**Schoolbags**

- How heavy is too heavy?

<table>
<thead>
<tr>
<th>Person’s Weight (lb.)</th>
<th>Maximum Backpack Weight (lb.)</th>
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<tr>
<td>60</td>
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<td>60-75</td>
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** 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:

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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
Schoolbags

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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 20th 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
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
Computers

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

• 40-50% of 6th-8th graders report over-use
• 40% of 6th graders report symptoms of musculoskeletal discomfort
• 64% of 6th 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

- Eyes level with text on the monitor
- Hands and wrists straight
- Neck slightly bent and head almost straight
- Shoulders down, and arms relaxed at sides
- Elbows level with keyboard
- Feet and low back supported
Laptops

- The prevalence of laptops is increasing
- Ergonomic hazards:
  - Forced 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 tasks 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