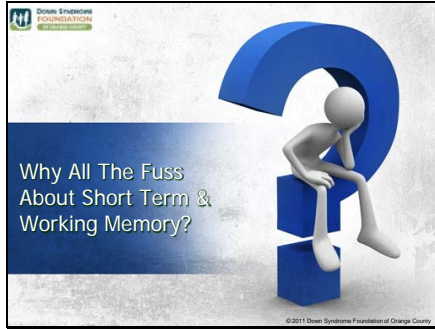


Slide 1



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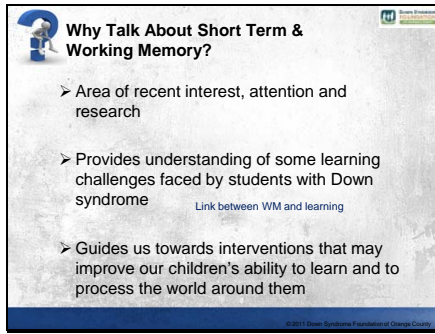
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Slide 2



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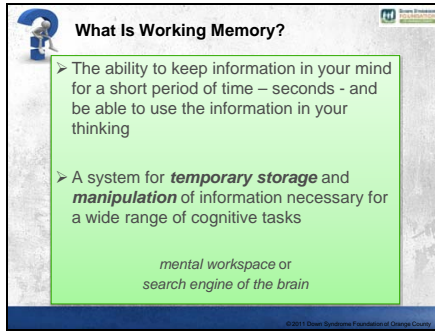
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Slide 3



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Slide 4

**Working Memory Impacts Daily Life**

Working Memory is used for

- Organization
- Concentration/Attention
- Problem solving
- Remembering tasks

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Slide 5

**Working Memory Impacts Learning**

Age	Working memory needed
Pre-school	Learning the alphabet
	Learning to talk
	Focusing on short instructions like "come brush your teeth"
	Remaining seated to complete independent activities (puzzle)
	Listening to and following directions

www.cogmed.org

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Slide 6

**Working Memory Impacts Learning**

Age	Working memory needed
Elementary School	Reading and understanding the content (comprehension)
	Mental arithmetic
	Writing while formulating next part of sentence
	Interacting and responding appropriately in peer activities (group projects/recess)

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Slide 7

### Working Memory Impacts Learning

Age	Working memory needed
Middle School	Doing homework independently
	Planning and packing for an activity
	Solving multi-step math problems
	Participating in team sports

Adults: getting to work on time, prioritizing activities, handling conflict  
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Slide 8

### Working Memory Model - System of Interlinked Components

```
graph TD; CE((Central Executive)) <--> VSM((Visuo-spatial short-term memory)); CE <--> VSTM((Verbal short-term memory));
```

Short-term Memory – Storage of information

Working Memory – Storage and manipulation of information

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Slide 9

### Working Memory Model - System of Interlinked Components

```
graph TD; CE((Central Executive)) <--> VSM((Visuo-spatial short-term memory)); CE <--> VSTM((Verbal short-term memory));
```

Verbal STM – stores any material with a verbal label – (words, sentences, numbers)

- Presented verbally, visually or both
- Also called phonological loop

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Slide 10

**Working Memory Model - System of Interlinked Components**

Visuo-spatial STM – stores images, pictures, info re locations

Central Executive

Visuo-spatial short-term memory

Verbal short-term memory

□ Also stores shapes, orientations and patterns of movement.

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Slide 11

**Working Memory Model - System of Interlinked Components**

Central Executive – general component that directs attention and is involved in higher-level mental processes

Central Executive

Coordinates storage and effortful mental processing

Visuo-spatial short-term memory

Verbal short-term memory

□ No link between visuo-spatial and verbal STM – can't communicate directly

□ They store information in fundamentally different forms

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Slide 12

**How Do You Measure It?**

➤ Automated Working Memory Assessment (AWMA)

- Newer, simple and reliable measure of all significant elements of working memory, computer-based program

➤ Forward digit recall\* (avg. 7 units)

- must store and accurately reproduce material in same order (measures verbal STM)

➤ Backward digit recall\* (avg. 4-5 units)

- must store, reverse the order and recall (measures working memory because have to manipulate numbers)

\*Limits to these types of assessment (number based and only relate to information stored in verbal short term memory)

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Slide 13

### More Ways To Measure

- > Picture, Word or Nonword recall
  - similar to digit recall but using pictures, words or nonwords (measures verbal STM)
  - can be presented verbally or visually
- > Pattern recall
  - recall order of presented pattern (measures visuo-spatial STM)
- > Corsi blocks task
  - must recall order in which blocks are marked or tapped (measures visuo-spatial STM)
- > Reading Span
  - listen to sentences – tell true/false and last word of sentence (measures working memory)
- > Odd Man Out
  - Which shape different and where was it on the page.(measures WM and VS STM)

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Slide 14

### What Does Research Show?

Specific impairment in auditory STM

- Means processing verbal information is more difficult
- Makes learning from listening more difficult
- Impacts vocabulary and sentence learning
- Believed to explain some of the speech and language delay

It also shows that visuo-spatial STM is a relative strength

Source: DSE International, Ds11 - Memory Development for Individuals with Down syndrome

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Slide 15

### Contributing Factors?

- Hearing loss and weak sound discrimination provides poor information to store
  - If can't hear – can't store
- Impairment in phonological loop - verbal storage function
  - If can't capture – can't recall
- Less vocabulary = harder to rehearse and recall
  - Harder if unfamiliar with info
- Slower retrieval from long-term memory or slower speech rater
  - May lose some recall because takes longer to rehearse
- Lack of rehearsal strategies

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Slide 16

**What Does WM Deficit Look Like?**

Is easily distracted when working on or doing something that is not highly interesting.	Struggles with reading comprehension and has to read through texts repeatedly to understand.	Struggles with problem solving that require holding information in mind, for example mental math calculations.	Is inconsistent in remembering math facts.
Struggles with completing tasks, especially multiple step tasks.	Has difficulty remembering long instruction given in several steps (e.g., directions for schoolwork assignments).	Struggles to understand the context in a story or a conversation.	Has difficulties when planning and organizing something that needs to be done in separate steps.
Has difficulty staying focused during cognitively demanding tasks but attends well when cognitive demands are minimal.	Has difficulty integrating new information with prior knowledge.	When called on, forgets what he/she was planning to say.	Has difficulty taking notes and listening at the same time.

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Slide 17

**What Can We Do At Home/School?**

Interventions

1. Check hearing regularly
2. General literacy instruction
3. Targeted activities
4. Rehearsal training
5. Working memory support in classroom

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Slide 18

**What Can We Do?**

**General Literacy Instruction**

- Reading, phonics & spelling = improve auditory discrimination – more accurate phonological representations
- Practicing sentences helps improve memory for longer sentences
- Reading aloud may help with clarity of spoken words and more accurate storage
- Increasing vocabulary
- Language rich and language demanding setting

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Slide 19

**What Can We Do?**

**Targeted Tasks/Games**

Activities to improve sound discrimination and phonological awareness

Activities to improve attention and increase processing capacity

Activities to improve remembering of lists or numbers of items – called rehearsal training

Memory games

[SEE COMPENDIUM FOR ACTIVITIES](#)

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Slide 20

**What Can We Do?**

**Memory Training Tasks – Rehearsal Training**

Rehearsal training can improve STM

Both visual and verbal memory spans can be improved

Visual STM improvements greater than verbal

Parents can be effective trainers

Periodic maintenance necessary to make improvements last longer than months

Remaining Questions – Can skills be generalized and transferred to other tasks? Do they translate into better academic performance?

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Slide 21

**Memory Training: Visually Prompted STM Activities**

**Digit span tasks:**

- You show
- Child says, signs (or shows)

Numbers	Pictures	Direction/Touch Sequences
3 5 1 7 2	dog bird clock	wave clap jump

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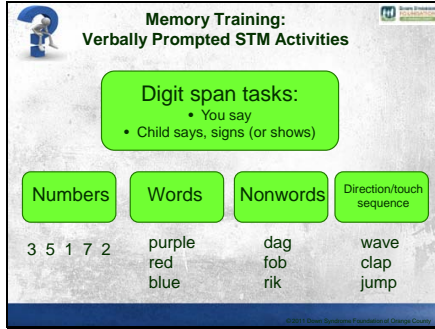
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Slide 22



**Memory Training:  
Verbally Prompted STM Activities**

**Digit span tasks:**

- You say
- Child says, signs (or shows)

Numbers	Words	Nonwords	Direction/touch sequence
3 5 1 7 2	purple red blue	dag fob rik	wave clap jump

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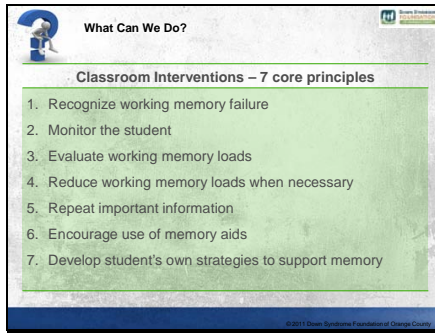
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Slide 23



**What Can We Do?**

**Classroom Interventions – 7 core principles**

1. Recognize working memory failure
2. Monitor the student
3. Evaluate working memory loads
4. Reduce working memory loads when necessary
5. Repeat important information
6. Encourage use of memory aids
7. Develop student's own strategies to support memory

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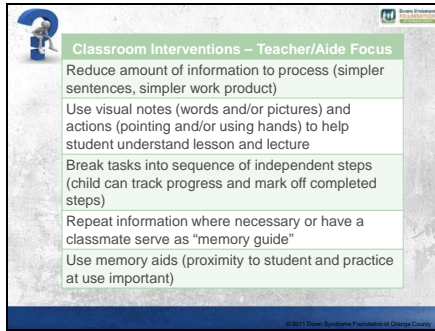
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Slide 24



**Classroom Interventions – Teacher/Aide Focus**

- Reduce amount of information to process (simpler sentences, simpler work product)
- Use visual notes (words and/or pictures) and actions (pointing and/or using hands) to help student understand lesson and lecture
- Break tasks into sequence of independent steps (child can track progress and mark off completed steps)
- Repeat information where necessary or have a classmate serve as "memory guide"
- Use memory aids (proximity to student and practice at use important)

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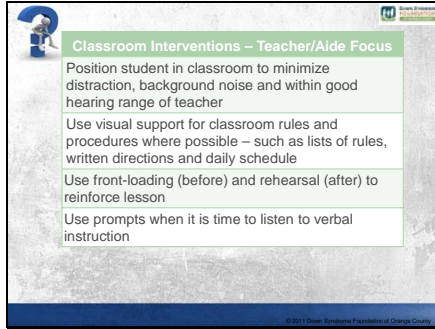
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Slide 25



**Classroom Interventions – Teacher/Aide Focus**

- Position student in classroom to minimize distraction, background noise and within good hearing range of teacher
- Use visual support for classroom rules and procedures where possible – such as lists of rules, written directions and daily schedule
- Use front-loading (before) and rehearsal (after) to reinforce lesson
- Use prompts when it is time to listen to verbal instruction

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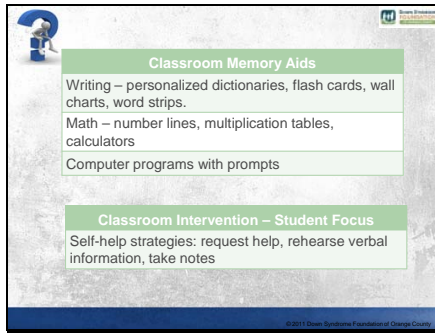
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Slide 26



**Classroom Memory Aids**

- Writing – personalized dictionaries, flash cards, wall charts, word strips.
- Math – number lines, multiplication tables, calculators
- Computer programs with prompts

**Classroom Intervention – Student Focus**

- Self-help strategies: request help, rehearse verbal information, take notes

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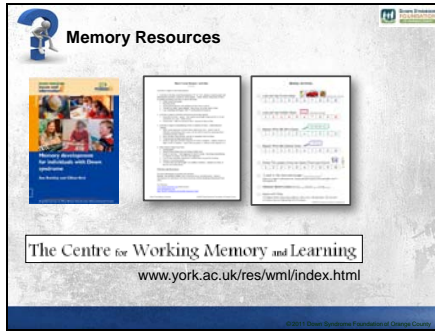
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Slide 27



**Memory Resources**

The Centre for Working Memory and Learning  
[www.york.ac.uk/res/wml/index.html](http://www.york.ac.uk/res/wml/index.html)

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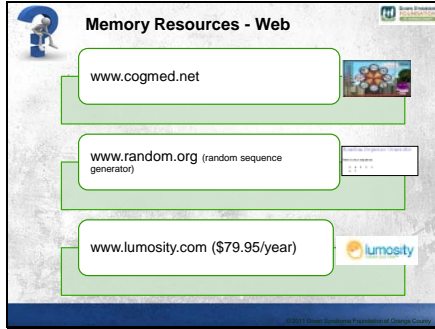
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Slide 28



**Memory Resources - Web**

- [www.cogmed.net](http://www.cogmed.net)
- [www.random.org](http://www.random.org) (random sequence generator)
- [www.lumosity.com](http://www.lumosity.com) (\$79.95/year)

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Slide 29



**Memory Resources - iPad**

iPad Apps

- Abby's Animal Memory...
- Abby - Go Memory...
- Princess Pony - Matching...
- Gravy Copy Games II...
- Memory Puzzles HD...
- Memory Matches

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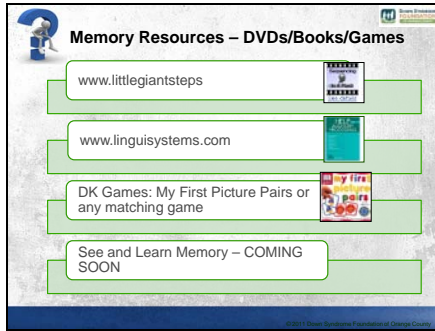
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Slide 30



**Memory Resources - DVDs/Books/Games**

- [www.littlegiantsteps](http://www.littlegiantsteps.com)
- [www.linguissystems.com](http://www.linguissystems.com)
- DK Games: My First Picture Pairs or any matching game
- See and Learn Memory - COMING SOON

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