FILE STORAGE SYSTEMS

UNIT 10 – NETWORK OPERATING SYSTEMS

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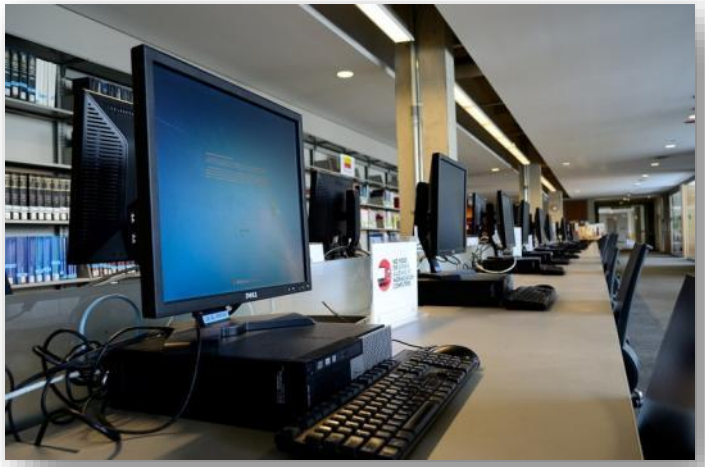
4 AREAS – A NEED TO KNOW

PERFORMANCE VS REDUNDANCY

DAS (direct attached storage)



NAS (network attached storage)

SAN (storage area network)

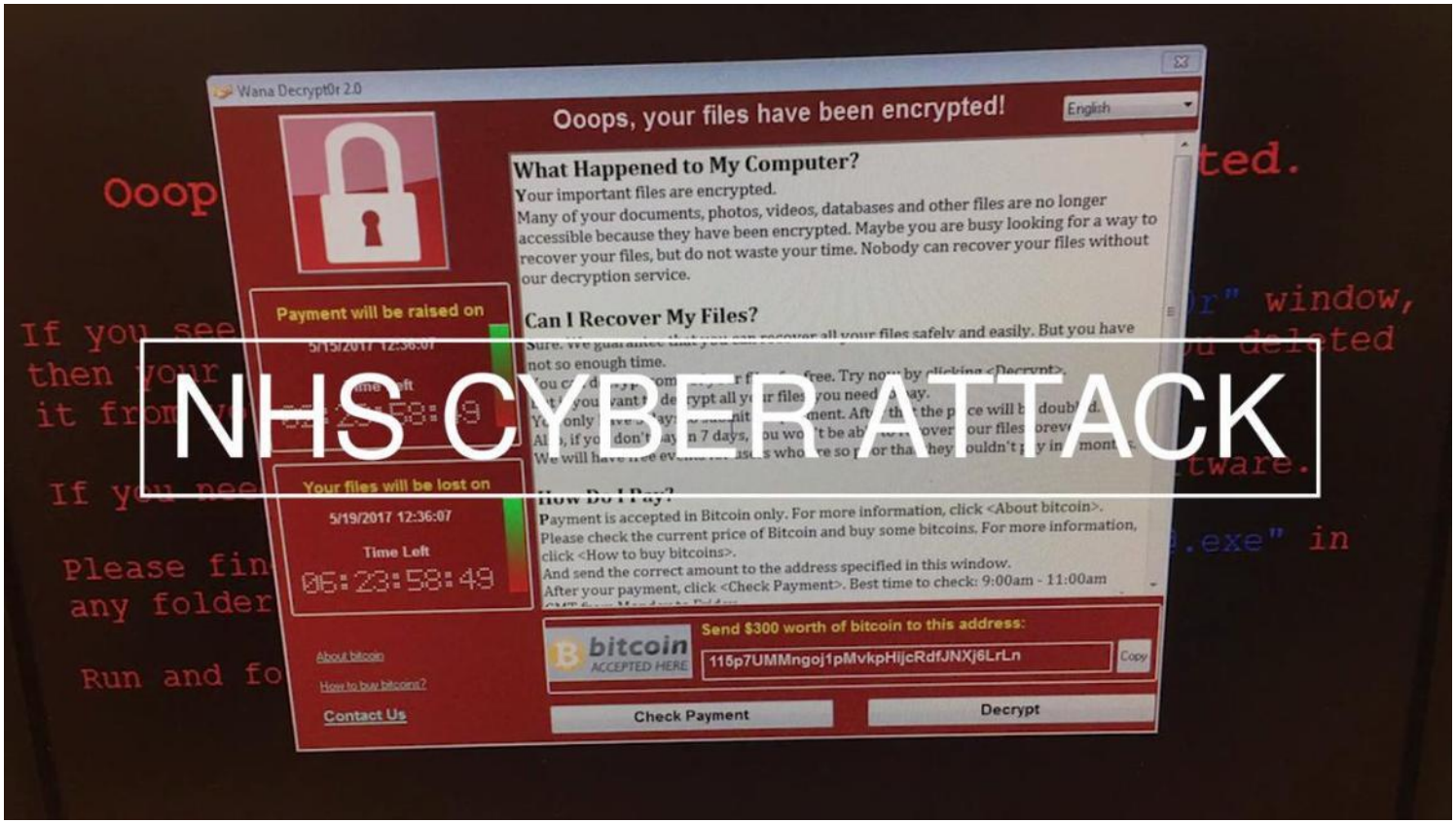
KNOWLEDGE CALP

- PRIOR:
  - SSD (solid state disk)
  - SAS (serial-attached SCSI).
  - SATA (serial advanced technology attachment).
  - Partition – volume.
  - IP addressing.
  - Network adapter.
  - Service.
  - Port.
  - Fibre.
  - Ethernet.
  - RAID (redundant array of independent disks).
- NEW:
  - DAS (direct-attached storage).
  - NAS (network-attached storage).
  - SAN (storage area network).
  - iSCSI (internet small computer system interface).
  - Fibre Channel.
  - Portal.
  - Target.
  - Initiator.
  - Extension.

ADVANCE ORGANIZER (I)

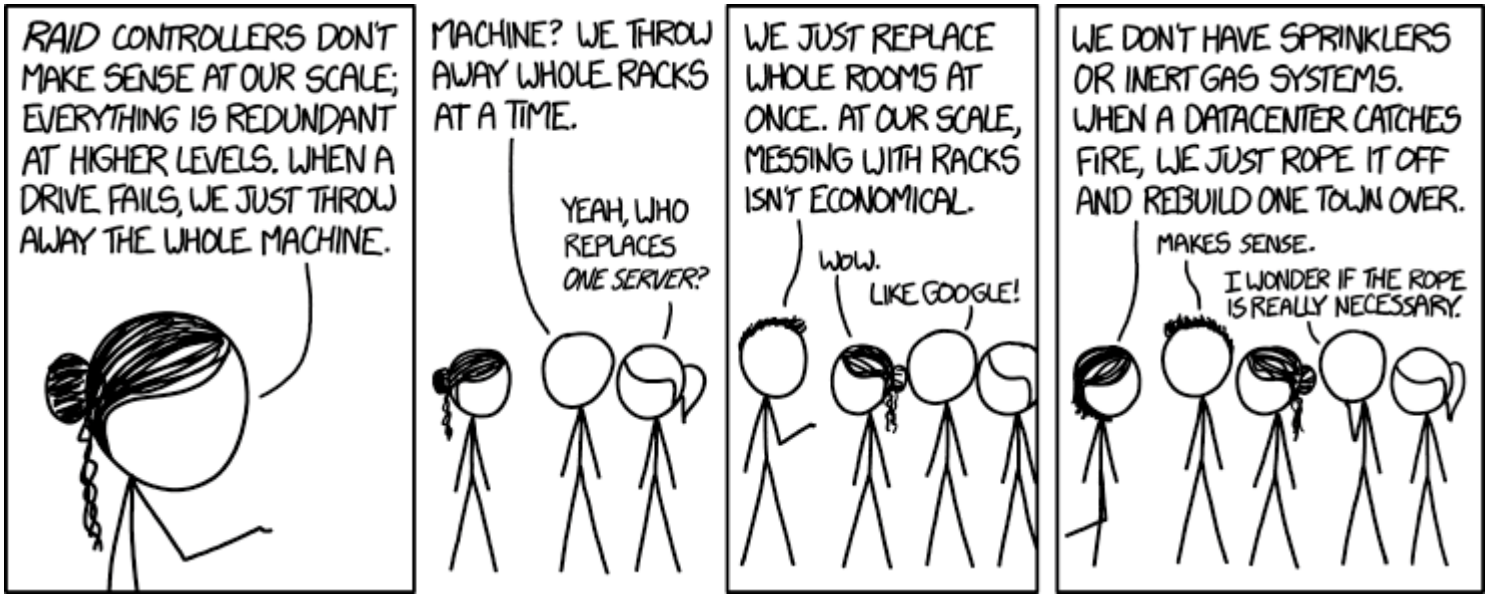
www.partition-tool.com

ADVANCE ORGANIZER (II)



http://brightcove.com

ADVANCE ORGANIZER (III)

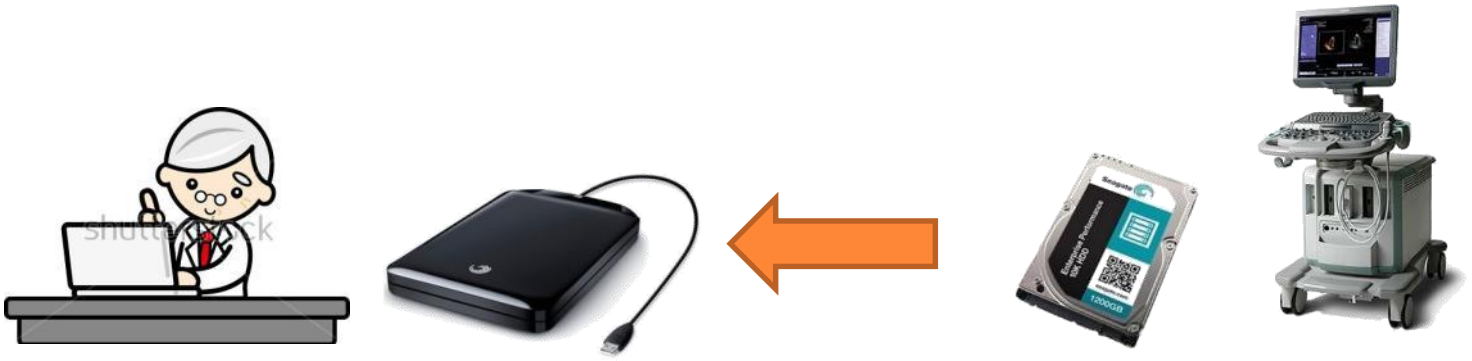


https://www.explainxkcd.com

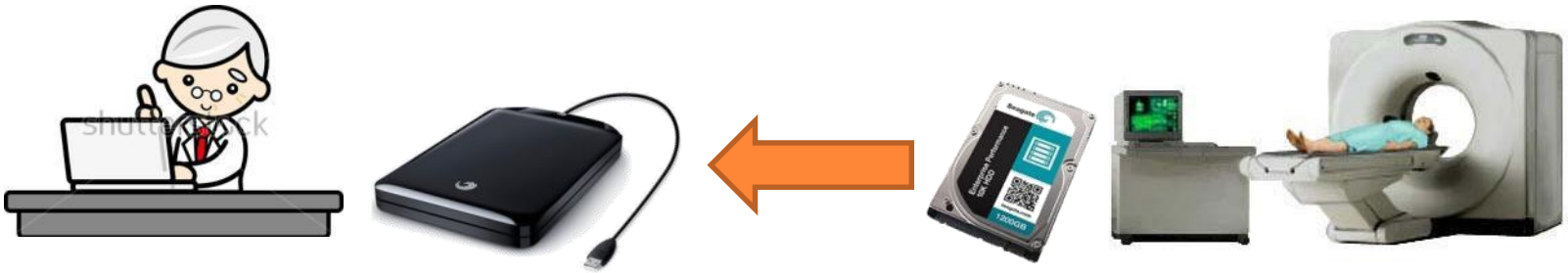
DRIVING QUESTION

How do you find a compromise between *data integrity* versus *performance* in different storage *location* scenarios in a hospital?

EXEMPLARS: DAS



ULTRASOUND



CT-SCAN

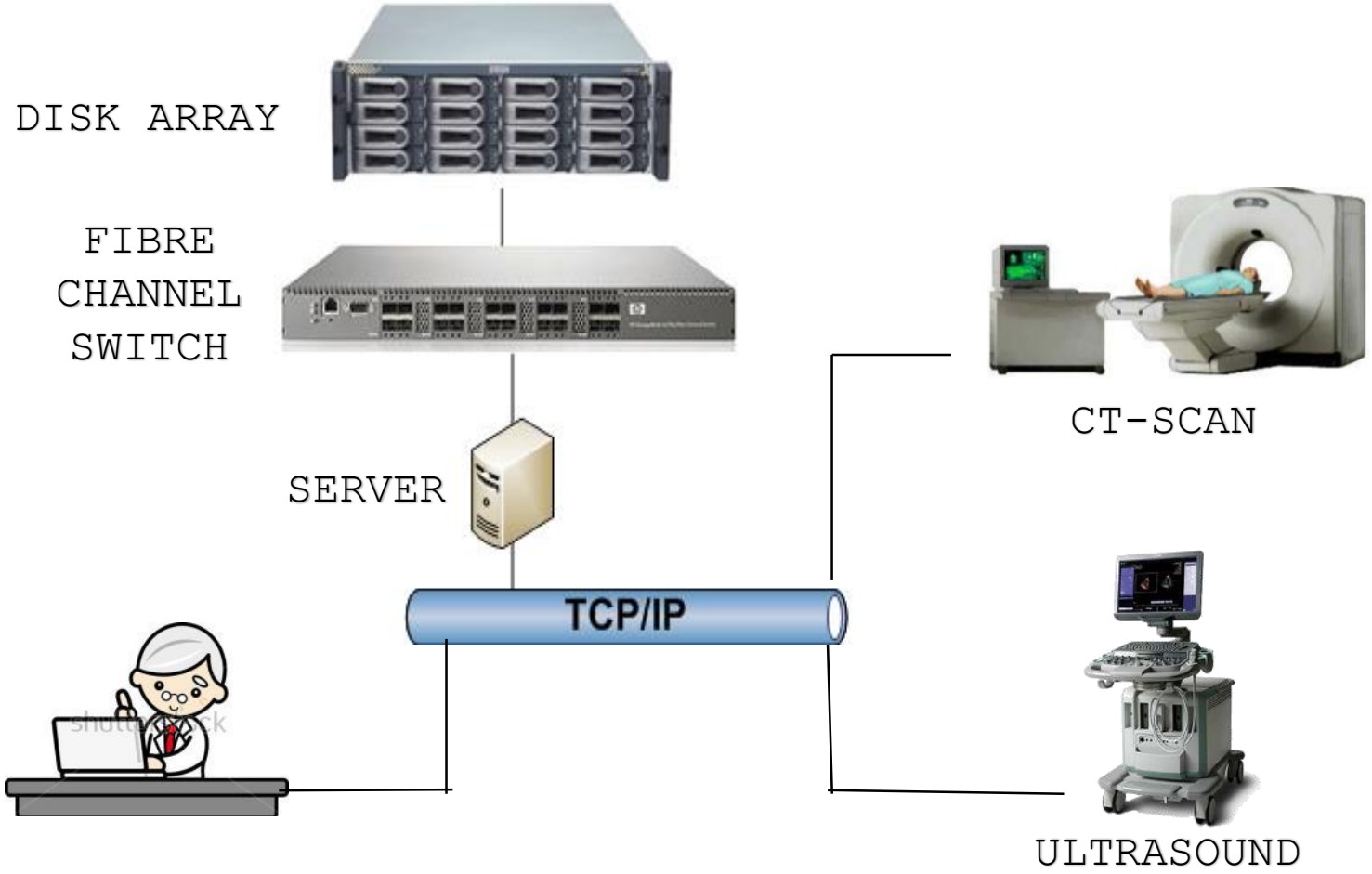
EXEMPLARS: NAS

NETWORK-ATTACHED
STORAGE
(DISKS+SERVICES)

ULTRASOUND

CT-SCAN

EXEMPLARS: SAN



HOTS: ANALYZE.

- Show different exemplars of storage systems in a hospital and the technologies involved:
  - Disk storage technologies (SSD, HDD).
  - RAID modes.
  - Interfaces (SCSI, SATA, SAS).
  - Networking (iSCSI, fibre channel).
  - Services used (CIFS/SMB, FTP, NFS).
  - Application in a hospital datacenter.

HOTS: EVALUATE.

- For RAID:
  - Speed.
  - Fault tolerance.
  - Number of disks.
- For interfaces:
  - Speed.
  - Portability.
- For services:
  - Operating system used.
  - Ease of installation and configuration (server).
  - Usability (client).
  - Speed.
- Decide a good combination of these technologies for sharing data in a hospital considering some restrictions given by the teacher (number of disks, power consumption, hardware and software costs).
- Make a draft of the chosen combination.

HOTS: CREATE

- In the workshop we have:
  - 32 GB SSD SATA disks.
  - 160 GB SCSI disks.
  - 160 GB SATA disks.
  - 120 GB SAS disks.
  - Network devices (Ethernet & fibre channel switches).
- Disks can be connected to HP Proliant servers or to HP storage arrays.
- Use the selected configuration to keep integrity and speed. Share the storage to other users.

TRACKING THE PROJECT: MAKE A POWERPOINT

- Make a draft of each solution and put it in a slide.
- Make photos of each connection, installation or configuration step.
  - Write down a brief description of each step.
- Make speed tests to measure the quality of the solution. Capture the screen and put it in a slide.
- Upload the Powerpoint file to the virtual classroom.

TRACKING THE PROJECT: KEEPING STATUS IN VIRTUAL CLASSROOM

- The teacher, by observation, has a register of the completion status of the project.

TASK-BASED LEARNING (I)

- PRESENTATION.
  - Show the problem: we need to share information between departments in a hospital with some constraints:
    - Each doctor has a client computer (Windows 10 or Ubuntu).
    - Each department owns a server (HP Proliant) without O.S., it has a license for Windows Server 2012R2 (if needed).
    - Each department can spend at most 300 € in hard disks.
    - The department needs at least 4 TB of storage capacity.
    - The information can be shared with other departments, but access control must be implemented.

TASK-BASED LEARNING (II)

- PRACTICE:
  - Each student of the designated department should find out the best combination of components to achieve the requirements using the given constraints and make a proposal to the department.

- PRODUCTION:
  - Share these proposal to the rest of the department, discuss the best solution and implement it in real devices.

PROBLEM-BASED LEARNING

- Present the content: sometimes a motherboard server burns up and the information must get ready ASAP.
- Problem: how to move disk information quickly and put it online in each architecture without having to restore it from backup?
- Possible solutions: I expect the students to find out how to move the information in each case:
  - DAS: they must open the server, remove the disk and put it online in another server.
  - NAS: the same as DAS.
  - SAN: they can assign the disk to another server without having to move it physically.
  - Each case must be documented and implemented.

SESSIONS (D.A.S.)

- **SESSION 1:**
  - Advance organizer 15 min.
  - Content: enterprise storage systems.
  - Content: DAS systems.
  - Show how to apply DAS technologies in the datacenter of a hospital (medical reports).

- **SESSION 2:**
  - TASK-BASED LEARNING: Decide a good combination of these technologies to store medical reports in a hospital considering speed, data integrity, ease of configuration and cost. Make a draft of the chosen combination. Share it with your group and decide one for real implementation..
  - Install the selected operating system in the machine (using images).
  - Connect the selected disks and implement the chosen redundancy.
  - Establish access control.
  - Measure the performance of this solution.
  - Install a client. Measure the performance of the network storage.
  - Inquiry and innovation question: what inconvenients do you have when you need to share the information stored in DAS with other doctors?

SESSIONS (N.A.S.)

- **SESSION 3:**
  - Content: NAS systems.
  - Let the students calculate the power consumption of a HP Proliant Server. Let them choose a NAS and compare the costs. Make an estimation of the cost involved in electricity per year.
    - Let the student investigate the power system used in a hospital and the working time of an uninterrumpible power supply in case of blackout.
    - Show how to apply NAS technologies to share medical reports.
    - Investigate the NAS operating systems based on PC. Choose one for real implementation.

- **SESSION 4:**
  - Make a draft of the chosen combination (NAS operating system + RAID strategy + user network access).
    - **Feedback session:** peer feedback – students will offer each other feedback on the NAS architecture draft and modify their designs if needed.
  - Install the selected operating system in the machine.
  - Connect the selected disks and implement the chosen redundancy.
  - Establish access control.
  - Measure the performance of this solution.
  - Install a client. Test the performance of the network storage.
  - Compare the performance obtained between DAS and NAS.
  - **Inquiry and innovation question**: let the students think in where a huge amount of data space must be installed. Could this space be store in a single NAS?

SESSIONS (S.A.N.)

- **SESSION 5:**
  - Content: SAN systems.
  - Why do we buy a SAN system:
    - Investigate the maximum number of hard disk disks that can be connected in a desktop computer and in a server.
    - Let the students estimate the time consumption to physically connect a disk and the related downtime. How could the hospital be affected by the downtime?
    - Show how to apply SAN technologies to save a huge amount of data (e.g.: resonance, tomography and ultrasound images, etc) and how to add massive storage space without downtime.

- **SESSION 6:**
  - Make a draft of the chosen combination (server operating system + connection method + storage array RAID strategy).
  - Install the server operating system in the machine.
  - Connect the storage array to the server using the selected method.
  - Establish access control in the storage array and in the server.
  - Measure the performance of this solution.
  - Install a client. Test the performance of the network storage.
  - Compare the performance obtained between DAS, NAS and SAN.
  - **Inquiry and innovation question**: do you think that is a good idea to form a **software** RAID 0 with SAN disks?

SESSIONS

- **SESSION 7:**
  - Problem-based learning: how to move information to other server if a server motherboard burns up (for each storage architecture).
  - Last measures and refine the PPT file.
  - Prepare the public presentation.

- **SESSION 8:**
  - Public presentation..

CHECKLIST FOR PRESENTATION (I)

- Presentation.
  - Engage listener (hospital background, potential problems).
  - Consider: body movement, voice, speech, dressing, notes, eye contact, use of hands to emphasize.
  - Group order (avoid long pauses between speakers).
  - Max 15 minutes per group.

CHECKLIST FOR PRESENTATION (II)

- Project PPT.
  - Title.
  - Group components.
  - Divide the presentation in three parts, one for each schema used.
  - Max 10 slides per storage technology.

CHECKLIST FOR PRESENTATION (III)

- Content.
  - Draft of each solution.
  - Photos of each connection, installation or configuration step.
  - Brief description of each step.
  - Interpretation of speed test captures to measure the quality of the solution.
  - Task-based learning solution.
  - Problem-based learning solution.
  - Difficulties found in implementation.
  - Conclusions for that solution.

ASSESSMENT (I)

Student Name: _____

CATEGORY	4	3	2	1
Investigation	The relationship between the variables is discussed and trends/patterns logically analyzed. Predictions are made about what might happen if part of the lab were changed or how the experimental design could be changed.	The relationship between the variables is discussed and trends/patterns logically analyzed.	The relationship between the variables is discussed but no patterns, trends or predictions are made based on the data.	The relationship between the variables is not discussed.
Procedures	Procedures are listed in clear steps. Each step is numbered and is a complete sentence.	Procedures are listed in a logical order, but steps are not numbered and/or are not in complete sentences.	Procedures are listed but are not in a logical order or are difficult to follow.	Procedures do not accurately list the steps of the experiment.
Real implementation	Experimental design is a well-constructed test of the stated hypothesis.	Experimental design is adequate to test the hypothesis, but leaves some unanswered questions.	Experimental design is relevant to the hypothesis, but is not a complete test.	Experimental design is not relevant to the hypothesis.
Participation	Used time well in lab and focused attention on the experiment.	Used time pretty well. Stayed focused on the experiment most of the time.	Did the lab but did not appear very interested. Focus was lost on several occasions.	Participation was minimal OR student was hostile about participating.

ASSESSMENT (II)

Safety	Lab is carried out with full attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual.	Lab is generally carried out with attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual, but one safety procedure needs to be reviewed.	Lab is carried out with some attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual, but several safety procedures need to be reviewed.	Safety procedures were ignored and/or some aspect of the experiment posed a threat to the safety of the student or others.
PPT	All required elements are present and additional elements that add to the report (e.g., thoughtful comments, graphics) have been added.	All required elements are present.	One required element is missing, but additional elements that add to the report (e.g., thoughtful comments, graphics) have been added.	Several required elements are missing.
Presentation	Presentation describes the skills learned, the information learned and some future applications to real life situations.	Presentation describes the information learned and a possible application to a real life situation.	Presentation describes the information learned.	Weak presentation.