knowledge that, for example, the 2 being in the tens place in 426 tells us that it refers to two groups of ten, to generate alternative partitions
- find it obvious that if 3 rows of 5 is 15, then both 15 divided by 3 and one third of 15 are 5
- visualise or draw their own diagrams to compare fractions with the same denominator (e.g. 37 and 57) or simple equivalences (e.g. 14 and 38)
- use the idea of splitting a whole into parts to understand, for example, that 2.4 is 2 + 4/10 and 2.45 is 2 + 45/100
- relate fractions and division knowing, for example, that 3/4 can be thought of as 3 ÷ 4 and 3 things shared among 4 students has to be 3/4
- select an appropriate multiplication or division operation on whole numbers including for problems that are not easily interpreted as 'lots of'; e.g. combination and comparison problems
- use properties to convince themselves and others why a figure or object belongs to a class; e.g. This is a square because it has four equal sides even though it is not resting on a 'flat bottom'.
- understand relationships between properties of figures; e.g. if a triangle has two equal angles then it has two equal sides
- produce their own nets, considering in advance the level of precision needed to ensure the shape is correct in form and size, where tabs will be, and so on
- predict the effect of particular movements (translations, rotations and reflections) on the orientation and position of figures and objects