### What is number sense?

The term "number sense" is a relatively new one in mathematics education. It is difficult to define precisely, but broadly speaking, it refers to "a well organised conceptual framework of number information that enables a person to understand numbers and number relationships and to solve mathematical problems that are not bound by traditional algorithms" (Bobis, 1996). The National Council of Teachers (USA, 1989) identified five components that characterise number sense: number meaning, number relationships, number magnitude, operations involving numbers and referents for numbers and quantities. These skills are considered important because they contribute to general intuitions about numbers and lay the foundation for more advanced skills.

**What does the research tell us?**
The research into the development of number sense is divided into two camps. The first of these is concerned with the development of number sense in young children whereas the second is focused on the number sense that people require to function well in the world.

Common elements of research:

1. An awareness of the relationship between number and quantity
2. An understanding of number symbols, vocabulary and meaning
3. The ability to engage in systematic counting, including notions of cardinality and ordinality
4. An awareness of magnitude and comparisons between different magnitudes
5. An understanding of different representations of number
6. Competence with simple mathematical operations
7. An awareness of number patterns including recognising missing numbers

These seven ideas seem to capture the essence of what is being referred to as ‘number sense’.

‘Number sense develops gradually over time as a result of exploring numbers, visualising them in a variety of contexts, and relating them in ways that are not limited by traditional algorithms’

**What strategies promote early number sense?**
Learning to count with understanding is a crucial number skill, but other skills, such as perceiving subgroups, need to develop alongside counting to provide a firm foundation for number sense. There are a number of strategies that help to support developing number sense. It is suggested that children need opportunities to:

1. Work with concrete materials and familiar ideas
2. Compose and recompose different arrangements and representations of number
3. Discuss and share their discoveries and solutions
4. Investigate the realistic uses of number in their everyday world
5. Explore number patterns and relationships
6. Create alternative methods of calculation and estimation
7. Solve realistic problems using a variety of approaches
8. Calculate for a purpose rather than just for the sake of calculating
9. Gather, organise, display and interpret quantitative data
10.  Measure and estimate measure for a purpose
11.  Explore very large numbers and their representations including using number lines

*Work with concrete materials and familiar ideas*
To begin with, early number activities are best done with moveable objects such as counters, blocks and small toys. Most children will need the concrete experience of physically manipulating groups of objects into sub-groups and combining small groups to make a larger group. After these essential experiences more static materials such as 'dot cards' become very useful.

*Compose and recompose different arrangements and representations of number*
By simply presenting objects (such as collections of concrete objects, stamps on a flashcard, buttons sewn onto a card) in various arrangements, different mental strategies can be prompted. For example, showing six stamps in a cluster of four and a pair prompts the combination of 'four and two makes six'. If the four is not subitised, it may be seen as 'two and two and two makes six'. This arrangement is obviously a little more complex than two groups of three. So different arrangements will prompt different strategies, and these strategies will vary from person to person, from learner to learner. Asking children to find all the dominoes in a six spot set with 6 spots on will encourage them to consider all the ways in which 6 can be partitioned into two sets and build up their understanding of the number bonds for six.

*Discuss and share their discoveries and solutions*
If mental strategies such as these are to be encouraged (and counting discouraged) then an element of speed is necessary. Seeing the objects for only a few seconds challenges the mind to find strategies other than counting. It is also important to have children reflect on and share their strategies. Verbalising a strategy brings the strategy to a conscious level and allows the person to learn about their own thinking. Listening to how another person verbalise enables them to pick up new strategies;

Dot cards are simply cards with dot stickers of a single colour stuck on one side. (However, any markings can be used. Self-inking stamps are fast when making a lot of cards). The important factors in the design of the cards are the number of dots and the arrangement of these dots. The various combinations of these factors determine the mathematical structure of each card, and hence the types of number relations and mental strategies prompted by them.

Investigate the realistic uses of number in their everyday world
Devoting time to each of the numbers under ten in turn and looking for examples of it in the everyday world as well in the classroom and school context. For example the number 3 you look for items that have aspects of 3 associated with them such as tricycles or three legged stools. Explore stories with three in such as Goldilocks and the Three Bears, the Billy Goats Gruff or the Three Little Pigs. Talk about those who are in families with three children in them, those who have three siblings or families with three in the house. Explore children aged three years and buses and houses with the number 3. Coming third in a queue or a race can be been connected to the notion and making a special point of considering things that happen at 3 o’clock. This deep and thorough investigation of numbers will support the children’s developing sense of the number and we could gain from building it into the experiences we offer our young learners.

**Some games can assist development of early number sense?**

Games can be very useful for reinforcing and developing ideas and procedures previously introduced to children. Although a suggested age group is given for each of the following games, it is the children's level of experience that should determine the suitability of the game. Several demonstration games should be played, until the children become comfortable with the rules and procedures of the games.

***Deal and Copy*** (4-5 years) 3-4 players

*Materials:* 15 dot cards with a variety of dot patterns representing the numbers from one to five and a plentiful supply of counters or buttons.

*Rules:* One child deals out one card face up to each other player. Each child then uses the counters to replicate the arrangement of dots on his/her card and says the number aloud. The dealer checks each result, then deals out a new card to each player, placing it on top of the previous card. The children then rearrange their counters to match the new card. This continues until all the cards have been used.

*Variations/Extensions*

1. Each child can predict aloud whether the new card has more, less or the same number of dots as the previous card. The prediction is checked by the dealer, by observing whether counters need to be taken away or added.
2. Increase the number of dots on the cards.

***Memory Match*** (5-7 years) 2 players

*Materials:* 12 dot cards, consisting of six pairs of cards showing two different arrangements of a particular number of dots, from 1 to 6 dots. (For example, a pair for 5 might be Card A and Card B from the set above).

*Rules:* Spread all the cards out face down. The first player turns over any two cards. If they are a pair (i.e. have the same number of dots), the player removes the cards and scores a point. If they are not a pair, both cards are turned back down in their places. The second player then turns over two cards and so on. When all the cards have been matched, the player with more pairs wins.

*Variations/Extensions*

1. Increase the number of pairs of cards used.
2. Use a greater number of dots on the cards.
3. Pair a dot card with a numeral card.