

# Schoolbags

- How heavy is too heavy?

| Person's Weight (lb.) | Maximum Backpack Weight (lb.) |
|-----------------------|-------------------------------|
| 60                    | 5                             |
| 60-75                 | 10                            |
| 100                   | 15                            |
| 125                   | 18                            |
| 150                   | 20                            |
| 200 or more           | 25**                          |

\*\* No one should carry more than 25 lb.

# Ergonomics for Schoolchildren

**Schoolbags, Furniture,  
Computers, Visual & Auditory**



# Children and Ergonomics

- Children spend hours a day playing computer games, video games, and working on school projects
- There is a mismatch between a child's body size and the size of adult furniture and computer equipment
- Challenges presented by children:
  - *Range of body sizes*
  - *Rate of growth*
  - *Strength capabilities*
  - *Cognitive characteristics*

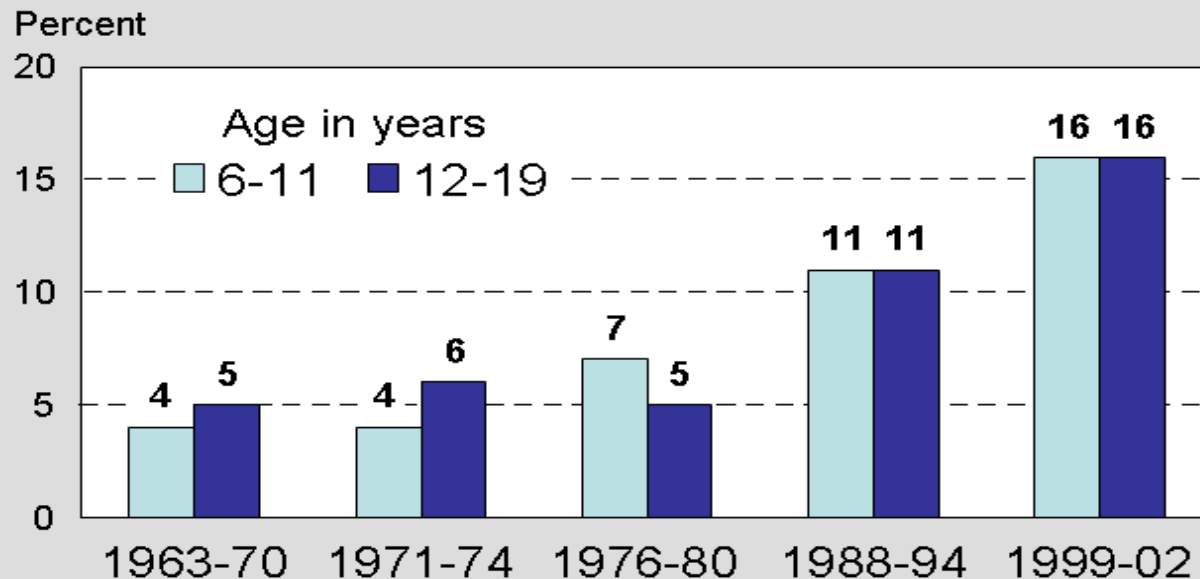
# Range of Body Sizes

- Different sizes of second grade children
- In general, girls grow faster than boys
- By age 7, girl's bone size is 80% of their peak bone size



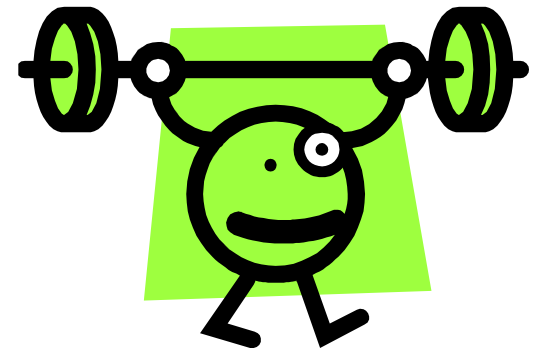
# Rate of Growth

- Obesity in children has tripled from the 1960's - 1990's:
  - *Children aged 6-11 years increased from 4% - 13%*
  - *Children aged 12-19 years increased from 5% - 14%*
- Prevalence of overweight children and adolescents in the United States:



# Strength Capabilities

- Boys are stronger than girls by the age of 10
- By age 16, males are much stronger than females
- Maximum strength does not increase after the age of 16
- Children's abilities are often over-estimated
- Children have smaller muscle fibre and slower muscle relaxation



# Cognitive Characteristics

- Children want to do activities they enjoy, and tend to do these in excess:
  - *Sports*
  - *Surfing the web*
  - *Video games*
  - *Musical Instruments*
  - *Handwriting*
- If children are not taught proper biomechanics at an early age, they will never learn:
  - *Patterns of posture begin around the age of 7*



# Ergonomics for the Classroom

- Every office place of work must provide ergonomic surroundings
- A school is a place of work
- Ergonomics education is not provided in **any** schools in the United States
- A lot of different work is performed in the classroom and a workstation must be provided for each type of work



# Schoolbags

- In the United States, 40 million youth carry their school materials in backpacks
- In 1999, the use of backpacks resulted in more than 6000 injuries in the United States
- 23% of elementary students and 33% of secondary students complain of back aches
- 60% of orthopedics report seeing children with pain caused by heavy backpacks



# Schoolbags

- Carrying schoolbags may contribute to low back pain in children
- The maximum load should be 15% of body weight
- Secondary school children carry backpacks around 7.0kg
- High school students carry backpacks around 6.3kg
- In one study, musculoskeletal symptoms were reported by 77.1% of students



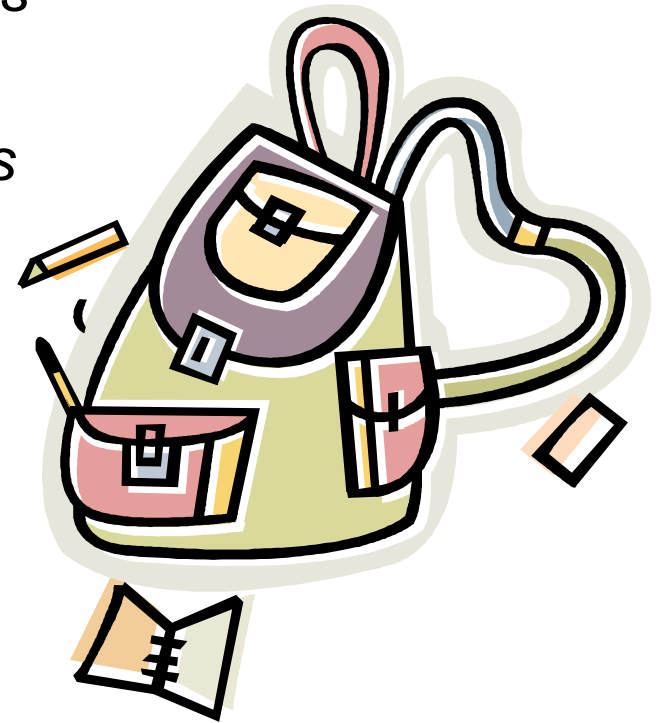
# Schoolbags

- The musculoskeletal system has limited rejuvenation possibilities
- Damage that is inflicted in youth may show up years later in even more serious back injuries
- Scientific studies have not yet been performed to show that backpacks cause permanent back damage



# Schoolbags

- Factors that contribute to MSIs from school bags:
  - *Heavier school bags*
  - *Longer carriage durations*
  - *Carrying additional bags*
  - *Lack of access to lockers*



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# Schoolbags

- Choosing the right school bag:
  - *Ensure the bag is appropriate for the age and size of the carrier*
  - *Select a pack with padded shoulder straps*
  - *Choose a bag with a waist belt*
  - *Carry no more than 15% of body weight*
  - *Load heaviest items closest to the child's back*
  - *Choose backpacks with several compartments*
  - *Consider a bag with wheels*
  - *Always wear both shoulder straps*
  - *Adjust shoulder straps so the bag fits snugly to the back*



# Schoolbags – Some Solutions

- A bill was introduced in California that required textbook printers to decrease the weight of their books
- A private school in Minneapolis, Minnehaha Academy, banned backpacks in its middle school
- Florida's Palm Beach County supplies two sets of textbooks: one for home, one for the classroom
- It was proposed that full-scale ergonomics education become part of the curriculum for students in New Jersey



# Furniture

- Children have become increasingly physically inactive and are sitting more and more
- Designed to enforce the upright posture throughout most of the 20<sup>th</sup> century
- The upright position calls for an excess amount of muscle exertion
- Adjustable furniture is preferred, due to the different dimensions of the body
- Schoolchildren have the most fluctuating body dimensions



# Furniture Facts

- Over 83% of elementary school children sit at chair-desk combinations which are not suitable for their body height
- Elementary children spend around 9 hours sitting per day
- Most school furniture is out of date and does not conform to minimum orthopedic-physiological requirements



# Furniture – Chairs

- Conventional chairs have a rigid seat that inclines backwards and merges into a seating hollow causing:
  - *Lack of blood circulation*
  - *A rounding of the back*
  - *Tense shoulder, neck, and back muscles*
  - *The spinal cord to be pressed to one side*
  - *A constriction of the digestive organs*



# Furniture - Chairs

- Must be suitable for the child's anthropometric data as well as their varying work postures
- Needs to allow for sitting with movement
- Two suggested designs:
  - *Flexichair – changing seat inclination*
  - *Rocking mechanism – swivel chair with height adjustment*



**<- Flexichair**

**Rocking  
Mechanism ->**



# Furniture - Desks

- Horizontal tops causes the child's back to become round and their head to bend back as they are working
- Fit desks sitting on the floor with castors
- Suggested design:
  - *Stand in lectern – a height adjustable working table*
  - *Inclined top - approximately 16° inclination*

**Stand in Lectern ->**



# Computers

- It is a challenge to provide adjustability in elementary classrooms due to the ranging size of the students



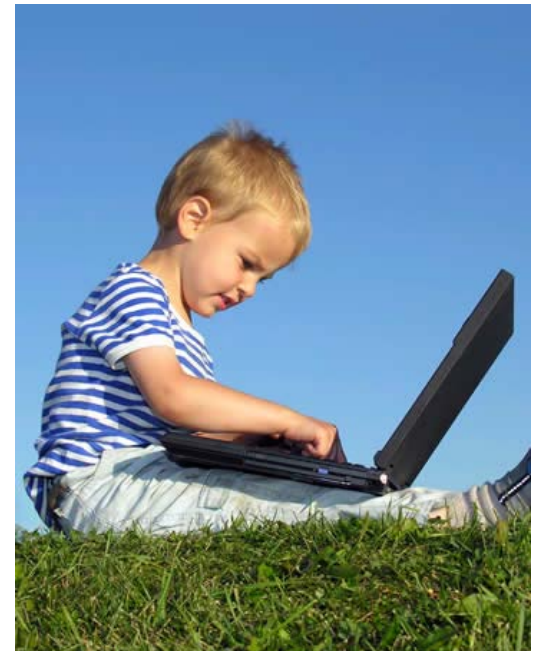
**First Grader**



**Fifth Grader**

# Computer Facts

- 40-50% of 6<sup>th</sup>-8<sup>th</sup> graders report over-use
- 40% of 6<sup>th</sup> graders report symptoms of musculoskeletal discomfort
- 64% of 6<sup>th</sup> grade laptop users report neck discomfort
- Musculoskeletal discomfort increases with the amount of hours spent on the computer



# Computers

- Teach children to:
  - *Not sit too close to the monitor*
  - *Take frequent rest breaks and “eye breaks”*
  - *Stand up, stretch, and wiggle often*
  - *Blink frequently*
  - *Avoid using the mouse for long periods of time*
- The best safety measure for children working on the computer is adult supervision and guidance

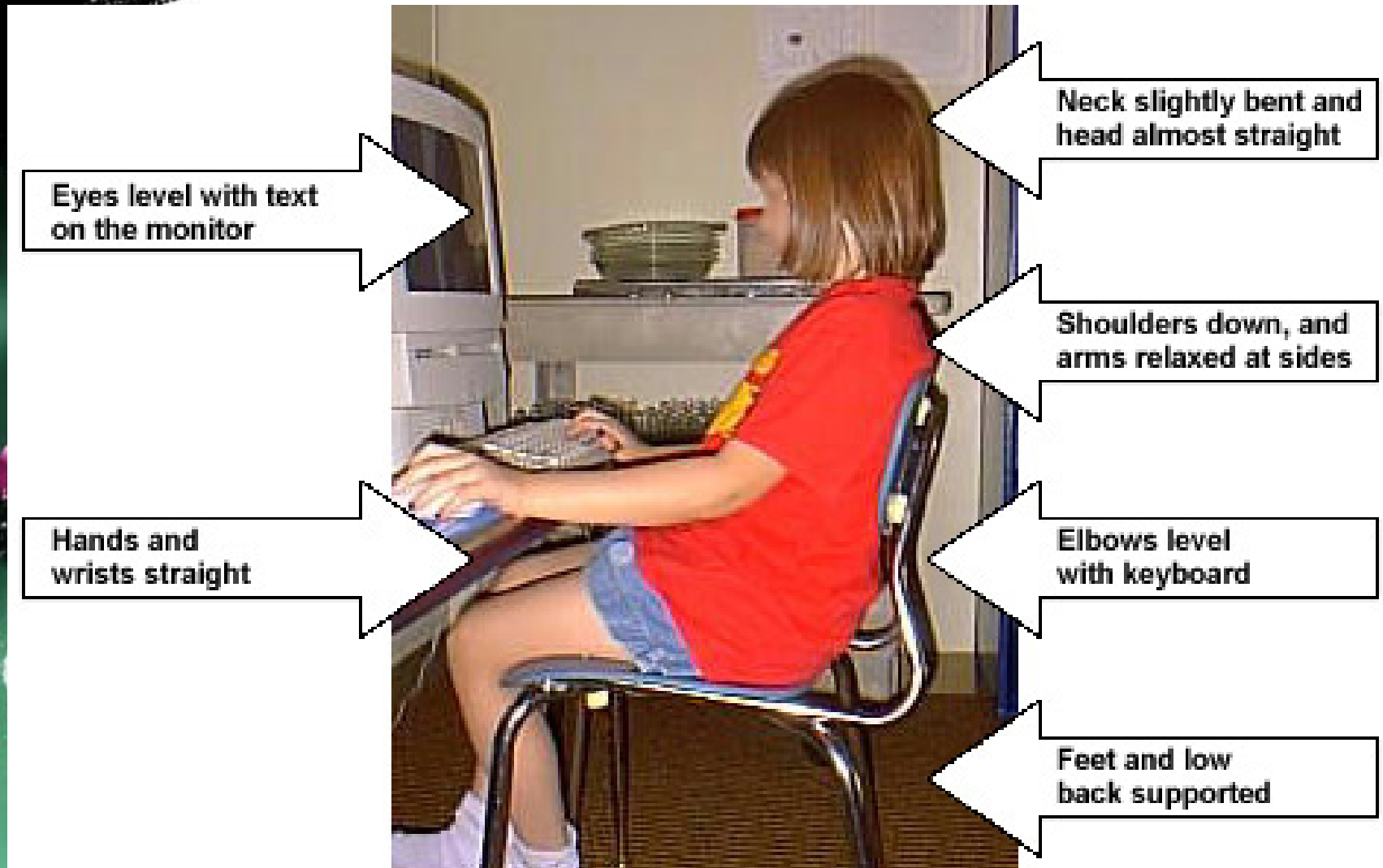


# Computers – Ergonomic Guidelines

- **Viewing distance:** the monitor should be 2 – 2½ feet from the child's eyes
- **Time at computer:** encourage children to use their physical energy
- **Seat and height posture:** the child should sit high enough to have their arms bent at 90°
- **Footrest:** use to prevent dangling feet
- **Mouse:** find one that fits small hands
- **Keyboard:** child-sized keyboards with light pressure keying



# Computers – Ergonomic Guidelines



# Laptops

- The prevalence of laptops is increasing
- Ergonomic hazards:
  - *Forces the user to lean forward*
  - *Laptop display is too low for most users*
- To eliminate these hazards, use an adjustable stand or an external keyboard



# Computer Vision Syndrome (CVS)

- Eye and vision problems which are experienced during or related to computer use
- Eyestrain, headaches, blurred distance or near vision, dry or red eyes, neck/back ache, double vision, and light sensitivity
- Improper classroom conditions, poor work habits, and existing refractive errors lead to CVS



# Computer Vision Syndrome (CVS)

- Caused in children by the following factors:
  - *A limited degree of self-awareness*
  - *Reduced blinking due to concentration*
  - *Ignoring problems that would normally be addressed by adults*
  - *Looking farther up due to computer workstation design*



# Vision

- Visual skills are not fully developed in children
- There is a correlation between:
  - *Heavy reading and myopia (near sightedness)*
  - *Computer, television, and video game use and premature myopia*
- In general, people alter their body posture to alleviate stress on the eyes



# Vision Facts

- 25% of K-6 graders have refractive errors
- 2/3 of homes have video games
- 60% of children watch over 2 hours of TV per day
- 56% of elementary students and 60% of undergraduate students experience eyestrain



# Classroom Lighting

- Conventional lighting is too high, too inefficient, and too costly
- Reduced ambient lighting with adjustable task lights is recommended
- To establish good classroom lighting conditions:
  1. *Become aware of how the students are working*
  2. *Identify risk factors and corrective options*
  3. *Develop solutions involving teacher and administrative cooperation*

