Teacher Guide

Scientific Concept: Data Packets and Data Transfer Speed

Title: The mailman and the five packages

Concept:

This lesson will explain the process of data transfer throughout computer systems and the form it gets transferred into. Additionally, we will touch on some factors that alter the transfer speed. We will use simple analogies and examples to explain complicated concepts. We will present a situation where a mailman has five packages to deliver, and he is constrained by time to make them. We will also include an analogy that includes running with a folder through the hallways of a school to deliver it to a certain office by using a relay system with different students taking turns at the task. Those two examples and their solutions will help the students understand the basics of data transfer, and the factors affecting the speed at which that happens. Additionally, they will be able to calculate the time it takes to transfer folders and files after knowing their respective sizes.

Required Background:

- Knowledge of the concept of digital data
- Understanding of file size units (Bits, Bytes, Kilobytes, etc)
- Understanding the concepts of networks and protocols
- Ability to handle local networks and the internet
- Ability to solve mathematical problems

Educational Goals:

By the end of the lesson, students will be able to:

1. Define the speed of data transfer
2. Know the factors affecting the speed of transfer
3. Understand the composition of data packets
4. Calculate the size of data
5. Calculate the time it takes to transfer the data through a network
6. Make connection between human thinking and the technology of data transfer

Tools Needed:

- 5 Cardboard boxes in different sizes)
- Stickers
- A series of books (Encyclopedia which has several volumes)
- 3 Bags

Educational Strategies:

1. Teaching based on several types of intelligence
2. Problem solving approach
3. Learning by exploring and doing

Exercises between breaks:

Break #1 (2 minutes)

Students turn in their solutions to help the mailman.

Break #2 (2 minutes)

Teacher reviews the concept of the web and internet. Write down the students' predictions for the way data transfer takes place.

Break #3 (3 minutes)

The teacher writes down the measuring units for data size, and then calculates the number of bits ina sentence.

8 bits= 1 byte

1 Byte = 1 letter

Teachers could go ahead and calculate the time it takes to transfer data based on the level on understanding of their students.

Break #4 (2 minutes)

Correct the answers collected after the concept of data packets is explained.

Break #5 (10 minutes)

1. Record the expectation made by the students after calculating the distance, speed, and estimating how crowded the path is. (It is recommended that teachers know most of the measurements in advance to save time).
2. Compare estimations to actual times.
3. Make some conclusions

Break #6 (3 minutes)

Teacher will discuss the following:

- How would changing the order of students affect the speed? Consider that bigger students will find it harder to go through the crowded path.

- What would happen if all the books were carried in one bag? Consider the added weight which makes it harder for the student to carry and slows down the process
- What would happen if the books had different weights? Consider that dividing the loads equally
- What if the bags were not labeled? Consider possibility of loss, or ending in the wrong destination and the added time from having to resort them.
- What if the transfer happened after regular hours? Speed will increase
- What if different bags were used, like those with wheels? Speed will increase
- What if the number of paths was less than that of bags? Speed will decrease

Break #7 (4 minutes)

We explain the way to get the solution and demonstrate it to students. We compare different answers. We make connections to the mailman's situation:

1. Indicate the name of sender and recipient on the packages.
2. Choose two quick and strong people to help the mailman
3. Have each person carry one of the packages and get on delivery path.
4. Packages will be delivered in time.

Illustrations:

Unlabeled boxes

Address stickers

Structure of a data packet

Illustration of labeled bags

Illustration for challenge #4

Factors affecting communicating speed:

Paths of transfer (number of open paths on the network) Green lines

Crowdedness of the network (number of current users and amount of data used) Orange points

Medium of transmission (type of cables, protocol tools) Purple and blue circles

Size of data (text, video, voice, picture) Yellow circles

Packet Data: What is being transferred from the data in the form of parts? Yellow circles

Challenge 4:

If we want to transfer the six books electronically over the network:

• replace the school corridors crossings with network ports (green lines)

• Students carrying bags will be replaced by modes of transport (pink circles)

• replace bags (bags photos) with packet data (yellow circles)

• replace the student who sorts the books and distributes bags by the protocol of the network (blue circle)

• The student who is in charge of re-grouping and ordering will be replaced by the protocol applied to the folder in the network (Blue circle)

- Replace the student that gives directions to his peers with devices that direct data in the network. (Black rectangles)

References:

- **Introduction to microprocessors . Lance A. Leventhal – Grossmant College .**
- **Richard C. Larson – BLOSSOMS Initiative .**
- **http://dvd4arab.maktoob.com/archive/index.php/t-2557902.html**
- **Mwafiy Yasser – KFUPM**
- **www.yanbu2.com**