All you need to know about

Visual Perception

Roelien Herholdt

JET EDUCATION SERVICES

JET Education Services

PO Box 178

WITS 2050

South Africa

Tel: +27 (0)11 403 6401

Fax: +27 (0)11 339 7844

Web site: www.jet.org.za

Roelien Herholdt

6 Tobani street

Vanderbijlpark 1911

South Africa

Cell: +27 (0)76 810 5596

Email: rherholdt@jet.org.za

Layout & design

Jako Kühne

Vanderbijlpark 1911

South Africa

Cell: +27 (0)84 602 7736

Email: squirejj@gmail.com

Contents

1. Perception

Perception is a set of processes by which we recognise, organise and make sense of sensations we receive from environmental stimuli (Sternberg, 2009). Another definition of perception is the use of previous knowledge to gather and interpret stimuli received from the senses (Matlin, 2009).

Visual perception involves visual stimuli or stimuli that we see. Therefore, visual acuity is a prerequisite for visual perception (Van den Boomen, Van der Smagt & Kemner, 2012).

2. Visual perception

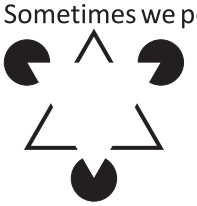
The mind uses visual sensory information and manipulates the information to create a mental representation of the objects, properties and spatial relationships (Sternberg, 2009).

The way we represent these objects depends in part on our viewpoint during perception, and in part on the stimulus we are viewing, e.g.:

- Sometimes we don't perceive what does exists, e.g. a dog

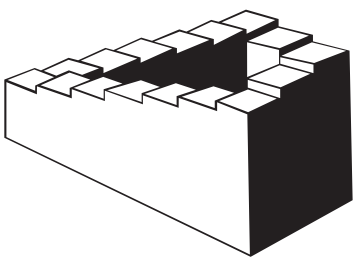
[Adapted from Sternberg, 2009]

- Sometimes we perceive what doesn't exists, e.g.: a triangle



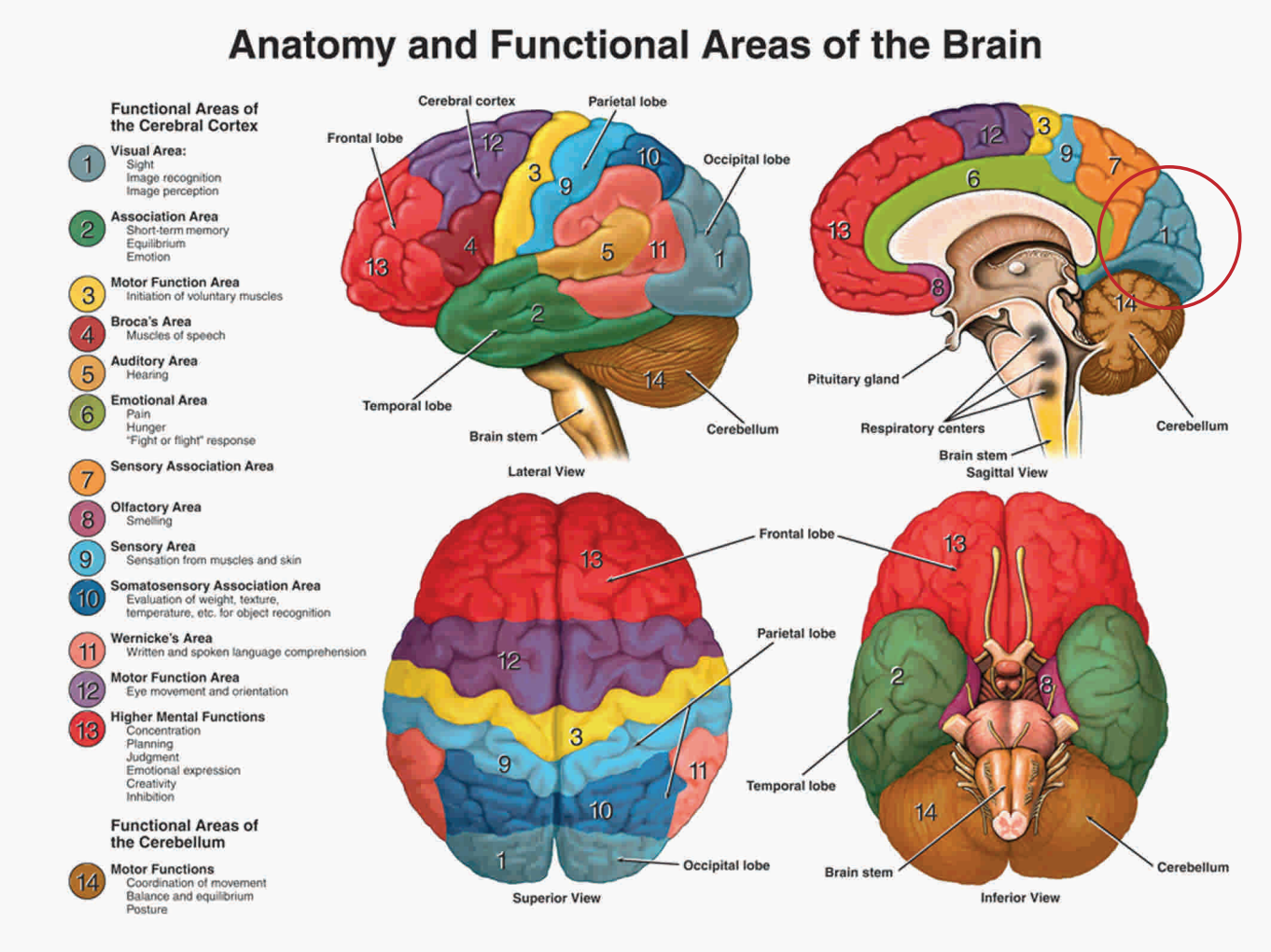
[Adapted from Sternberg, 2009]

- Sometimes we perceive what is impossible (optical illusions), e.g.: a staircase



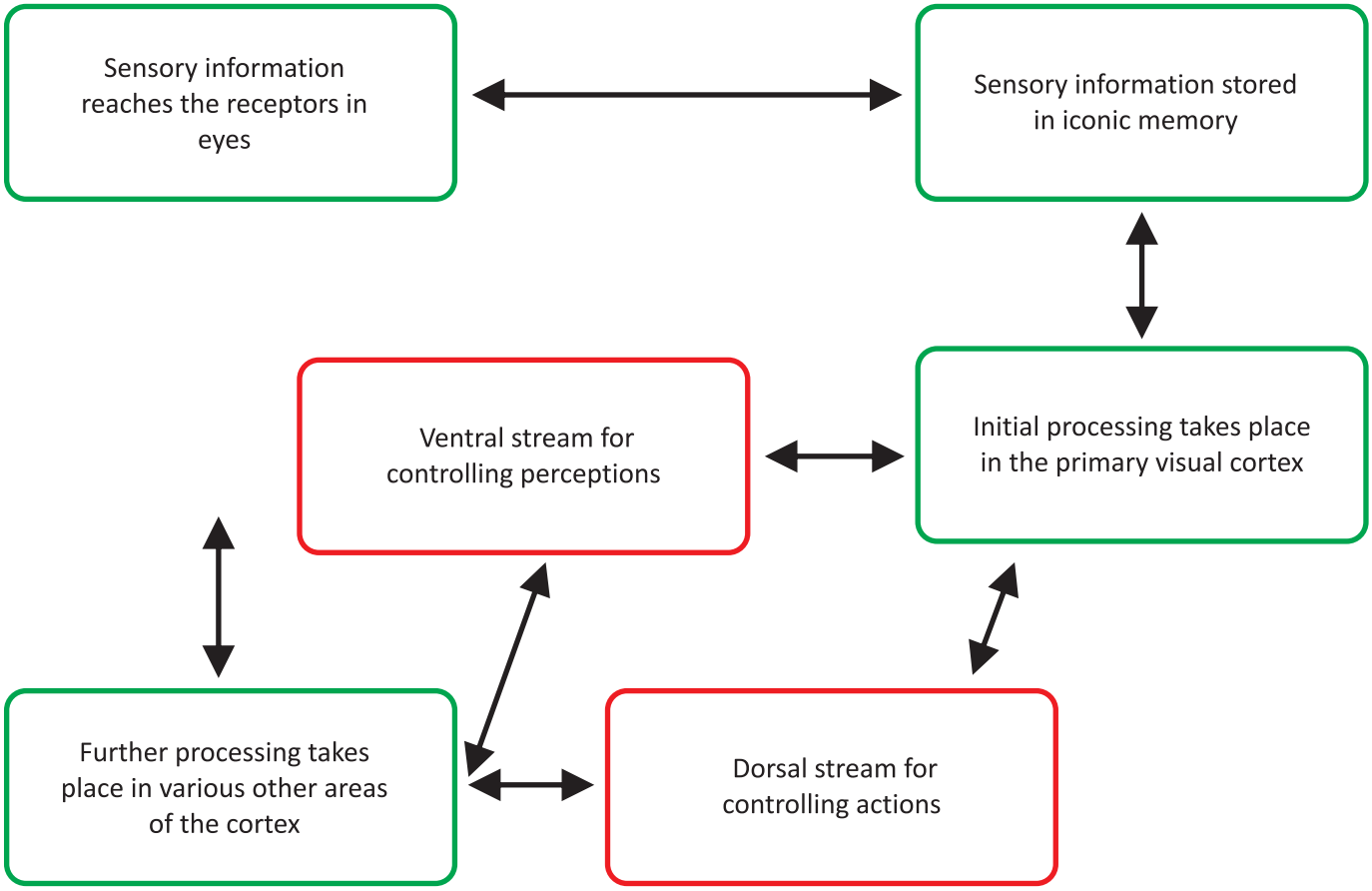
[Adapted from Sternberg, 2009]

Processing of visual information or stimuli takes place in the primary visual cortex in the occipital lobe of the brain (Sternberg, 2009). Processing happens extremely fast, recognition of an object takes one tenth of a second (Matlin, 2009).



[Adapted from www.neuroanatomy.org, 2014]

A very simplistic summary of the process of visual perception is shown below (adapted from Matlin, 2009; Farroni & Menon, 2008):



Note that there are double arrows in the figure above. That is because cognitive psychologists theorise that there are at least two types of processing involved in visual perception, namely:

- bottom-up processing
- top-down processing

(Matlin, 2009).

Bottom-up processing starts with the object and its characteristics being perceived. The stimulus being perceived then influences how it will be processed (Matlin, 2009). Bottom-up processing is captured in template theories, prototype theories, feature theories and structural-description theories (Sternberg, 2009).

In top-down processing, the mental processes influence how we perceive objects (Matlin, 2009). Top-down processing is often referred to as constructive perception (Sternberg, 2009). Top-down processing is dominant in situations in which the stimulus is incomplete, ambiguous or only visible for a fraction of a second (Matlin, 2009).

Video 1: Gorilla illusion

What happened here? Why didn't you notice the changes? How does this apply to your teaching?

The visual processing system is immature at birth (Van den Boomen, Van der Smagt & Kemner, 2012). Farroni & Menon (2008) go as far as saying that visual sensory experience influences the way the brain wires itself after birth. The optimal period for development of visual perceptual skills is from four and a half years to seven years, but may continue up to the age of twelve (Frostig, Lefever, & Whittlesey, 1966; Hanneford, 1995; Kephart, 1960; Frostig, Miller & Horne, unknown). This period overlaps with the age at which learners learn to read, spell, write and do mathematics. Optimal development of these academic skills requires optimal development of basic perceptual skills, including but not limited to:

- visual attention
- visual and auditory discrimination
- visual and auditory memory and sequential memory
- form and shape recognition
- visual analysis and synthesis
- visual motor integration
- fine motor functioning
- spatial orientation

(Frostig et al, 1966; Scneck, 1996; Fisher, Murray, & Bundy, 1991; Hung, Fisher & Cremak, 1987; Levine,1991; Catts & Kamhi, 1999; Cherry, Godwin & Staples,1989; Green & Chee, 1997; Kulp, 1999; Amundson, 1996; Case-Smith, 2002; Tseng& Chow, 2000; Tseng & Cremak, 1993; Ziviani &Watson-Will, 1998).

Vlok, Smit & Bester (2011) indicate that late intervention with children showing visual perceptual deficits often leads to extreme determination or overemphasis on task completion, task avoidance or other escape strategies. They maintain that visual perception intervention programmes should include :

- basic eye movement skills
- visual perceptual skills
- cognitive skills (Vlok, Smit & Bester, 2011)

3. Some concepts for understanding perception

Vision – sight

Distal stimulus – the actual or real object that you are looking at (Matlin, 2009)

Proximal stimulus – the photon/light particles that are absorbed by the rod and cone cells of the retina or receptor surface at the back of the eye (Sternberg, 2009; Matlin, 2009). This is the information that your eyes receive.

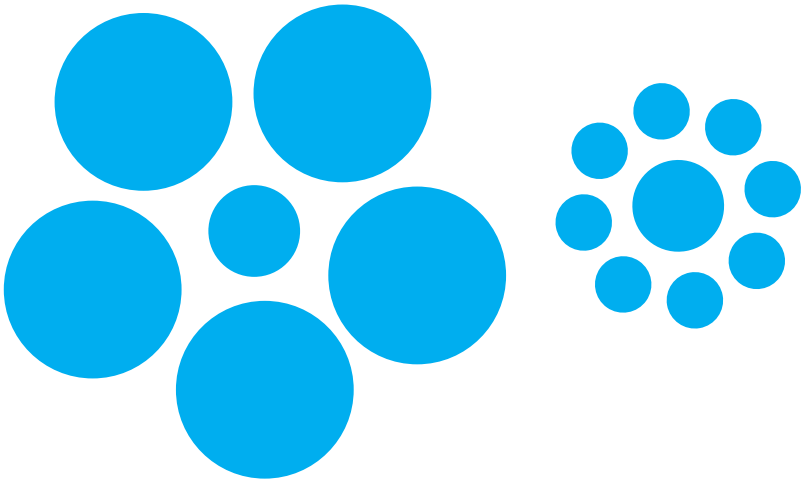
4. Perceptual Constancy

Perceptual constancy occurs when the perception of an object remains the same, even when the proximal sensation changes (Sternberg, 2009). The proximal sensation is the sensation that occurs when light hits receptors at the back of the eye.

4.1 Size constancy

Size constancy is the perception that an object remains the same size despite changes in the size of the proximal stimulus, e.g. when seeing a person at a distance and then walking towards the person, the proximal stimulation on your retina will become bigger as you walk towards the person, but your brain will still perceive the person as the same size.

When we exploit this principle of constancy in perception we can create illusions, e.g.: Which inner circle is the largest?



4.2 Shape or form constancy

Shape or form constancy refers to the perception that a shape remains the same shape despite changes in the shape or orientation of the proximal stimulus, e.g. the shape of door in different positions. Form constancy improves between the ages of three and five and stabilises at the age of six to seven years (Vlok, Smit & Bester, 2011). Shape constancy help learners to generalise visual material, e.g. recognising that a block remains a block even when viewed from different angles (Frostig, Miller & Horne, unknown).

This is all very interesting but how does this relate to learning and teaching?

Activity 1

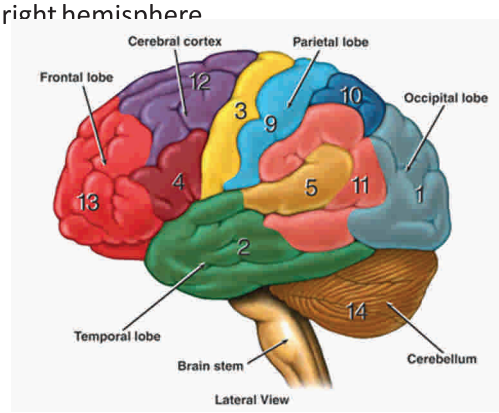
Everyone received a yellow card with a letter on it (Annexure A). Please find all the other people in the room with the same letter. Which visual perceptual skill was used in this activity?

5. Visual invariance

Visual invariance is a special kind of visual constancy, in which letters are recognised as the same whether they are handwritten or typed, capital or small letters, in small or big font, and regardless where on a page they appear (Dehaene, 2010). These associations are learned and thus must be taught.

Recognition of letters, plausible letter groupings and words takes place in a brain area referred to as the letterbox. This area is in the left occipital-temporal area within the lateral occipital-temporal sulcus or groove.

However, recognition of letters and words by shape only, e.g. Zoo and zoo, takes place in the symmetrical vision area in the right hemisphere.



[Adapted from www.neuroanatomy.org, 2014]

What does this mean for teaching and learning?

We need to vary our visual perceptual exercises in order to stimulate the different neurological pathways in the brain.

Thus, exercise 1 would stimulate different neurological pathways than exercise 2.

Exercise 1: Find the one that looks the same as the one in the block.

can	man	can	fan	pan

Exercise 2: Find the one that looks the same as the one in the block.

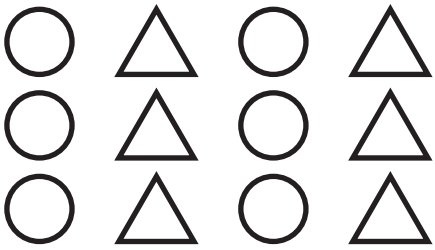
prh	hrp	rph	prh	phr

6. Gestalt approach of object recognition

The Gestalt approach of perception, founded by Kohler and Wertheimer (Sternberg, 2009), are based on the law of Pragnanz. The law of Pragnanz simply states that we tend to organise disparate objects being perceived in the most stable and coherent whole possible (Sternberg). Sternberg (2009) details some of the Gestalt principles as follows:

- **Figure-ground:** When perceiving a visual field, some objects appear to be more prominent (figure) and the rest form the background of the prominent figure/s.
- **Proximity:** When we view a group of objects, we tend to group objects that are closer together.

- **Similarity:** When we view a group of objects, we tend to group objects that are similar in appearance.



- **Continuity:** We tend to perceive smooth lines as opposed to disrupted or discontinuous lines.

- **Closure:** We tend to complete objects which are not complete.

- **Symmetry:** We tend to perceive objects as symmetric around a midline.

Activity 2

Every person received a blue card with either a picture or a shadow. Those with pictures must find their shadows. Those with shadows must find their pictures. Matching pictures and shadows must please sit next to each other. What perceptual skill did you use to find your picture or shadow?

7. Visual discrimination and classification

Visual discrimination involves the ability to determine differences between objects and symbols by sight. Some researchers include the discrimination of items from a background in the definition of visual discrimination, although this action. is more commonly referred to as visual figure-ground discrimination.

7.1 Effects of poor visual discrimination

Learners with poor visual discrimination skills struggle to differentiate between letters that look very similar, such as p, b and d. These learners would then, for example, read the word “pat” as “bat”.

Learners with poor visual discrimination often reverse letters and words, simply because they do not see the differences between certain letters and words. The learners would, for example, read “dig” instead of “big” or “saw” instead of “was”.

Franceschini et al (2012) found that poor reading acquisition in early grades can be predicted by poor visual discrimination and search skills in preschool.

7.2 Activities to develop visual discrimination

7.2.1 Similarities and differences between real objects

Teaching learners to perceive similarities and differences between real objects is the first step in teaching visual discrimination. At first learners need to hold and touch the real objects to tell how objects are alike or different. Learners usually focus on colour, size and physical characteristics.

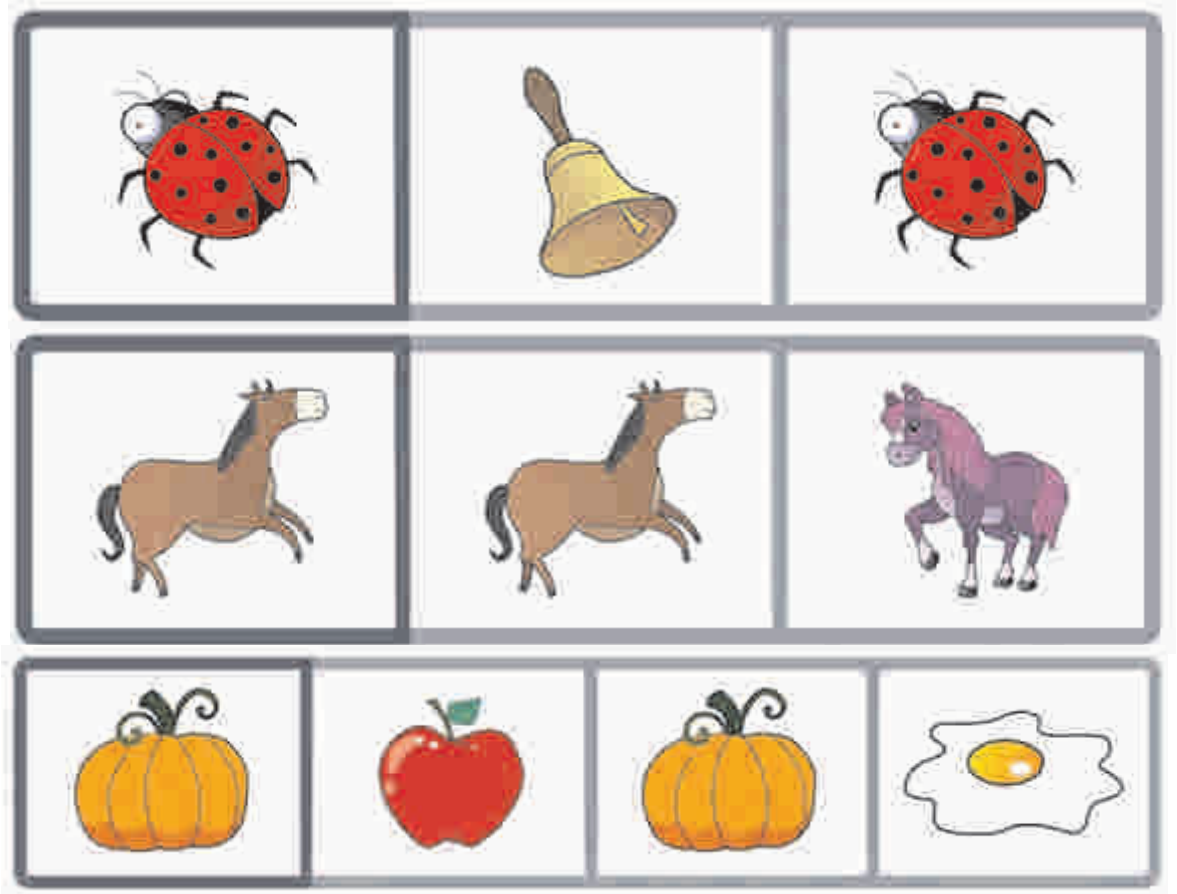
For example, have two toy cars that look exactly the same except for the colour. Ask learners how the two toy cars are the same. Ask learners how are they different.

7.2.2 Matching pictures

Learners should move from finding differences and similarities between real objects to finding differences and similarities in pictures.

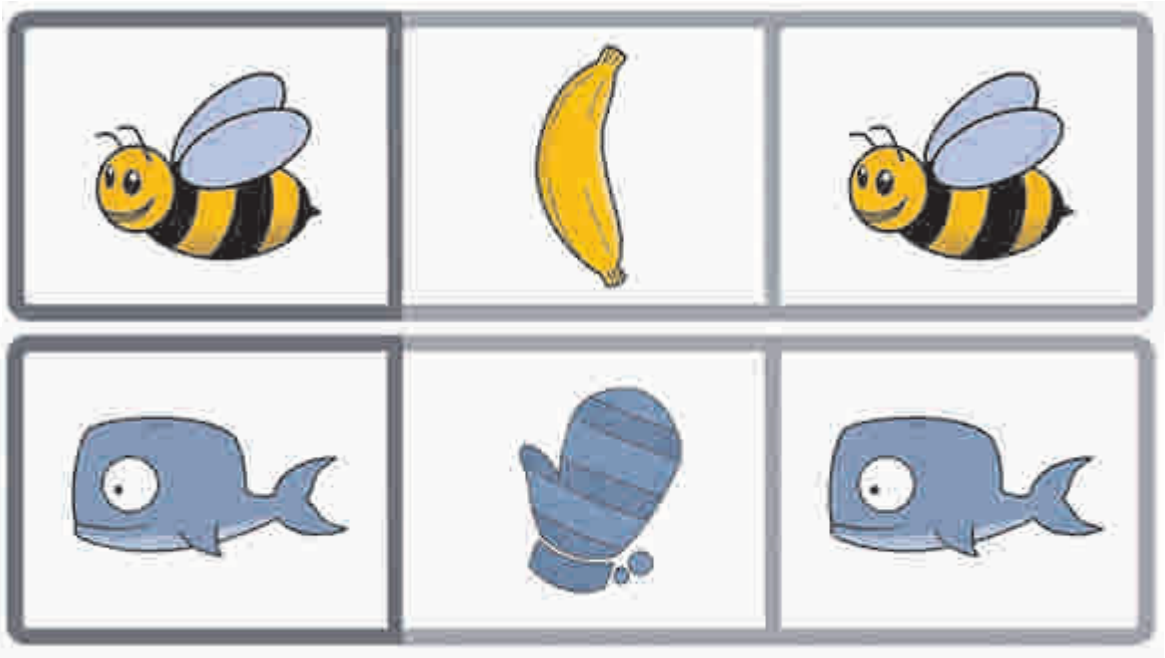
a. Find the same picture

Find the picture that is the same as the picture in the first block.



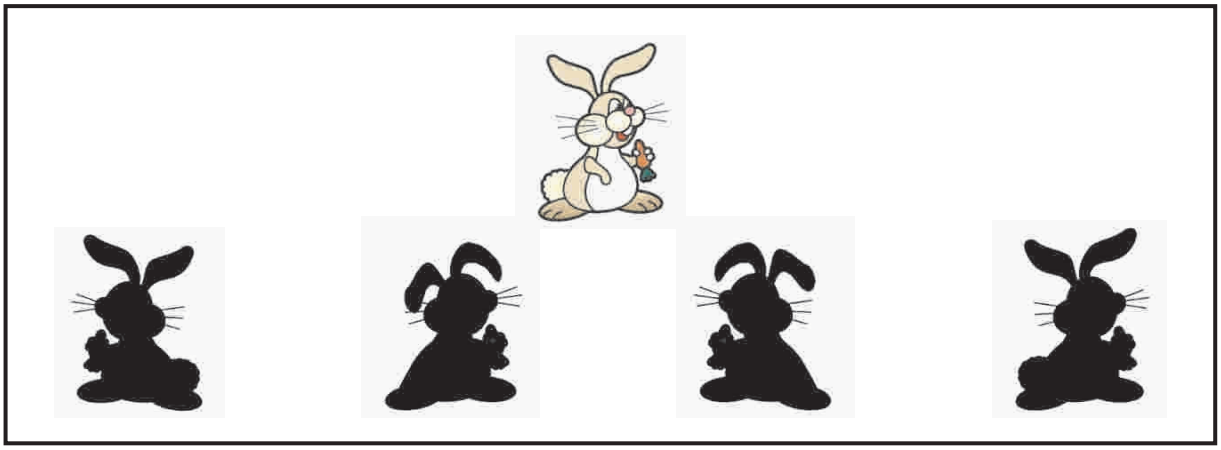
b. Find the different picture (find the odd-one-out)

Find the picture/s that is different from the others.

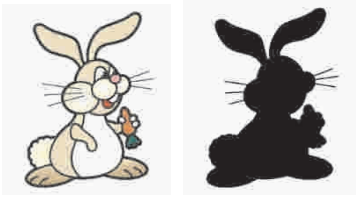


c. Matching pictures to silhouettes

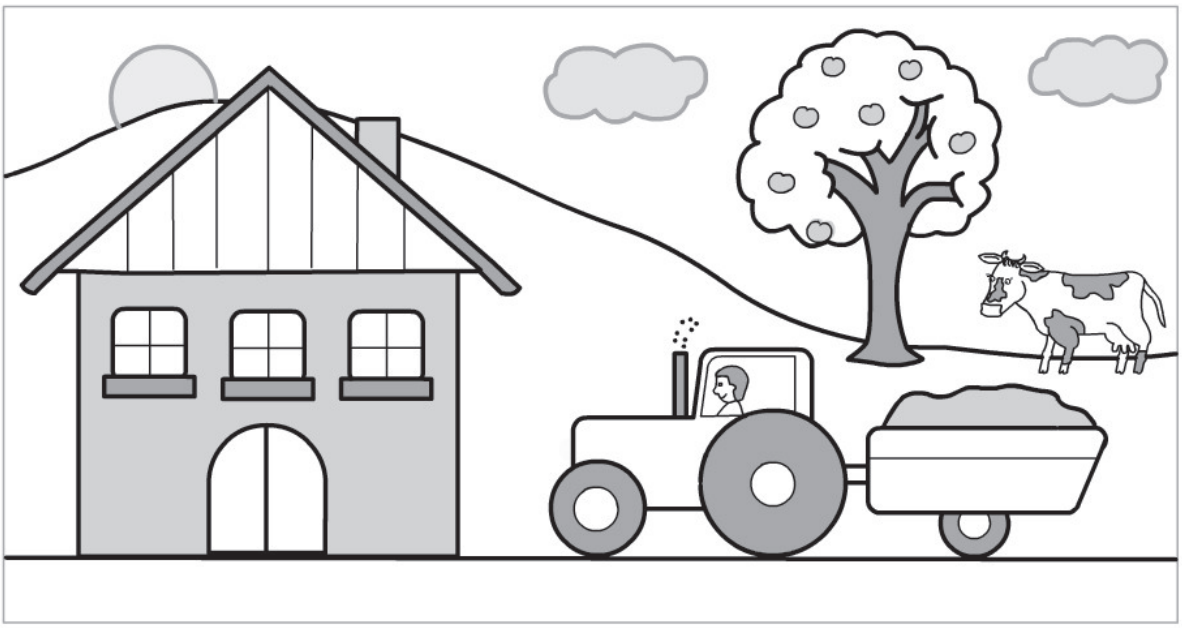
Find the animal's shadow.

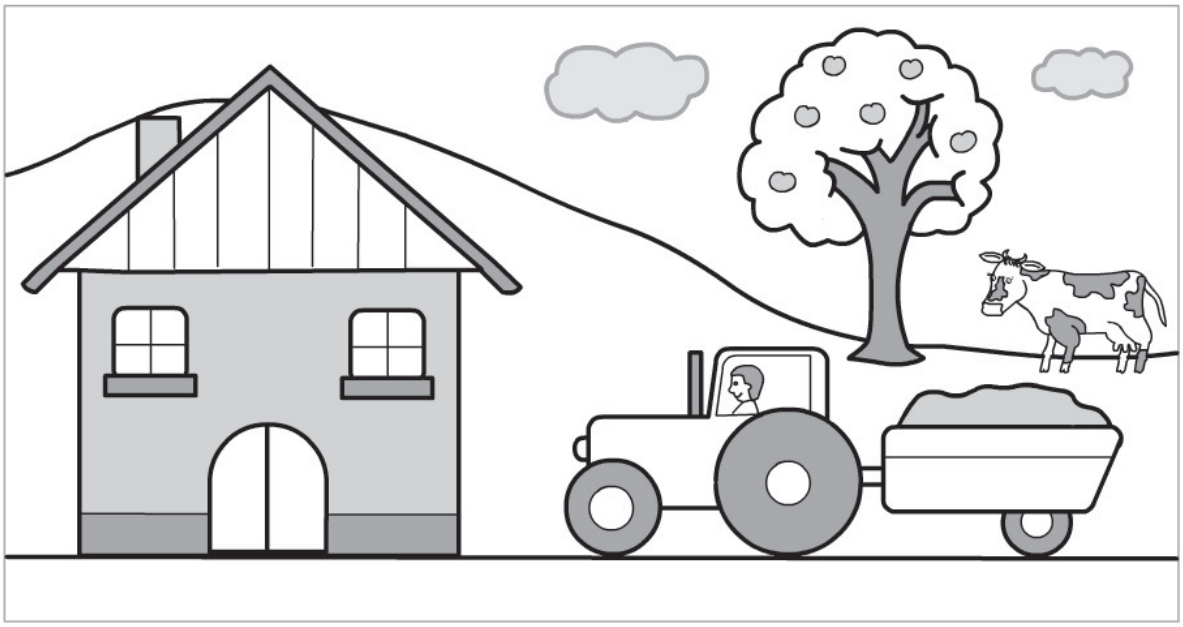


The practitioner can assist learners by initially cutting out the picture and its outline, for example:



e. Finding differences between more complex pictures



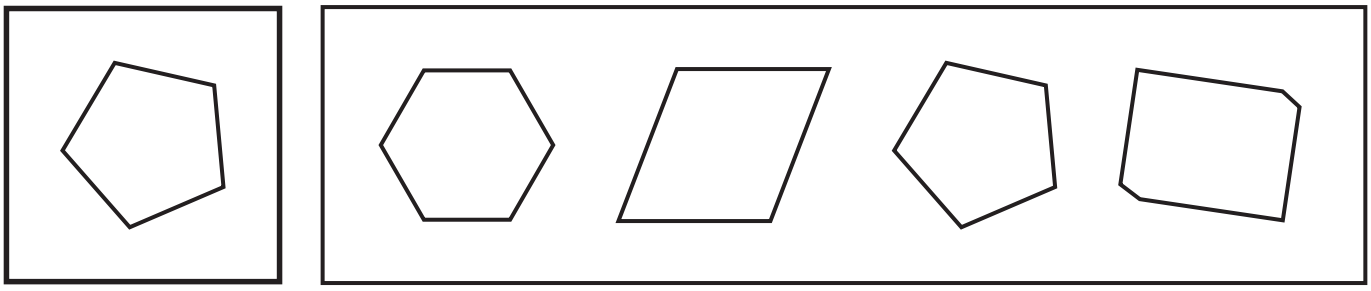


7.2.3 Matching shapes

a. Matching simple shapes

This is the next step in teaching visual discrimination.

Find the shape that is the same as the shape in the first block.



Things to remember:

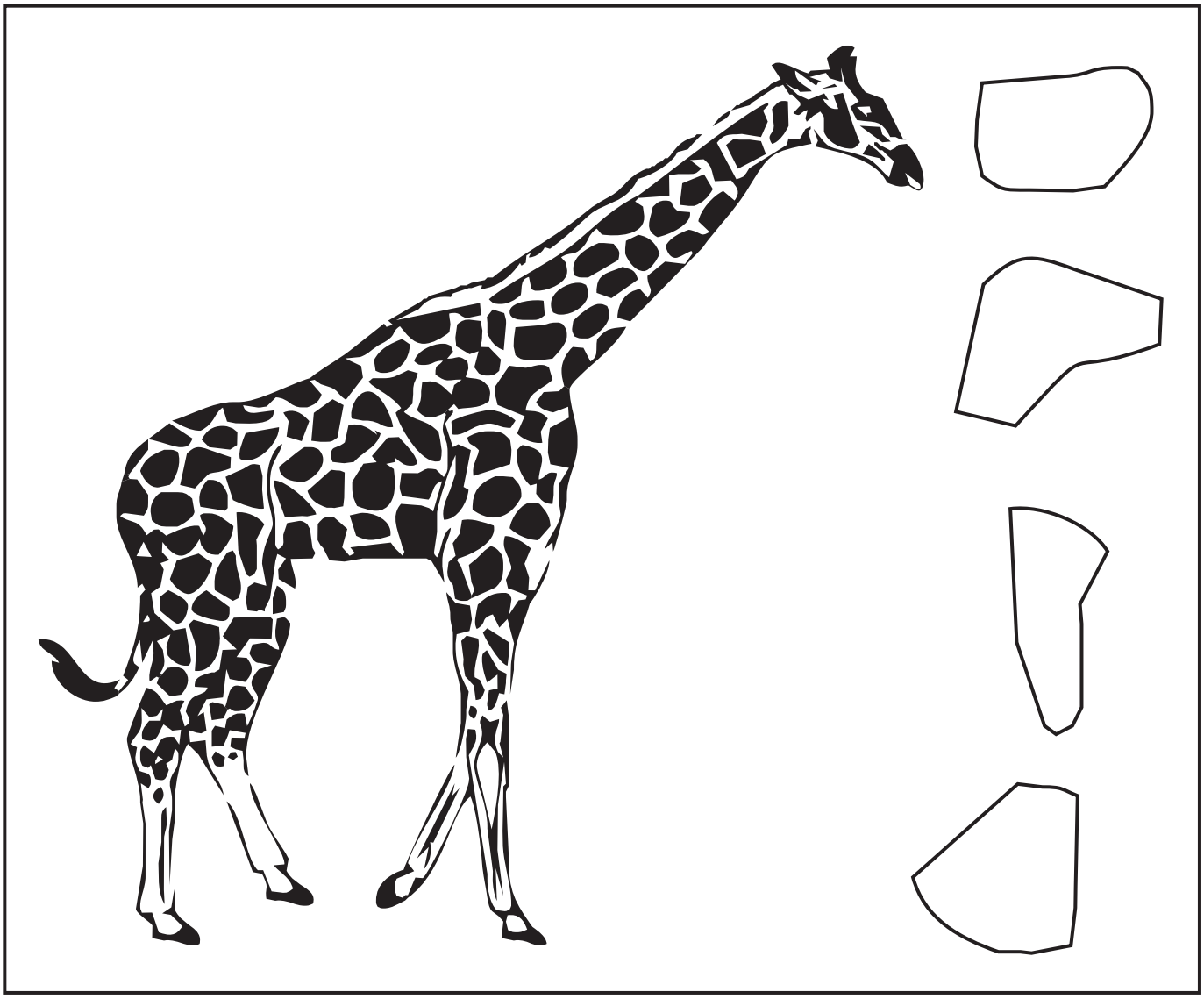
- The more choices you give learners, the more difficult it is for them to choose the correct answer.
- The more similar the shapes are, the more difficult it is for the learners to choose the correct answer.

b. Matching shapes to silhouettes

This is more difficult than just finding the same shape outline. The "shadow" acts as an additional distractor.

Find the shadow that matches the shape in the first block.

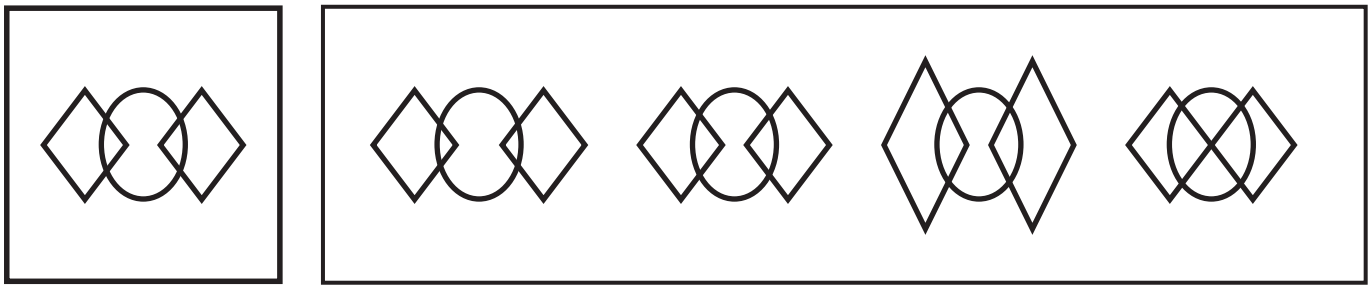
Help the giraffe find his spots.



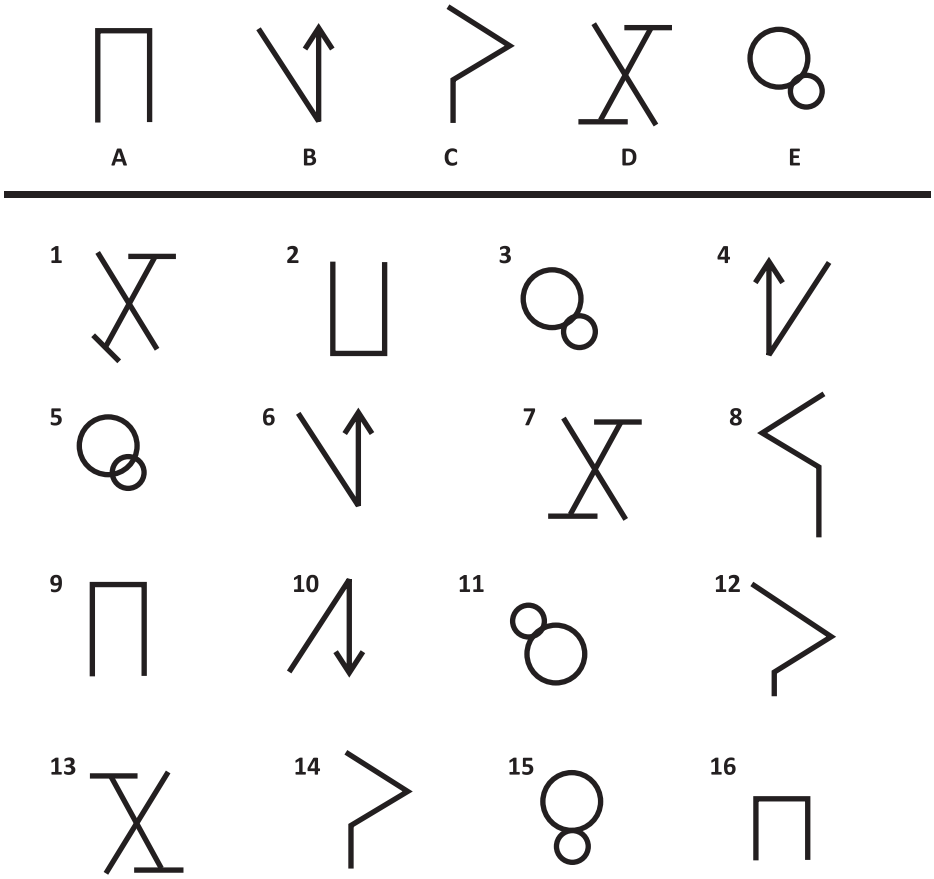
d. Matching complex shapes

This is an even more demanding visual discrimination exercise, since it requires learners to pay careful attention to small details.

Find the picture that is the same as the picture in the first block.



Can you match the shapes on top to the exact same shapes below?

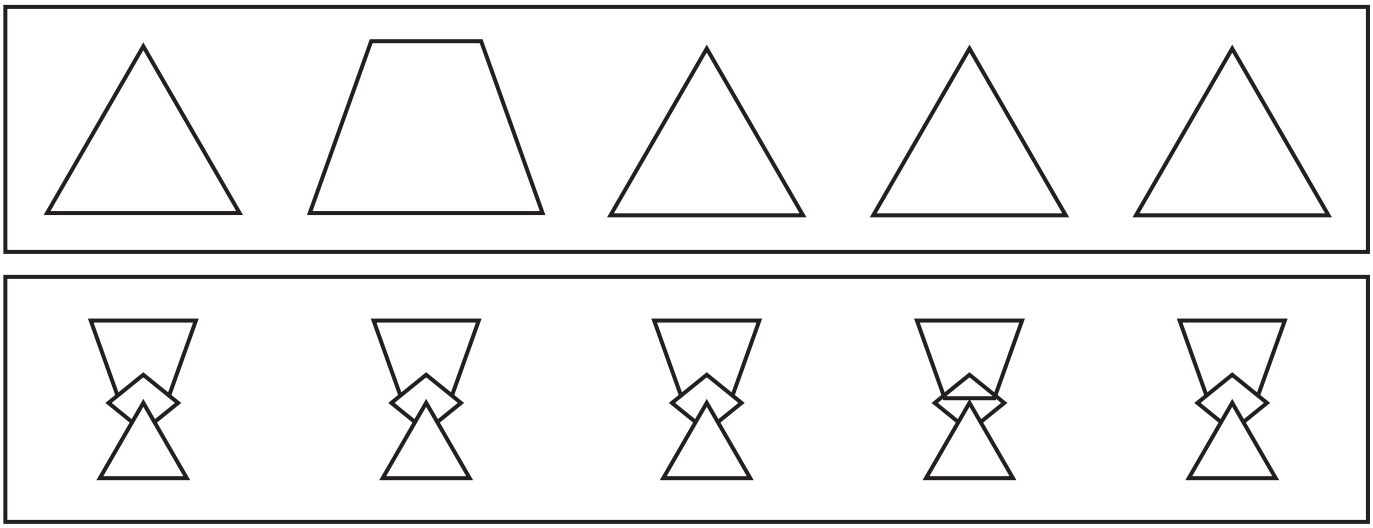


e. Mail the shape

Match the shape to the correct opening.

f. Find the odd-one-out

Find the shape that is different from the others.

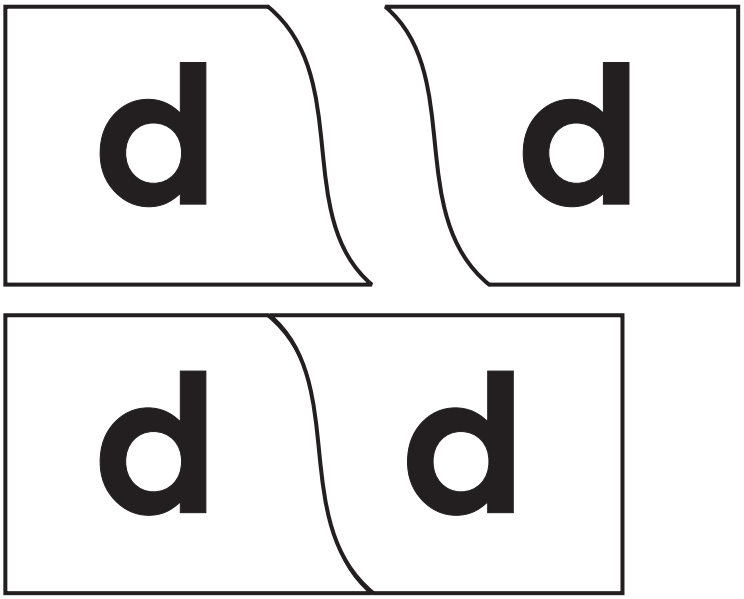


7.2.4 Matching abstract symbols (e.g. letters and numbers)

Matching symbols is more difficult than matching pictures or shapes. Matching symbols lays the foundation for visual discrimination during reading.

a. Letter pairs

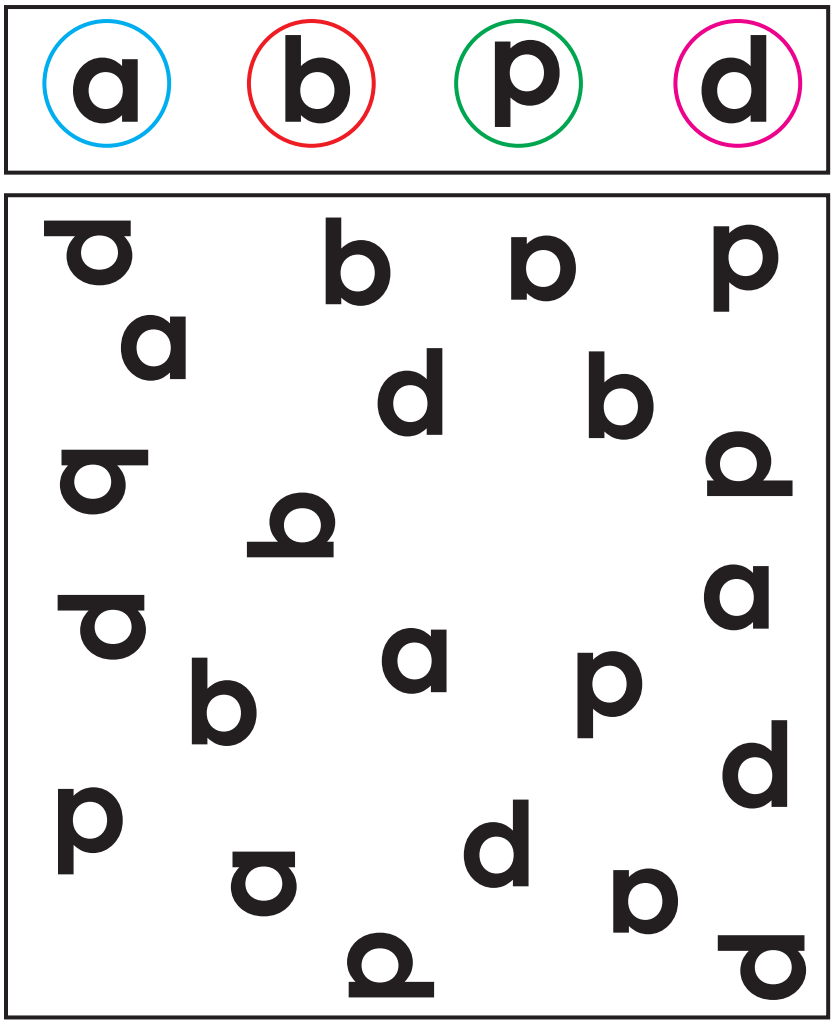
Cut pairs of letters to form puzzle pieces. Learners have to match the two letters that are the same, for example:



The same can be done with numbers

b. Finding the same letters

Find and circle the letters that look exactly like the ones at the top.



c. Matching letter strings

Discriminating between letter strings is more difficult than discriminating between single letters.

Find the group of letters that is the same as the group in the first block.

hpcn	hpcn	hcpn	hcnp

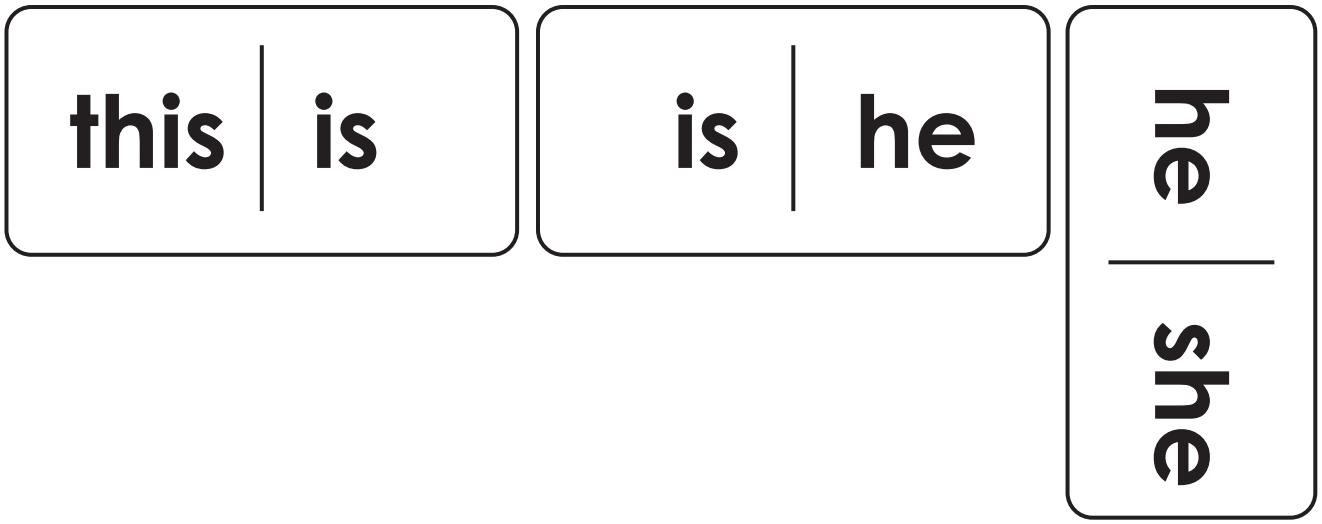
Find the group of letters that is different from the others.

acls	acls	cals	acls	acls

7.2.5 Matching words

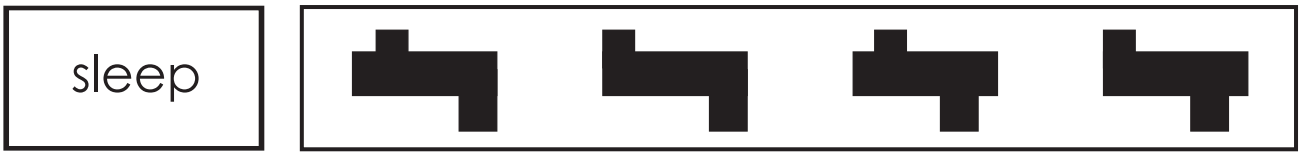
a. Word dominoes

Make a set of dominoes with high frequency words. Learners have to match similar words, for example:



b. Matching word to word-shape ("word-house")

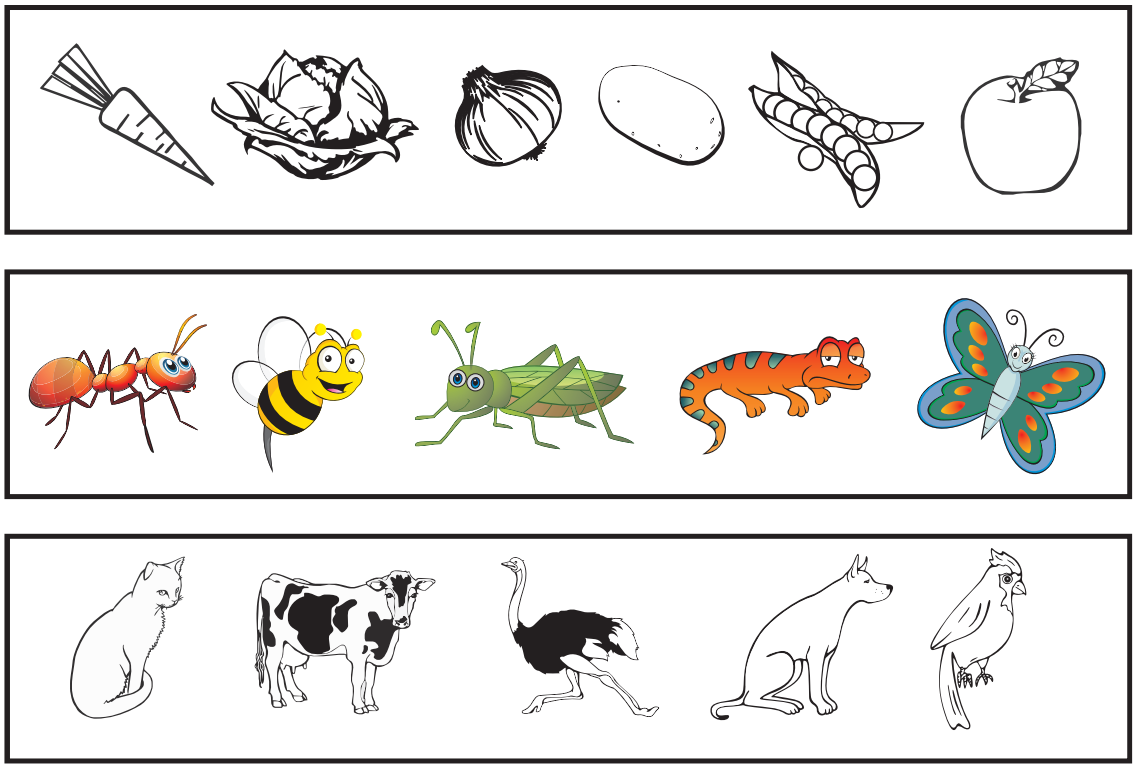
Find the word-house that matches the word in the first block.



Classification is based on the Gestalt principle of proximity and similarity, but also lingual and numerical understanding and knowledge of categories. In order for a learner to recognise patterns and regularities and see the connection between quantities and numbers, the learner need to develop the ability to look carefully, to compare, to differentiate, and to group objects. It is important that learners learn that objects can be grouped (categorised) and sorted.

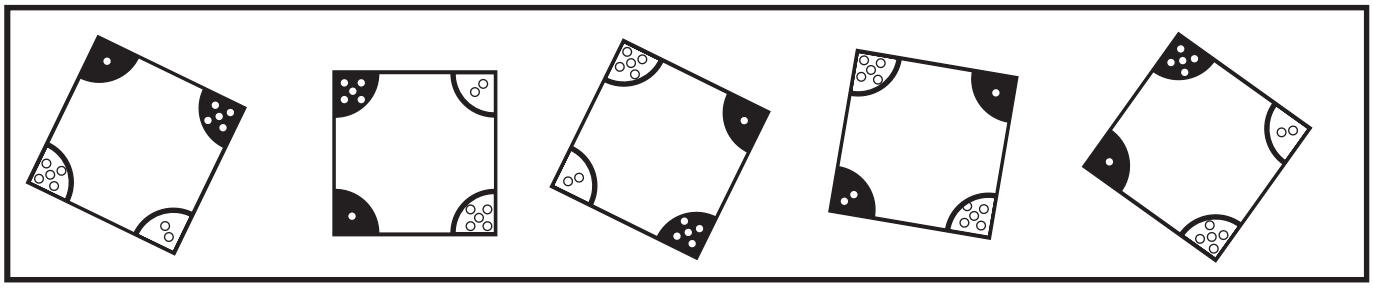
c. Classification worksheet

Which one doesn't belong?



d. Shapes that doesn't belong

Find the shape that doesn't match the rest.



Activity 3

On each desk there is a "Where's Waldo?" activity card. Find as many of the Waldo characters as possible in one minute. Which visual perceptual skill did you use to find the characters? How do you think this relates to teaching and learning?

8. Figure-ground perception

Visual figure-ground discrimination is the ability to distinguish a figure, object or symbol from irrelevant background information. This is a special form of visual discrimination that involves determining what visual details are relevant and important. Gestalt psychologists theorise that human beings have the tendency to organise the visual world (Matlin, 2009). Frostig, Miller & Horne (unknown) indicate that we see those aspects in our visual field that are most important as the figure and the rest of the visual field becomes the dimly observed (back)ground. We can swiftly change our attention from one figure to the next.

8.1 Effects of poor figure-ground discrimination

Learners with poor figure-ground discrimination will easily get lost when faced with a lot of text or a busy page in a workbook (Frostig, Miller & Horne, unknown). These learners struggle to find their place when reading. They struggle with scanning and searching exercises. They often struggle with completing mazes or dot-to-dot pictures.

These learners also appear inattentive and disorganised, since their attention jumps from one aspect to the other indiscriminately and do not focus on one aspect . These learners are said to be stimulus bound (Frostig, Miller & Horne, unknown).

8.2 Activities to develop visual figure-ground discrimination

8.2.1 Sorting objects

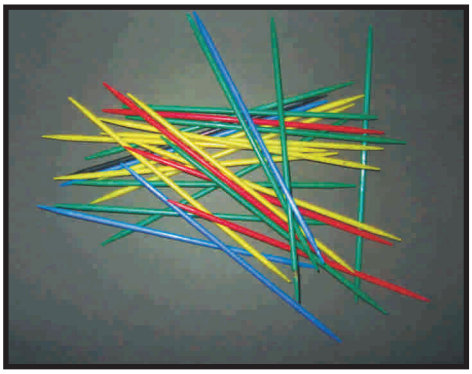
Sorting helps children to concentrate on specific stimuli. It involves correct identification of size, shape, colour etc. The incorporation of touch in this activity is important in teaching young children.

Mix 2 - 3 different types of items, for example, beads, blocks, reels of different sizes and colours, objects of different textures and ask the learner to sort the objects into groups.

Ask the learner to pick out one type of object from a box containing a mixture of items. At first, the objects used should

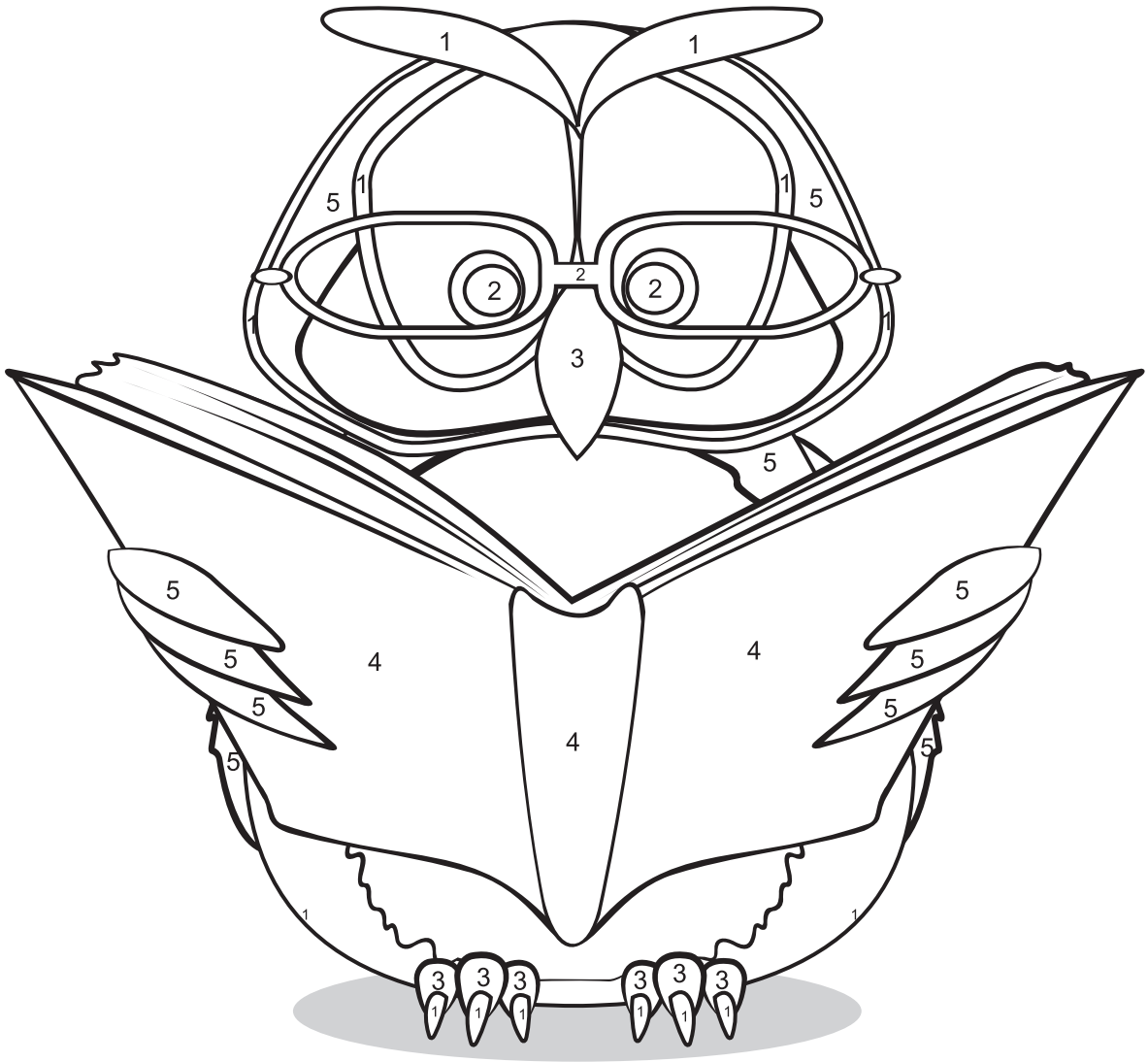
differ greatly. Then progress to using objects that are very similar. For example, ask the learner to find a square button in a box of round ones or a blue marble in a box of green ones.

8.2.2 Pick-up-sticks



This is a game for only two. The object of the game is to pick up the most sticks. To begin the game, a bundle of sticks is somewhat randomly distributed so that the sticks end up in a tangled pile. The more tangled the resulting disarray, the more challenging the game. The first player attempts to remove a single stick without moving any other stick. In some versions of the game, players use a tool to move the stick away from the pile; this "tool" may be one of the sticks, held aside before the game begins. In other versions, players must pick up the sticks by hand. In either case, players must not move any other sticks while attempting to remove the chosen stick; if any other stick moves, his or her turn ends immediately. Players who successfully pick up a stick can then have another turn; the player keeps removing sticks until he or she causes a secondary stick to move. The game is over when the last stick is removed. The winner is the player with the highest number of sticks picked up.

8.2.3 Paint-by-numbers or colour-by-numbers



1 = Black **2 = Light Blue** **3 = Yellow** **4 = Red** **5= Brown**

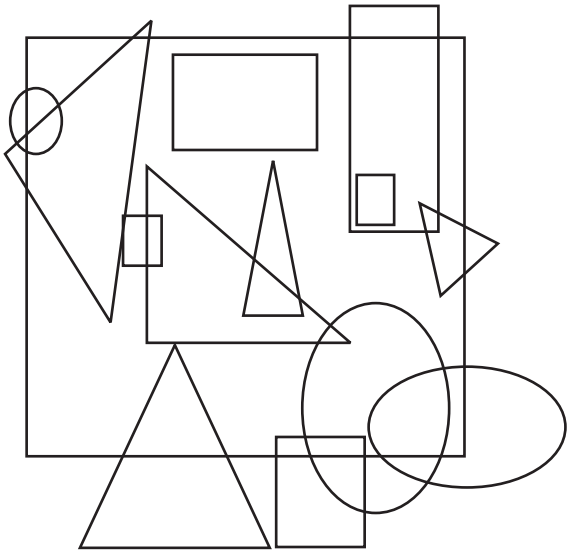
8.2.4 "I spy" games

This game involves finding a specific object against a busy background. At first, the game should be played using real objects.

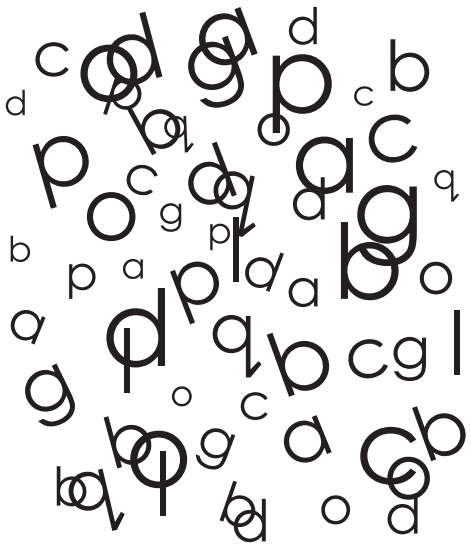
8.2.5 Overlapping shapes, letters and numbers

Start with shapes and then progress to more difficult pictures, letters and numbers.

Colour all the triangles.



How many times does the letter "b" appear?



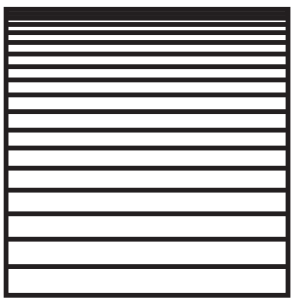
9. Depth perception

Depth is the distance between you and a surface. There are two types of depth cues (Sternberg, 2009) that you use to perceive depth, namely:

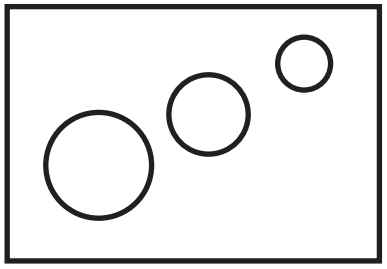
- Monocular depth cues
- Binocular depth cues

Monocular depth cues can be shown in two dimensions and perceived by just one eye (Sternberg, 2009). Sternberg defines the monocular depth cues as follows:

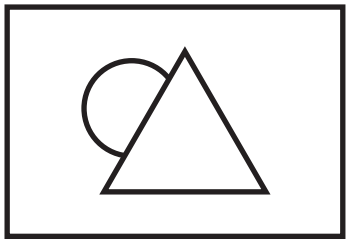
- texture gradients with larger grains that are further apart appearing closer and smaller grains that are closer together appearing farther away;



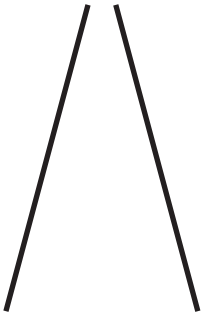
- relative size with bigger objects appearing to be closer and smaller objects appearing farther away;



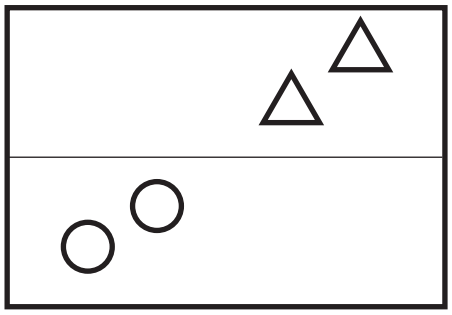
- Interposition with objects obscuring another object appearing closer and objects being objects appearing farther away;



- linear perspective with parallel lines converging appearing farther away;



- Location in the picture plane with objects below the horizon and lower down appearing closer, whereas objects below the horizon and higher up appearing farther away; and



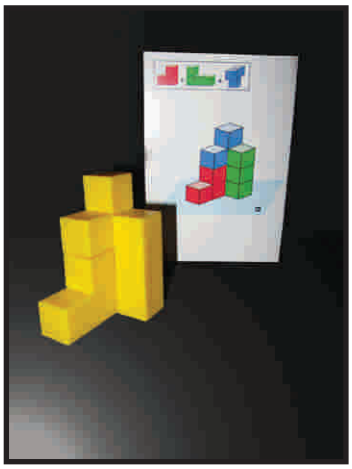
- motion parallax with objects coming closer getting larger with increasing speed and object moving away getting smaller with decreasing speed.

Binocular depth cues are made possible by the slightly different sensory information received by your two eyes (Sternberg, 2009). The closer and object are to you the more disparate or different the two images perceived by your eyes are (Sternberg, 2009). Furthermore, as an object approaches you the more your eyes turn inward to observe the object clearly. This is called binocular convergence.

Activity 4

Each group received a green card. The figure at the top is your model. Find the figure among the three options below it that matches the top figure when you mentally rotate it. Which visual perceptual skill did you use? In which subjects do you think learners will use this skill? Why? During which classroom activities do children develop these skills?

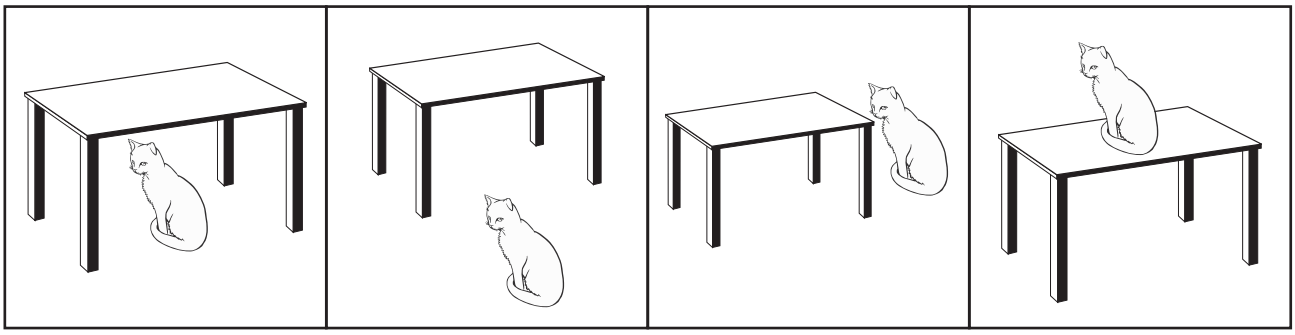
10. Visual-spatial skills



Spatial visualisation ability or visual-spatial ability is the ability to mentally manipulate 2-dimensional and 3-dimensional figures, e.g. by rotating them in your mind, breaking bigger shapes down into smaller parts or building bigger shapes using smaller shapes.

Position in space is the ability to define the relationship between an object and the observer, e.g. the table is behind me.

Spatial relationships refer the relationship between two or more objects and the observer, e.g. the book is on top of the table, but in front of me. It involves the capacity to understand and remember the spatial relationships among objects, e.g. when reading a map or visualising an object from another perspective.



Another spatial skill is packing, e.g. deciding whether a specific object will fit into a specific box.

Spatial skills are thought to develop when children explore their environments and gain experience with how objects look from different perspectives. Schneck (2001) indicates that the critical period for development of visual spatial skills is between seven and nine years of age.

10.1. Gender differences

Men on average perform better in visual spatial tasks than women (Dewar, 2013). It has also been found that spatial ability correlates with verbal ability in women but not in men, suggesting that women may use different strategies for spatial visualisation tasks than men do. However, spatial ability is correlated with video games and other such activities (Franceschini et al, 2012) and thus gender difference in spatial ability may be linked to a difference in spatial experience, rather than actual difference in innate spatial ability.

Tzuriel and Egozi (2010) measured the mental rotation abilities of 116 Israeli first graders (average age, 6.5 years). The first graders were randomly assigned, with half of them doing a mental rotation training programme and the other half a non-spatial training programme. At the beginning of the study, boys outperformed girls (Tzuriel & Egozi, 2010). But after only eight weekly sessions, the girls in the spatial training programme performed as well as the boys. The gender effect was gone.

Wright et al (2008) did a similar study with young adults. Wright et al (2008) showed that after 21 days of daily training on mental rotation and mental paper folding tasks, men and women performed equally well on both tasks.

10.2 Good spatial skills

New research suggests that a pre-schooler's visual spatial attention ability predicts his future reading skills (Franceschini et al, 2012). In a longitudinal study, poor grade 1 readers made twice as many errors in a serial visual search as good grade 1 readers (Franceschini et al, 2012).

Researchers trained 6- to 8-year-olds in mental rotation, a spatial ability, for twenty minutes and found their scores on addition and subtraction problems improved significantly.

10.3 Deficits in spatial skills

Nonverbal learning disability is characterised by normal verbal abilities, but impaired visual spatial abilities (Fitzgerald & Corvin, 2001). Problem areas for children with nonverbal learning disabilities are arithmetic, geometry, and science (Mammarella, Lucangeli & Cornoldi, 2010). Nonverbal learning disorders and other learning difficulties are characterised by poor spatial memory (Mammarella, Lucangeli & Cornoldi, 2010).

Passolunghi and Mammarella (2010) suggest that successful completion of arithmetic word problems involves spatial working memory involved in building schematic representations, because mental operations and transformations are required. Children in their study completed the Corsi Block Task (forward and backward series) and a spatial matrix task, as well as a visual memory task called the house recognition test. Poor problem-solvers were impaired on the Corsi Block Tasks and the spatial matrix task, but performed normally on the house recognition test when compared to normally achieving children. The experiment demonstrated that poor problem solving is related specifically to deficient processing of spatial information (Passolunghi & Mammarella, 2010).

10.4 The child with spatial deficits

Children with poor spatial awareness tend to have visual perceptual difficulties as well (Newcombe & Huttenlocher, 2000). They may appear clumsy and may bump into others. They often stand too close or too far away from the people or objects that they are interacting with. In the classroom they may have difficulty with presentation of written work and may find it hard to structure and organise such work. These children often find it hard to tell their left from right and they confuse positional language i.e. over, under, in or out, left or right. This makes it hard for them to follow

directions that use such language. They may have difficulty with team games and games that use apparatus.

In the classroom the child with spatial awareness difficulties often finds mathematics hard (Newcombe & Huttenlocher, 2000). This is due to the abstract concepts of the subject, especially where shape, area, volume and space is involved. They will have problems reproducing patterns, sequences and shapes. Their strengths, however, are in the more practical and concrete subjects. These children often excel at using a multisensory way of learning (Newcombe & Huttenlocher, 2000). They tend to have good auditory memory skills and have strength in speaking confidently whilst being able to listen well. They tend to have good verbal comprehension skills and their strength is usually in verbal and non-verbal reasoning (Newcombe & Huttenlocher, 2000).

10.5 Activities to develop spatial skills

10.5.1 Expose learners to spatial vocabulary

Big, little, tall, short, fat, thin, thick, empty, tiny, full

Circle, rectangle, octagon, triangle, oval, pentagon

Bent, curvy, straight, flat, edge, pointy, side, line

Pruden, Levine and Huttenlocher (2011) found a link between toddlers' language exposure and preschool spatial skills. Babies and toddlers who heard a lot of spatial words and who used a lot of spatial words, scored higher on spatial skills tests when they were pre-schoolers.

Loewenstein and Gentner (2005) found, using the "bookcases-experiment", that children were more likely to get it right when directions included spatial language than when it did not.

10.5.2 Everyday opportunities to think spatially

You can motivate children to think spatially by asking questions like:

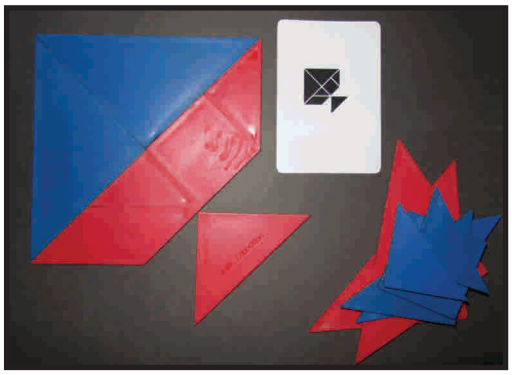
- Will the groceries fit in one bag?
- Which way does the sheet fit on the bed?
- Does the left shoelace go over or under?

10.5.3 Block designs

The Block Design test is a standard subtest to measure spatial skills in children. Children are shown the "blueprints" for a structure and given a set of blocks to recreate it. You can do the same thing– with wooden blocks, interlocking plastic blocks (e.g. Lego, Duplo) or Geocubes.

10.5.4 Tangram and Logi-shapes

Puzzle-solving ability and spatial intelligence are interrelated. Frequent puzzle solving before age four lead to higher scores on a test of mental transformations at age four and a half (Levine et al 2012).



10.5.5 Maps

Most children are ready to learn simple lessons about maps by the age of 3 or 4 years (Newcombe & Huttenlocher, 2000). For instance, young children can learn to interpret a map of their living room floor plan, and then use the map to show where, in the real room, they have hidden a toy.

But here's an important tip: Children use maps more accurately when they are required to explain their choices.

Draw the letter R in box B2.

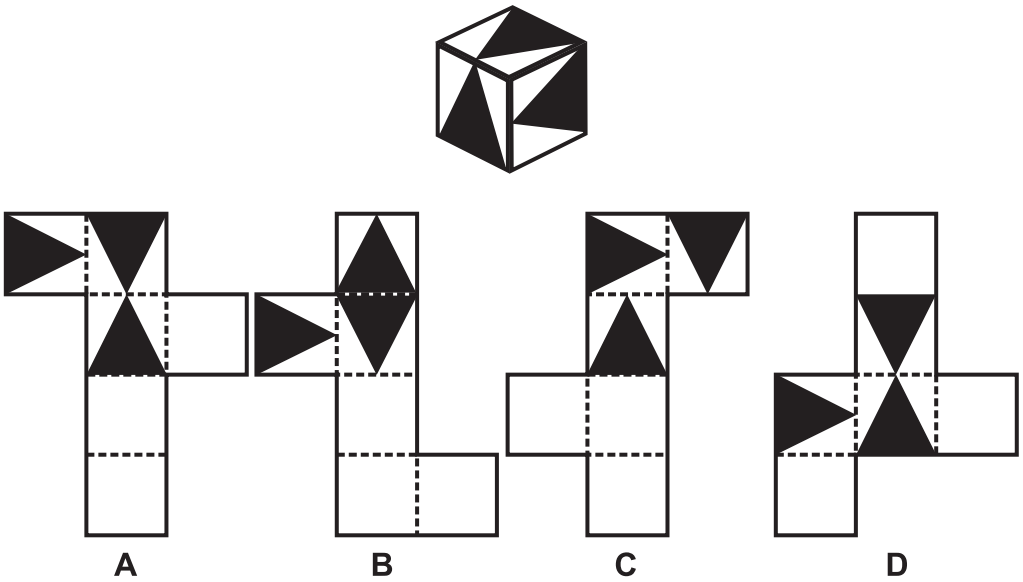
Draw the letter E in box B1.

Draw the letter U in box A1.

	1	2
A		
B		

10.5.6 Object nets

Learners must visualise unfolding a cube into its net or folding a net into a cube.



10.5.7 Action video games

Dye & Bavelier (2010) found that video game players showed:

- quicker response time in a visual search task
- increased visual selective attention
- more accurate processing of rapidly presented stimuli

Action video game players could also track more objects simultaneously than non-video game players (Dye & Bavelier, 2010). However, the potential for action video games to increase aggressive behaviour in children should not be ignored (Anderson & Dill, 2000).

Activity 5

How to Make an Origami Swan

Items Needed

- Origami Paper
- Pencils
- Rulers
- Pair of Scissors

- **Instructions**
- Cut out a square piece from the origami paper; the size depends on how big you want the swan to be.
- Place the paper on a table, with the colored side facing down. Hold the top-left corner of the paper and fold it in such a way that it meets the bottom-right corner.
- Make a firm crease at the point where the paper has just been folded. Now, unfold the paper and return it back to the original position.
- Bring the left edge of the paper into the centre of the square and make a firm crease at the point where the paper has been folded.
- Repeat the above step with the right edge of the paper.
- Turn over the paper and repeat the above two steps with this side. Now the paper should resemble an elongated diamond.
- Hold the bottom point of the diamond and fold it from the centre, in such a way that it meets the top point. Crease. The folded portion will make the head and neck of the swan.
- For making the swan's head, fold the top area of the portion folded in the previous step. Make sure you fold only ¼ of the section, so that the head remains smaller than the neck.
- Now, fold the entire piece of paper into half underneath itself, along the central line made in the third step.
- Flatten the paper.
- Gently pull the swan's neck and head and bring them into an upright position.

Which visual skills did you use during this activity? (Hint: there is more than one). During which activities in class do children use these skills? Why are these skills important for academic success?

11. Visual-motor integration

Motor skills can be divided into two broad categories: fine motor skills and gross motor skills. Gross motor skills involve movements and control of the large, force-producing muscles in the trunk, arms and legs (Tepeli, 2013). Gross motor activities include actions such as running, crawling, walking, swimming, and other activities that involve larger muscles. Fine motor activities refer to the movement and control of the smaller muscles in the hands, wrists, fingers, feet, toes, lips and tongue. This includes smaller actions such as picking up objects between the thumb and finger, using a pencil to write carefully, holding a fork and using it to eat, and other small muscle tasks that occur on a daily basis.

Tepeli (2013) found that learners' visual perceptual skills improve when their gross motor skills improve and that their gross motor skills decrease as their visual perceptual skills decrease. Thus, the gross motor system and visual perceptual skills are interrelated.

Eye-motor-coordination is the ability to coordinate movements of the body with vision (Tepeli, 2013), e.g. catching a ball requires coordination of what the eyes see and what the hands are doing. Eye-motor-coordination is a predictor for gross motor development. The first visual motor integration skills mastered by infants are gazing (saccades, head movements and pursuit) and tracking (smooth pursuit) (Braddick & Atkinson, 2011). Visually controlled grasping and reaching for objects develops next (Braddick & Atkinson, 2011). Depth perception is especially important during this phase of development (Braddick & Atkinson, 2011). The visual-locomotion control system develops when a baby starts crawling and walking (Braddick & Atkinson, 2011).

Interestingly, shape and size constancy plays an important role in gross motor development (Tepeli, 2013), e.g. when a ball is thrown towards a person, as the distance between the person and the ball decreases, the image of the ball on the retina will increase in size. However, size constancy assists the person to make accurate judgements of the size of the ball despite changes in the size of the image on the retina. This allows the person to place his hands accurately in order to catch the ball.

11.1 Activities to develop visual-motor integration

The activities below develops fine motor skills, hand-eye-coordination and also figure-ground perception and position in space.

11.1.1 Beads in paint palette

Use a paint palette as a sorting tray for small plastic beads. The learner grasps each bead with his/her forefinger and thumb. Since the cups on the paint palette are small, the learner must be very precise about where to place each bead. This activity integrates fine motor skills with sorting skills as well as figure-ground discrimination.

If the learner struggles, a muffin pan or egg carton can be used as well as bigger beads.

11.1.2 Pom-poms and tweezers

The learner uses tweezers to grasp a pom-pom and place it in an ice cube tray. The learner uses finger muscles to squeeze the tweezers. The pom-poms can also be sorted according to color. Pom-poms can be purchased from Pick and Pay, CNA and craft shops.

11.1.3 Pom-poms with tongs

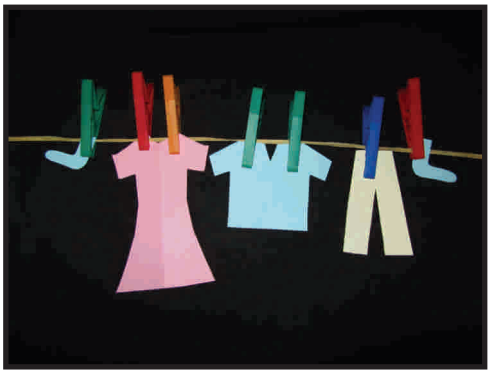
The learner uses tongs to sort pom-poms into containers. The learner uses his/her hand muscles to squeeze the tongs.

11.1.4 Hanging the washing

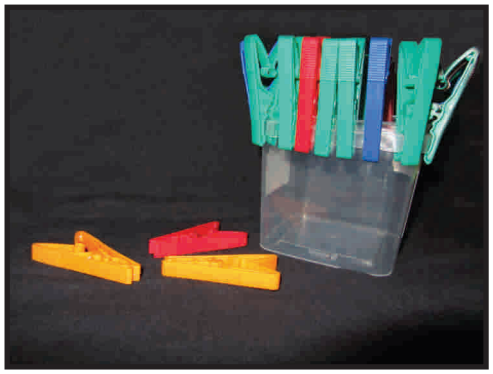
The learner uses pegs to hang paper clothes on a washing line or a line strung in the classroom. Doll's clothes or clothes cut from felt can also be used.

11.1.5 Pegs on a box

The learner squeezes a peg and clips it onto the sides of a box. Any sturdy box can be used.



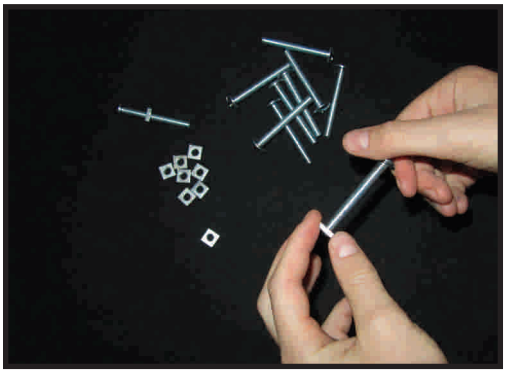
(Hanging the washing)



(Pegs on a box)

11.1.6 Nuts and bolts

The learner uses his/her wrists and fingers to grasp and screw the nuts onto the bolts. A high level of coordination is needed since both hands and eyes need to work together.



11.1.7 Spooning flat marbles

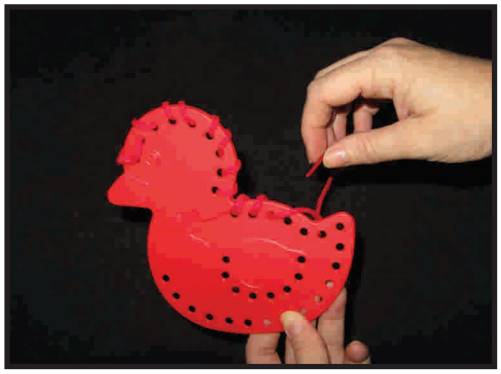
The learner scoops up flat marbles with a spoon and places them in another bowl or container. Instead of flat marbles, stones, round marbles or beads can be used.

11.1.8 Lacing cards

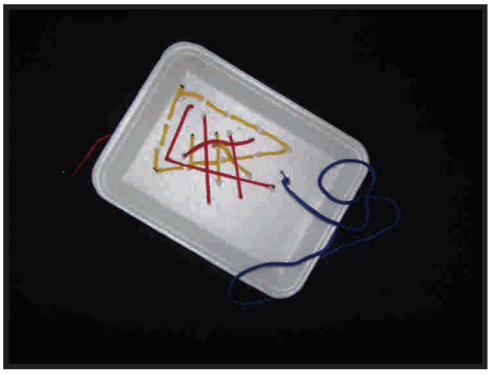
Lacing cards can be purchased or made from cardboard using a hole puncher. The learner uses a shoe lace or string to "sew" all the way around the card.

11.1.9 Sewing plates

Using a plastic needle and yarn, the learner sews patterns on a styrofoam plate by pushing the needle through the plate. Wool or ribbons can also be used instead of yarn.



(Lacing cards)



(Sewing Plates)

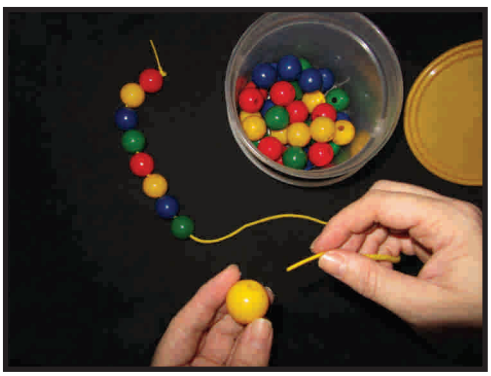
11.1.10 Stringing straws

Cut straws into small pieces of about 2 cm. The learner uses a plastic needle and yarn to lace straws into a necklace.

11.1.11 Stringing beads

The learner strings beads onto laces or pipe cleaners. This activity can be integrated with patterns in numeracy, by specifying the sequence of beads to be stringed. This could also be an auditory or visual memory exercise.

(stringing straws)



(Stringing beads)

11.1.12 Bean gluing

The learner draws a simple picture on paper and then traces the outline with g l u e (wood glue works best). The learner then places beans onto the glue line.

11.1.13 Feeding the rabbits

The learner uses tweezers to sort seeds by placing them into different cups. This activity can be made more interesting by using a silicon cupcake pan with rabbit shapes as a sorting tray. To make this activity easier, use bigger seeds or beans.

11.1.14 Unifix cubes

The learner stacks unifix cubes.

11.1.15 Eyedropper art

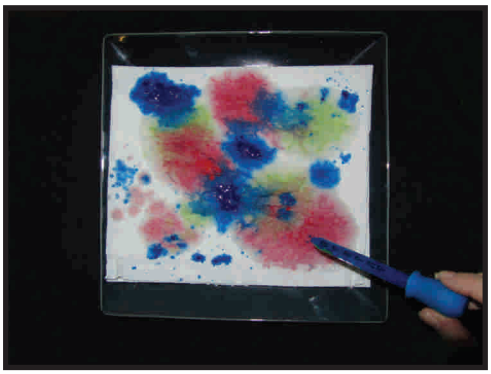
The learner drops liquid watercolour paint onto a paper towel.

11.1.16 Making paper clip necklaces

The learner clips paper clips together to form a necklace.

Bigger paper clips can be used to make this challenging activity easier.

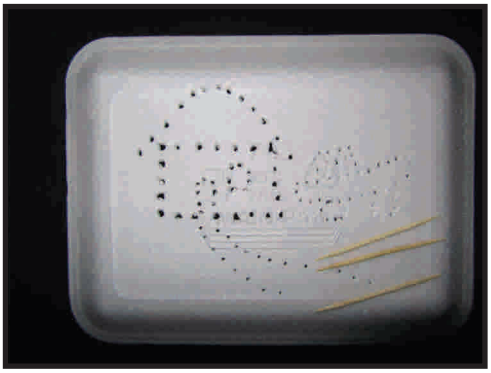
(Feeding the rabits)



(Eyedropper art)

11.1.17 Tooth pick punch

Draw a simple picture or pattern on a styrofoam tray or a piece of paper. The learner uses a tooth pick to punch holes through the Styrofoam tray or piece of paper following the outline of the picture. Once done, the learner can hold the tray or piece of paper up to the light to see the picture.



11.1.18 Sand art

Draw a simple picture onto a piece of paper. The learner covers the whole inside of the picture with glue and then sticks sand onto the glue. The idea is that the learner pinches some sand and then sprinkles it onto the glue.

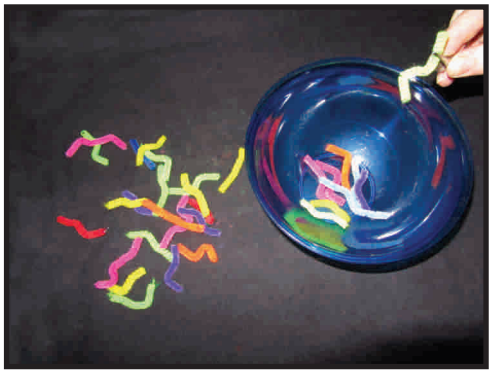
11.1.19 Insect wrapping

The teacher explains to the learners that spiders catch insects in their webs and then wrap them up in the web. The learner uses string ("spider web") to wrap up plastic insects.

11.1.20 Birds eating worms

Cut pipe cleaners into short pieces or "worms". The learner uses tweezers to catch the "worms". The learner pretends the tweezer is a bird's beak. A peg can also be used as a bird's beak.

(Wraping insects)



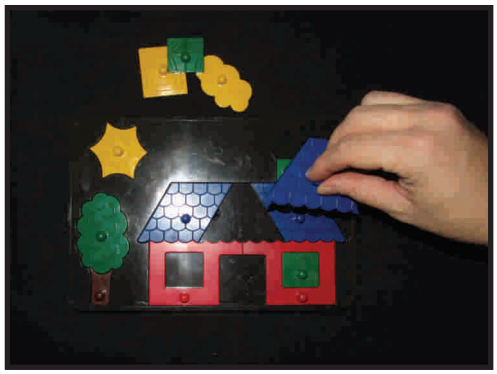
(Birds eating worms)

11.1.21 Knobbed puzzles

The learner fits the pieces into their correct places.

11.1.22 Lego or building blocks

These are essential to have in every grade R class.



(Knobbed puzzles)

(Lego or building blocks)

11.1.23 Play dough

The learner rolls balls and snakes using play dough. Clay can also be used.

11.1.24 Peg boards

Another excellent resource! A good peg board set usually comes with work cards that get increasingly more difficult.

(Wraping insects)

(Birds eating worms)

11.1.25 Shooting boats

Draw several boats onto a piece of paper. The learner pretends a pencil is his canon. The learner loads the canon by walking his fingers along the pencil and flipping it over. Once the canon is loaded the learner shoots a boat down by crossing it out. Before the learner can shoot down the next boat, the canon must first be reloaded.

11.1.26 Cutting and weaving paper

The learner cuts paper strips by cutting along pre-drawn lines. The learner can then use the paper strips to weave into a string.

11.1.27 Shaving cream art

Spray shaving cream onto a plate or plastic tray. The learner draws pictures in the shaving cream using his finger. This is finger painting with a twist!

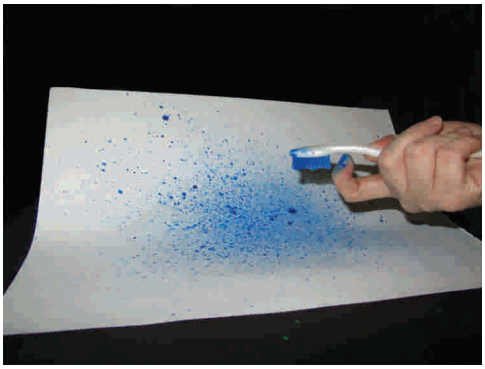
11.1.28 Water play

The learner transfers water from one cup to another using an eye dropper or a syringe. In summer time allow learners to play in a bucket of water. Squeeze bottles are lots of fun! Learners love to squirt water. Containers of different sizes can be used to practise pouring water from one container to another. Even washing their own cups in soapy water can be turned into a fun activity.

11.1.29 Tearing paper strips

Old newspaper can be used for tearing activities.

11.1.30 Splatter painting



Using an old toothbrush dipped in liquid watercolour paint, the learner splatters paint onto a piece of paper.

Activities to develop gross motor development and visual motor integration and coordination involves kicking, running, jumping, climbing, stomping, rolling, tumbling, etc.

12. Visual memory and sequential memory

12.1 Definition of visual memory

Visual memory involves the ability to store and retrieve previously experienced visual images when the stimuli that originally evoked them are no longer present (Gimeno-Galindo et al, 2009). That is, the learner must be capable of making a vivid visual image in his mind of the stimulus, such as a word, and once that stimulus is removed, be able to visualise or recall this image without help.

12.1.1 Visual memory and visual sequential memory

Visual memory differs from visual sequential memory. In visual sequential memory the information needs to be remembered in the sequence it was presented or in a specific order.

12.1.2 Difference between auditory and visual memory

Visual memory differs from auditory memory. Visual memory involves remembering the information that was seen. Auditory memory involves remembering the information that was heard.

12.1.3 Why do visual and auditory memory exercises?

The way we process and remember visual and auditory information is different. The path that visual and auditory information follows through our brains is different.

Information enters our brains through our senses. These paths are simply called the sensory registers. There is one for every sense. Visual information enters through the visual sensory register and auditory information through the auditory sensory register. Visual information remains in the visual sensory register for a very short time, as an exact image of what we have seen begins to fade after approximately 100 milliseconds. Information we heard remains in the auditory sensory register for approximately one to two seconds and is replaced by new information (it does not fade).

Short term memory is divided into several subsystems. These subsystems include visual and auditory memory systems. Working memory also consists of two subsystems: verbal working and visual working memory. The visual working memory can store an estimated four to seven items at a time (Gimeno-Galindo, 2009).

12.2 Effects of poor visual memory

Various researchers have stated that as much as eighty percent of all learning takes place through the eye with visual memory playing a crucial part in learning (Gimeno-Galindo et al, 2009).

Learners with poor visual memory frequently experience difficulty in remembering the overall visual appearance of words or the letter sequence of words needed for reading and spelling (Gimeno-Galindo et al, 2009). They may remember the letters of a word, but often cannot remember their order, or they may know the initial letter and configuration of the word without having absorbed the details, that is, the subsequent letters of the word. As a result, these students fail to develop a good sight vocabulary and frequently experience serious writing and spelling difficulties. Tseng and Chow (2000) found that learners with low scores on visual memory and sequential memory

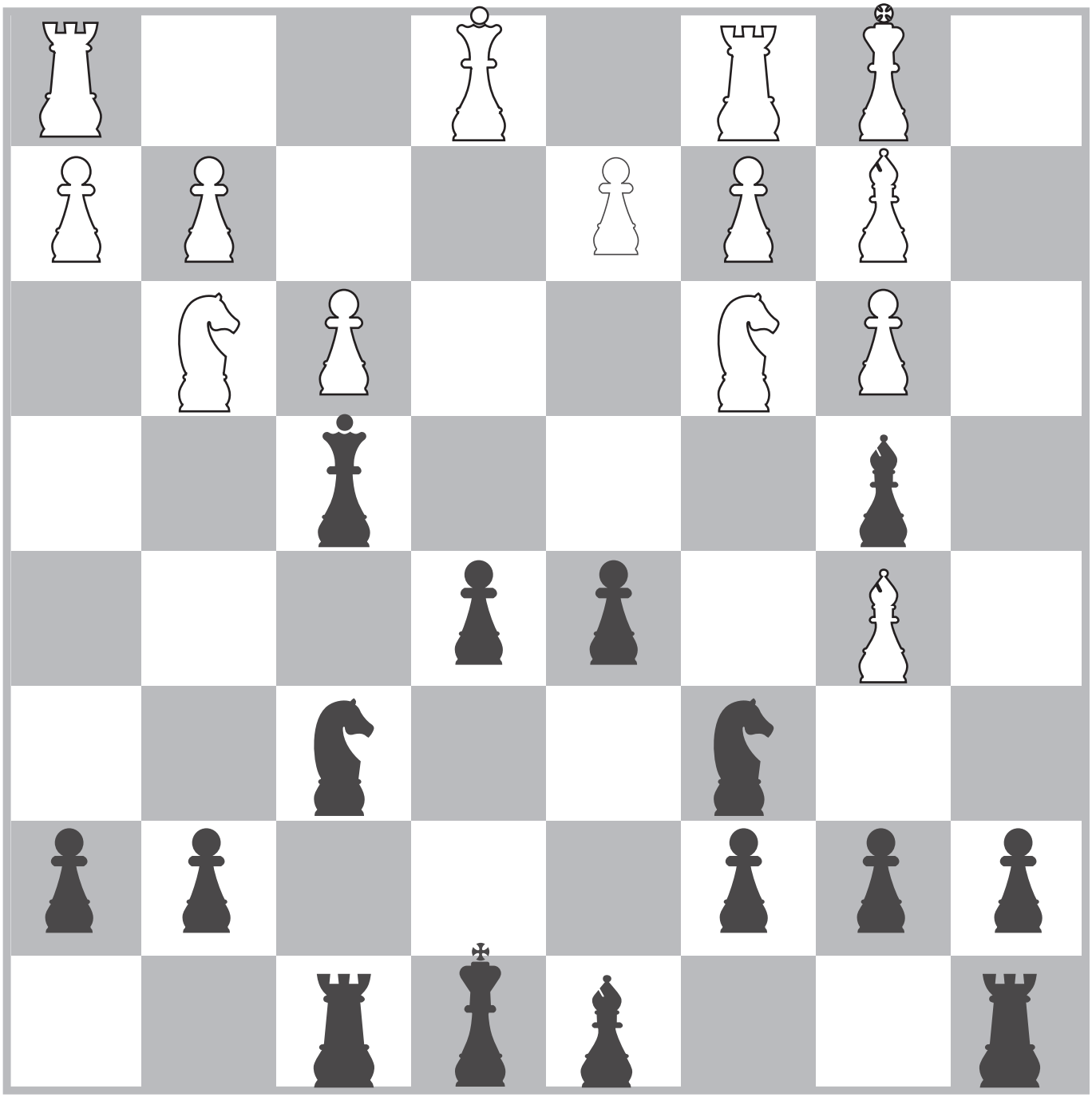
were the slowest writers.

Bull, Espy and Wiebe (2008) have found that ability in short term memory and visual spatial memory predicts ability on mathematics, at least in pre-school children.

Interestingly, learners with inadequate eye movements have difficulties with the organisation of information in tasks that requires visual memory (Gimeno-Galindo et al, 2009).

Activity 6

Look at the chess board below. Memorise the placement of as many of the pieces as you can. You have one minute.

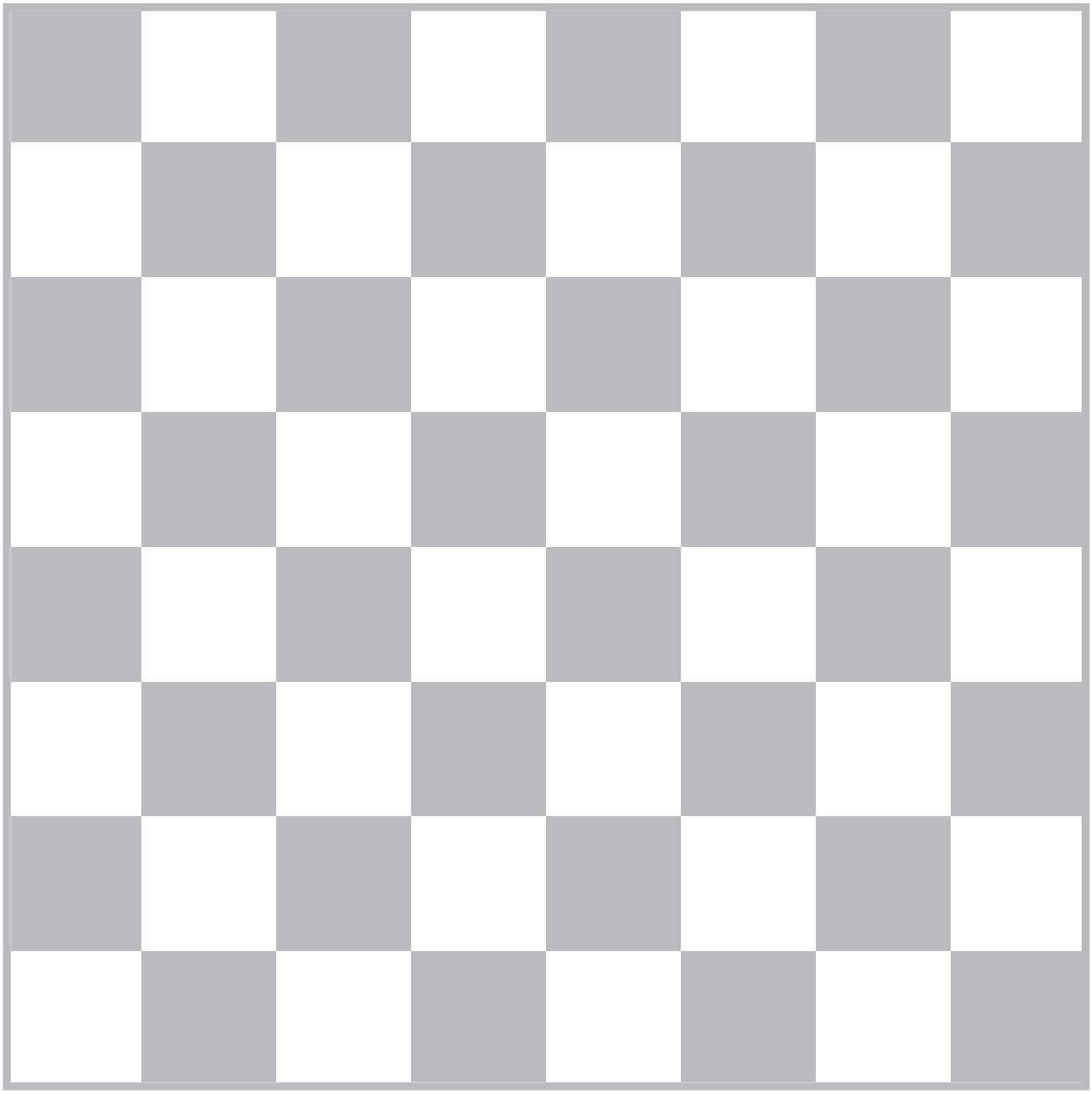


Now draw or write in the placement of pieces you can remember.

Group discussion: Why do some people find it easier to remember the placement of chess pieces?

Do you think chess players would be better at remembering the placement of pieces? Why?

Would that always be the case? What techniques can you teach your learners to improve their visual memory?



12.3 Mnemonics

"Tricks" which are used to make recall easier are called mnemonics.

- Teach learners to put things they need to remember in "chunks".
- Another simple mnemonic is to repeat what is heard aloud or to whisper it "in your mind". This is called sub-vocal rehearsal.

12.4 Activities to develop visual memory and sequential memory

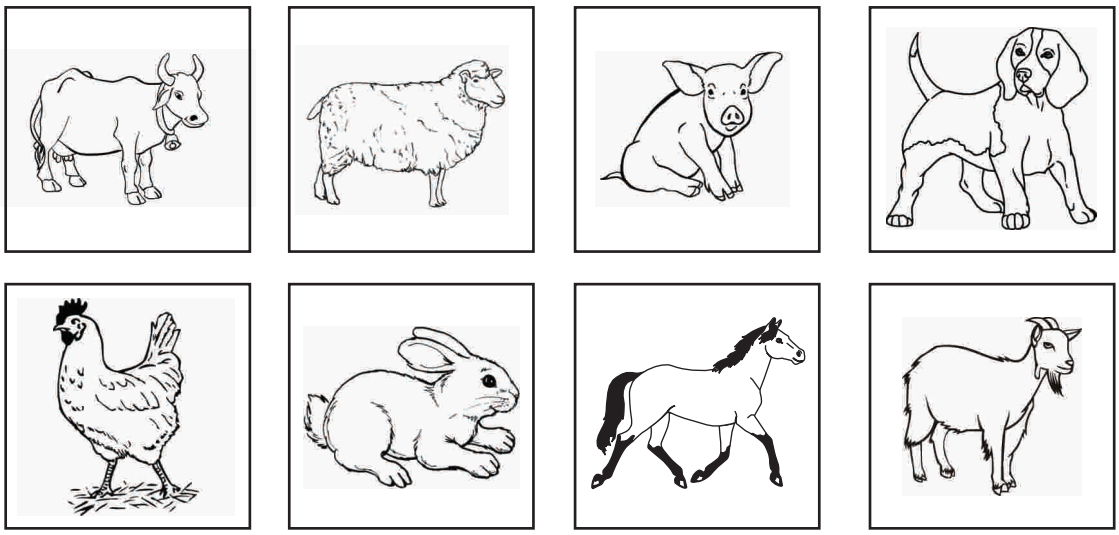
12.4.1 Memory cards

Every learner receives a set of eight memory cards. The teacher shows the learners a number of cards. The teacher asks learners to set out the cards that she has shown them with their own cards. Learners have to remember what to set out.

The activity can be made more difficult by:

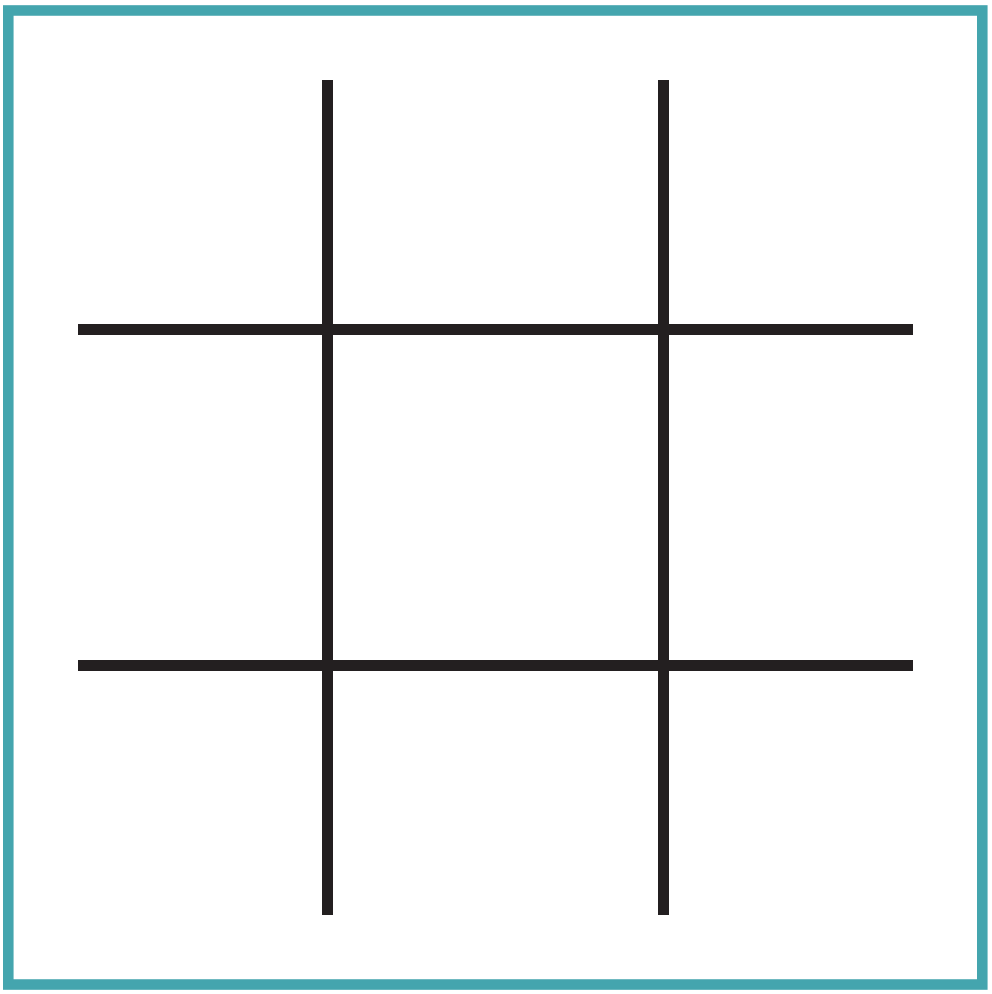
- Increasing the number of cars to be set out;
- Requiring learners to remember the sequence in which to set the cards out

This activity can also be done with coloured beads or blocks, shapes or real objects.



12.4.2 Colour tic-tac

Each learner gets an empty tic-tac card and coloured dots or bottle tops. The teacher shows the learners a tic-tac card with one or two coloured dots on it. The learners set out coloured dots or bottle tops on their tic-tac cards. Make it more difficult by including more coloured dots.



12.4.3 Remember the objects

The teacher sets out a number of objects (start with two or three). The teacher asks learners to look carefully at the objects and remember them. The teacher covers the objects, and asks learners what they have seen. Make it more difficult by including more objects or asking learners to recall the objects in sequence.

Variation:

The teacher set out a number of objects (start with two or three). The teacher asks learners to look carefully at the objects and remember them. The teacher covers the objects, and removes one object before showing the objects to the learners. The teacher asks the learners to identify which object is missing. Make it more difficult by including more objects.

12.4.4 Remember the picture (one minute game)

The teacher shows the learners a picture. The teacher asks the learners to look very carefully at the picture. The teacher takes the picture away and asks learners to recall as many of the objects in the picture as possible.

12.4.5 Matching pairs

The teacher sets out 16 cards in rows of 4. The cards must be placed upside down. The learner turns two cards over at a time. If the cards match, the learner leaves them face up. If not, the learner turns them upside-down. The learner carries on until all eight matching cards have been found.

13. Visual closure

Visual closure refers to the ability to the whole of an object when a part is hidden or incomplete. Visual closure also allows accurate judgments to be made from familiar but partial information, e.g. recognising a dot-to-dot picture before it is complete.

13.1 Visual closure deficits

Poor visual closure skills would make it difficult for the observer to visualise the missing parts of a

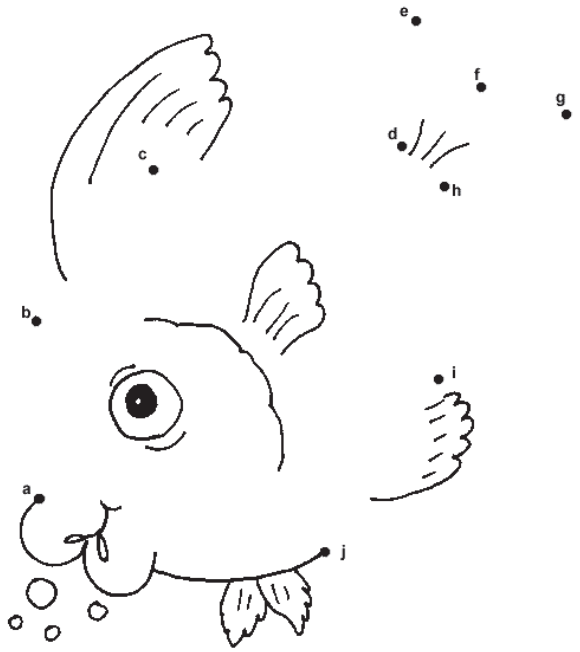
visualising the whole of an object when part of it is hidden or missing, e.g. visualizing the poorly photocopied page of print or pictures, or recognising an object when it is partially hidden by other objects in front of it. When reading, visual closure helps us recognise sight words. It is a foundation skill for fluency and speed in reading and spelling. Efficient reading relies on this skill because with each fixation of the eye only part of the letters of a word or phrase is actually perceived. As a child becomes more competent in reading, eye fixations become fewer and he or she must "fill in" more material and encompass a wider area of print. They may also confuse similar objects or words, especially words with close beginning or endings.

13.2 Activities to develop visual closure skills

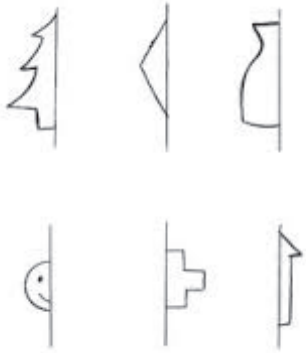
13.2.1 Guessing who or what is hidden

Partially obscure an object by e.g. covering a part of the object. The learner has to guess what is hidden. Use real objects before moving on to pencil-and-paper exercises.

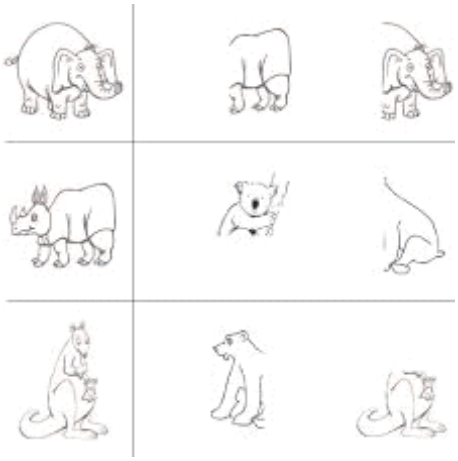
13.2.2 Dot-to dot pictures



13.2.3 Completing picture

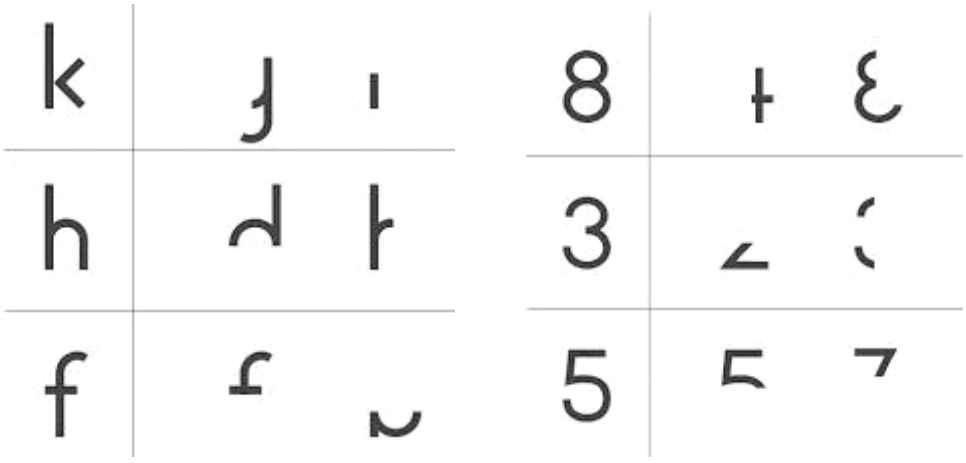


13.2.4 Choosing the other half of a picture



13.2.5 Completing shapes

13.2.6 Completing letters or numbers



13.2.7 Completing words

14. Visual analysis and synthesis

These two skills are very closely related. Visual analysis is the ability to break up pictures, objects and words into their parts. Visual synthesis is the ability to assemble the parts of pictures, objects and words to from comprehensive wholes.

14.1 Activities to develop visual analysis and synthesis

Puzzles, tangrams, blocks and pegboards are extremely important activities for developing visual analysis and synthesis.

Picture puzzles can be created by taking a picture of an object and cutting it into several pieces. The pieces are then handed to the child one by one until the child can guess what the object is.

For older learners scrabble type activities can be useful, e.g. learners use letters to build words. Word searches are also a good exercise.

15. Visual perception and developmental disorders

Many developmental disorders are characterised by social and cognitive deficits, but also visual processing deficits (van den Boomen et al, 2012), e.g.:

- Learners with Autism Spectrum Disorder show atypical motion processing.
- Learners with Schizophrenia show atypical contrast processing and deficits in metacognition.

- Learners with Schizophrenia have difficulty perceiving faces and facial expressions.
- Learners with William's syndrome show atypical motion processing, deficits in spatial representations and visual working memory.

Van den Boomen, Van der Smagt & Kemner (2012) claim that since social and cognitive development rely on early visual processing, deficits in visual processing might cause later social and cognitive deficits.

16. Tests for visual perceptual skills

16.1 Developmental Test of Visual Perception-2 (DTVP-2)

This test was standardised in 1993 in America for children age four to ten years. The reliability and validity of the test is good (Hammill, Pearson & Voress, 1993).

16.2 Test of Visual Perceptual Skills Revised (TVPS-R)

This test was standardised in 1996 in America for children age four to twelve. The reliability and validity of the test is good (Gardner, 1996).

16.3 Teacher Checklist – Classroom Performance

This checklist was developed and field tested in South Africa by Richmond and Holland (2010). The authors found that the checklist is a useful screening tool that can be used in conjunction with standardised tests and as a monitoring tool during intervention programmes. See Annexure C for a copy of the checklist.

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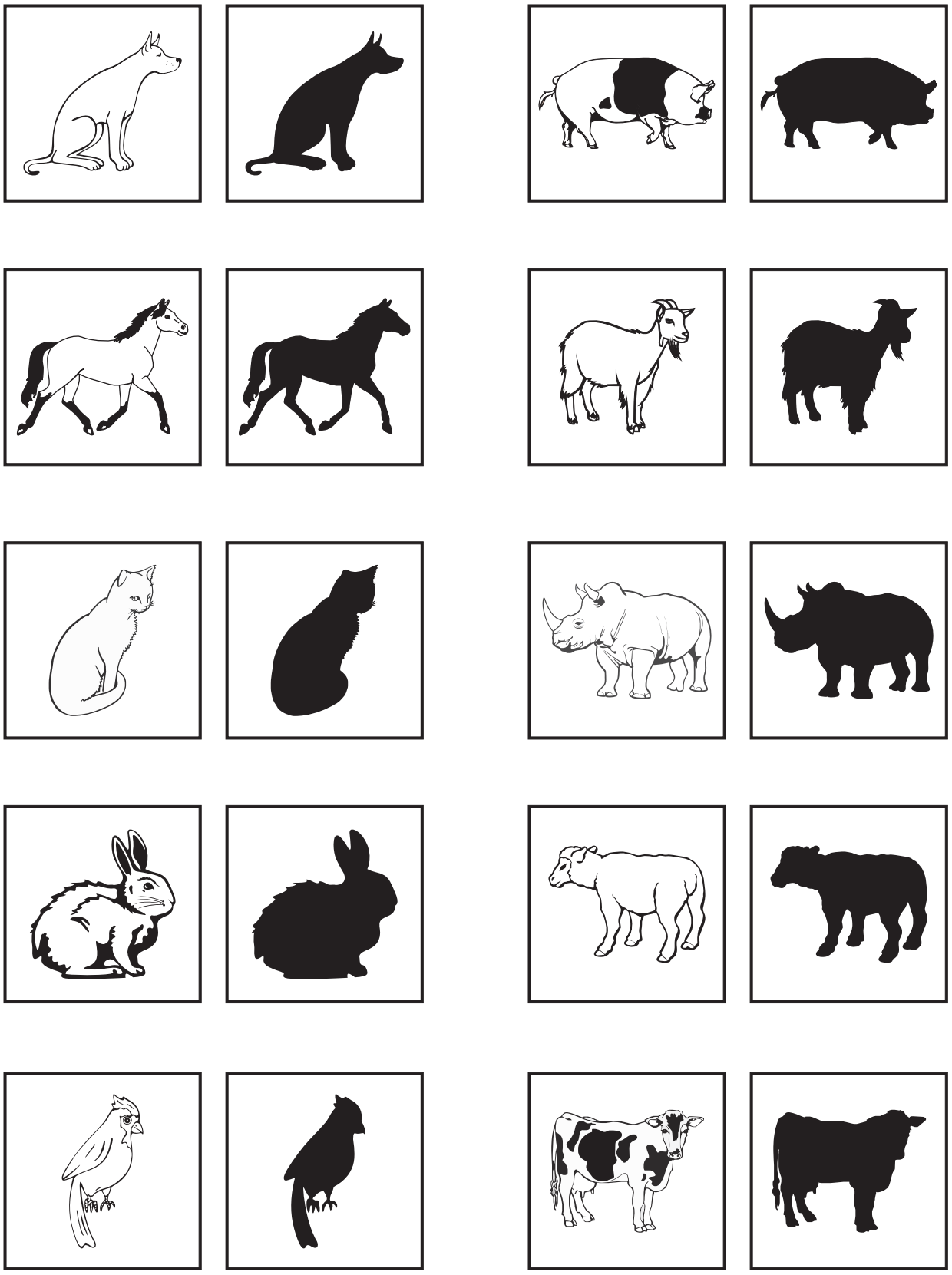
Annexure A: Activity 1 (print on yellow)

A	G	T	F
a	g	t	f
a	g	t	f
A	G	T	F
A	G	T	F

Annexure B: Activity 2 (print on blue)



Annexure C: Teacher Checklist

Permission to reproduce the checklist can be obtained from j.richmond@ecu.edu.au

Teacher Checklist — Classroom Performance

Name of Learner: .....
Age: .....
School: .....

Date: .....
Date of Birth: .....
Grade: .....
Teacher: .....

Please complete this form according to the learner's general performance, without using a fine tooth comb to find fault, but also without excusing obvious errors.

Is the learner on any medication?

Yes	No	Specify

	MOSTLY/ DAILY	OFTEN/ 1xWEEK	SELDOM	NEVER
CATEGORY A				
Incorrect pencil grip				
Presses very hard, holds pencil lightly, tremor				
Inconsistent rhythm; jerky, shaky letters				
Difficulty staying on the line				
Quality/size varies with sustained written output				
Poor desk posture/shifts around in chair				
CATEGORY B				
Reverses or inverts letters/numbers with similar structure but different orientation e.g. n/u, b/d, 2/S				
Difficulty with sequencing e.g. was/saw, of/for, 34/43 or phonic elements in incorrect order e.g. calm/clam, barn/bran				
Difficulty with place value in mathematics				
Poor/inconsistent spacing of letter or words				
Disorganised layout on page				
Difficulty with concepts of top, bottom, before, after, left, right				
Poor sequencing of events in story writing				
Confuses months, days, seasons, time of day				
Trouble observing the margin				
Difficulty seeing patterns and repeating them				
Difficulty seeing the link between ideas, pictures or events				
CATEGORY C				
Difficulty copying from book				
Difficulty copying from chalkboard				
Sees image is incorrect and keeps trying to correct it				
Difficulty with diagonal lines eg ⇑, ✕, A				
CATEGORY D				
Skips lines/confusion when moving on to the next line				
Uses marker/finger to read				
Loses place on page or when copying				
Easily distracted by visual stimuli				
Reads slowly/hesitantly				
Unable to find individual detail in a picture or story				
Difficulty choosing relevant/important information (comprehension)				

	MOSTLY/ DAILY	OFTEN/ 1xWEEK	SELDOM	NEVER
CATEGORY E				
Does not complete words e.g. CRAC = CRACK, th = the				
Difficulty solving abstract problems involving analysis and synthesis skills				
Difficulty reading a word by the end of a line e.g. mis- on one line and -take on next line = mistake				
Sound out words correctly but unable to combine the letters to form the word				
Difficulty completing problems e.g. 3+ ___ = 11				
CATEGORY F				
Poor task completion/can't decide when a task is complete				
Qaulity of writing decreases with speed increase				
Writing/motor speed slow (not due to poor concentration)				
CATEGORY G				
Confuses similar letters e.g. r/n, n/m				
Does not always recognise a word just read				
CATEGORY H				
Poor discrimination e.g. car/cat				
Does not notice small differences in letters e.g. h/n				
Does not notice small difference in works or pictures eg. pin/pen				
Difficulty with sorting, matching and comparing information				
Does not pay attention to detail				
CATEGORY I				
Poor memory of learned spelling				
Difficulty writing from dictation				
Forgets what has just been read or seen				
CATEGORY J				
Guesses word from initial/middle/final letters				
Incorrect letter information: specify please				
Tends to omit letters				
Reads very slowly				

.... continued on page 16

Intelligence range	Below 80	81 - 90	91 - 110	111 - 120	120 plus
Verbal					
Performance					
Total					

Scores of last three tests in the following:				
SUBJECT	SCORE 1	SCORE 2	SCORE 3	AVERAGE
Mathematics	/	/	/	/
Spelling	/	/	/	/
Dictation	/	/	/	/
Comprehension	/	/	/	/
Learning subjects	/	/	/	/

Corresponding Authors
Janet Richmond
j.richmond@ecu.edu.au
Kathy Holland
hollandk@ukzn.ac.za

Annexure D: Activity 3

Annexure E: Activity 4 (print on green)