Upon completion of the course the student will have knowledge of the following:

GATHER AND ANALYZE INFORMATION

Before testing, review:

- Orders and protocols for scheduled sleep study.
- Chief sleep/wake complaint.
- Infection or other special precautions.
- Current and/or recently discontinued medications.
- Medical history and physical.

Before testing, assess the following:

- Determine that all required documentation is present/complete.
- Casually converse with the patient to note any comments/behavior indicating physical/psychological discomfort.
- Interview patient to determine:
    - Current medicines (prescriptions, non- prescription and/or recreational).
    - Recent caffeine or alcohol ingestion.
    - Current sleep pattern.
    - Need for treatment intervention during testing (e.g., insulin).
    - Current emotional/psychological status including level of anxiety
    - Regarding the testing procedure.
    - Level of consciousness/orientation to time, place, and person.
    - Ability to cooperate.
    - Recent changes in medical condition.
    - Presence of prosthetic devices (e.g., teeth, eye, limb) and/or electromechanical assist devices (e.g., pacemaker, neurostimulator)

Analyze all available information to:

- Determine/verify parameters to be monitored during testing.
- Determine the reason for testing.
- 3c. determine precautions to be taken during testing.
- Determine factors, which may affect the outcome of the study (e.g. medications).
- Determine any necessary ancillary equipment required for testing.
- Determine special needs of the patient during testing (e.g., prescribed medication, snack, presence of family member).
- Anticipate the likelihood and consequences of the following occurring during testing:
    - Hypnagogic hallucinations, cataplexy, sleep paralysis, sleep attacks.
    - Violent behaviors.
    - Unusual vocalizations/motor activity.
    - 4. enuresis.

    - Waking with pain, disorientation and/or emotional upset.
    - Difficulty falling asleep.
    - Seizure and/or seizure-related activity.
    - Abnormal breathing.
    - Cardiac dysrhythmias.
    - Potential for Co2 narcosis.
    - Increased severity of obstructive sleep apnea in 2nd ,3rd REM.
    - Increased severity of obstructive sleep apnea in different body positions.
- Identify signs, symptoms and/or findings disturbances recognized by the nosology.

Communicate with the ordering physician or center/lab director regarding:

- Unclear or inappropriate orders.
- Changes in patient's status.

SET UP AND CALIBRATE EQUIPMENT

Before the patient arrives, the following setup and calibration procedures are accomplished:

- Prepare electrodes and other equipment required for patient application.
- Set up the recording equipment.
    - Load paper and label record with patient name, identification number, date of birth /age, height, and weight, etc...
    - Label with type of study, date, room, recording equipment and night Numbers, as well as technologist's identification.
    - Label channel montage such that the source and the pin (jack box) inputs are clearly identified.
    - Set and label all amplifier sensitivities and filters, as well as recorder paper speed.

Assess the recorder for appropriate machine calibrations including:

- Time axis alignment.
- Electrical and mechanical baseline.
- Input a calibration signal to all AC amplifiers, label voltage, then verify adjust signal deflection.
- Verify deflection for a given sensitivity and calibration voltage to AC amplifiers identify over/under- damping and filter settings.
- Evaluate baseline and all calibration points of polygraph DC channels for input signal from ancillary equipment (e.g. oximeter, strain gauges).
- Set montage as labeled.

After the patient arrives, the following setup and calibration procedures are accomplished:

- Explain pre-testing, testing and post-testing procedures

- Measure and mark the appropriate EEG electrode placements using the international 10-20 system.
- Identify appropriate electrode placements for:
    - Ground.
    - EKG.
    - Chin EKG.
    - Intercostals EMG.
    - Anterior- tibialis EMG.
    - Other EMG
    - Thoracic/abdominal cardiopneumograph.
    - EOG.
- Securely attach all electrodes.
    - Clean and prepare all necessary electrodes.
    - Install electro conductive material where applicable.
    - Verify appropriate impedance level for each electrode.
    - Reposition, reapply, or replace electro conductive material as necessary.
- Appropriately place, securely attach to the patient, and check proper function and assure an appropriate signal for:
    - Airflow (e.g. thermistor, thermocouple, capnograph).
    - Respiratory effort (e.g. strain gauges inductive plethysmo graph belt,
    - Esophageal balloon, static charge sensitive mattress).
    - Oximeter probe, transcutaneousO2/Co2 electrodes.
- Signal quality on all channels
- Reposition or replace electrodes and other equipment as necessary
- Additionally, do the following
    - Check proper function of audiovisual equipment.
    - Administer pre-sleep questionnaire.

Assess the record for appropriate physiologic calibrations as well as determine corrective action to assure proper calibration for the following procedures:

- Eyes closed/eyes opened for 30 seconds.
- Vertical and horizontal eye movements.
- Eyelids blink.
- Teeth grind, yawn, swallow, etc...
- Inhale and exhale
- Hold breath.
- Nasal/oral breathing only.
- Coughs.
- Dorsiflex foot.
- Other EMG.

Inform the patient of lights out and note:

- “Lights out” time.

- Patient's position.
- Oxygen saturation.
- Respiratory and heart rates.
- Other pertinent information such as supplemental oxygen level, NCPAP level, etc...

PEDIATRIC POLOSOMNOGRAPHY

Evaluate and properly perform polysomnography:

- Toddlers.
- School age children.
- Adolescents.

Evaluate and properly perform polysomnography for:

- Sleep apnea (e.g. central, obstructive)
- Seizures.

MULTIPLE SLEEP LATENCY TEST (MSLT)

- Verify order, review chart for previous polysomnograms results, and take appropriate action if pathology is present.
- Explain procedure to patient and administer pre- nap questionnaire.
- Provide quiet, dark, temperature- controlled room for naps.
- Perform appropriate recording equipment and patient calibration.
- Properly instruct patient to begin to nap, record lights out and patient position.
- Recognize and note sleep onset according to MSLT criteria.
- Recognize and note REM onset according to MSLT criteria.
- Determine when to end nap according to recommended guidelines.
- End nap, document lights on and administer post- naps and nap intervals.
- Follow recommended guidelines for number of naps and nap intervals.
- Monitor patient behavior between naps, determine contraindicated behavior, intervene as necessary and document accordingly (e.g. caffeine, alcohol, or recreational drug ingestion, use of tobacco, exercise, staying awake between naps, medication use).

MONITORING, RECORDING AND ENDING THE TEST

During the test, following are monitored and documented:

- Clock time at regular intervals.
- Body position changes.
- Alterations in amplifier settings or derivations.
- Patient complaints.

- Environmental conditions (e.g. noise, light).
- Interventions or treatments (e.g. adjusting leads applying NCPAP).
- Verification of readouts from ancifiary equipment (e.g. tachograph).
- Equipment problems or malfunctions.
- Electrode application integrity checks at regular intervals(e.g.5OI6OHz or impedance checks).
- Respiration and heart rate at regular intervals.
- Body position at regular intervals and changes as they occur. 121. patient behaviors (e.g. snoring, vocalizing, out of bed).

Events are recognized and appropriate actions are determined by the following:

- Seizures.
- Apnealhypopnea.
- Abnormal cardiac rhythms.
- Oxygen desaturation.
- Co2 retention.
- Unusual vocalization/motor activity.
- Violent behaviors.
- Cataplexy or sleep paralysis.
- Unusual EEG findings (e.g. drug induced or epileptiform activity).
- REM related behaviors.
- Difficulty falling asleep or staying asleep.
- Patient discomfort.

Artifacts are recognized and the source identified fir the following:

- High frequency interference (e.g. electrical, muscle 50/60Hz). 2b. low frequency interference (e.g. sweat, respiratory, EKG).
- Unstable or weaving DC baselines.
- Intermittent signal.
- Increased or reduced signal amplitude.
- Flat trace.
- Altered paper speed.
- Cessation of ink flow.
- High amplitude, intermittent artifact (e.g. popping)
- Software or hardware malfunctions or inadequacies.

When artifact cases are identified polysomnographic technologist take action by making appropriate repairs
or changes to assure the recording is adequate, including:

- Use back-up or alternative derivations.
- Alter montage to maintain essential information.
- Wake patient to replace/reposition electrodes or other.

- Alter patient's environment (e.g. turn on/off air conditioning).
- Change amplifier settings.
- Replace faulty equipment.

When ending the test, the following are done:

- Wake patient, record "lights on" and time.
- Perform post-test polygraph calibrations.
- Remove electrodes and other recording devices using appropriate technique.
- Gently and effectively clean all electrode/adhesive contact points.
- Administer post-sleep questionnaire.

Plan, conduct and evaluate education activities concerning:

- The impact of and treatment approach for a particular diagnosis.
- Family responsibility with regard to treatment.
- Implements sleep hygiene therapeutic.
- Professional development.

PERFORMING RECORD SCORING INCLUDING VERIFYING AND EDITING COMPUTER GENERATED DATA.

Polysomnographic Record Scoring

Identify normal/abnormal patterns and score the following sleep/wake stages (epoch staging) of the recording using standard R& K (Rechtschaffen & Kales, 1968) criteria.

- Awake, stage 1, 2, 3, 4 and REM.
- Modify R & K criteria to score the stages 3 & 4 as delta sleep.

Recognize the following clinical events and score the recording scoring to current standards of practice:

- Body movements.
- Movement arousals.
- Transient arousals.
- Seizure activity.
- Normal vs. abnormal cardiac rhythms.
- Other activity such as alpha-delta sleep, drug spindles, asymmetry.
- Limb movements.
    - Number of limb movements.
    - Event interval.
    - Event duration.
    - Event- related arousals.

- Respiratory events.
    - Obstructive apnea.
    - Central apnea.
    - Mixed apnea.
    - Obstructive hypopnea.
    - Central hypopnea.
    - Periodic breathing.
    - Cheyne-Stokes breathing.
    - Blood Oxygen desaturation level.
    - Event duration.
    - Event- related arousal.
    - Event-related Co2 level.
    - Event-related cardiac abnormalities.
    - Upper airway resistance.
    - Snoring.

Reduce the sleep/wake and clinical event data. Generate an accurate report containing the following information:

- Record sleep/wake data.
    - Lights out/lights on time.
    - Total recording time.
    - Total sleep time.
    - Total sleep time and sleep efficiency. 5. amount and percent of stage 1,2,3,4 combined stage 3&4.
    - Amount and percent of REM, NREM and movement time.
    - Amount and percent of wake time, wake after sleep onset, and wake after final arousal.
    - Latency from sleep onset to stage 2, 3, 4 and/or REM sleep.
- REM episode assessment.
    - REM interruptions.
    - REM period intervals.
    - REM episode duration.
- Arousal analysis (e.g. transient, movement arousals, body movements) per REM and NREM.
- Calculate the range of and typical/average.
    - Heart rate.
    - Respiratory rate.
- Determine the number and stage of EEG phenomena.
    - Seizure activity.
    - Others such as alpha/delta sleep, alpha intrusions, drugs spindles asymmetry.
- Identify cardiac events.
    - Type of dysrhythmias.
    - Frequency/duration of dysrhythmias.
- Identify respiratory events.
    - Percent of apneic sleep time.

- Number per total sleep, per REM and per NREM.
- Total number with/without arousal.
- PLM index with and without arousal.

MSLT SCORING.

Before the following MSLT findings:

- Latency from lights out to stage 1, sleep onset, persistent sleep onset, and/or stage 2, and the average/median for each nap. 2b. latency from sleep onset to stage 2, 3, 4, and/or REM sleep for each nap and the average/median.
- Number of sleep onset REM episodes.

Score the naps according to recommended MSLT guidelines and Rechtschaffen & Kales criteria for sleep/wake staging (epoch scoring awake, stage 1,2,3,4 and REM).

Generate MSLT report including:

- Number and times of naps.
- Latency from lights out to sleep onset for each nap and the average/median.
- Latency from sleep onset to REM sleep for each nap and the average/median.
- Number of sleep onset REM episodes.
- Patient's perception of nap (e.g. length, amount of sleep/dreaming.
- Total sleep time of previous night Polysomnograms.
- Comparison of previous night Polysomnograms sleep time with normal sleep time.
- Overall mean sleep latency.

PERFORMING PATIENT, EQUIPMENT SAFETY AND EMERGENCY PROCEDURES.

Patient Safety and Emergency Procedures.

Insure patient safety by the following:

- Recognize and respond appropriately to patient's medical problems (e.g. diabetic, stroke patients).
- Safely lift and move patient without harm to patient or self.
- Initiate hospital medical emergency, fire and other emergency plans.
- Assure the availabifity and proper function of emergency equipment and Supplies (e.g. crash cart, suction, and CPR board).
- Follow proper hand washing techniques when working with and between patients.
- Follow blood and body fluid precautions on all patients.
- Follow emergency protocol.
- Recognize "normal" vs. abnormal cardiac rates and rhythms for patients based on their individual medical history.

Considering patient's history and current condition, recognize and respond appropriately to:

- Asystole.
- Ventricular fibrifiation.
- Ventricular tachycardia.
- Unifocal premature ventricular contractions (PVCs).
- Premature atrial contractions (PACs).
- Bigeminy, trigeminy.
- Multi-focal PVCs.
- Atrial fibrifiation/flutter.
- 1st degree A-V block.
- 2nd degree A-V block.
- 3rd degree A-V block.
- Obstructive sleep apnea associated bradycardia/tachycardia.

Recognize the need for and accomplish the following:

- Initiate and properly perform emergency procedures:
    - Relieving airway obstruction (e.g. Heimlich maneuver).
    - Adult CPR.
    - Infant CPR.
- Implement precautions/procedures.
    - Seizure precautions (e.g. protect patient from harming self).
    - Cataplexy precautions.
    - Infection control procedures.
- Obtain physician's order and implement.
    - Supplemental oxygen.
    - NCPAP.

EQUIPMENT SAFETY, HANDLING AND CLEANING/STERILIZATION

Assure electrical safety by:

- Determining that all equipment used meets accepted standards for maximum current leakage and proper grounding.
- Recognizing unsafe electrical equipment and removing from use (e.g. frayed cord, equipment emitting a shock when touched).
- Recognizing special hazards for patients.

Conduct special handlinj' of supplies:

- Storing coilodion and acetone in approved containers/location.
- Providing for proper ventilation of the patient area when using collodion or acetone.
- Following policy regarding contamination by and disposal of hazardous materials.
- Safely using needles and "sharps" and disposing of them properly in an approved container.

Determine the appropriate methods to clean, disinfect or sterilize electrodes and ancillary equipment using:

- a. bleach.
- b. cold chemical disinfectants.
- c. alcohol, or soap and water.

PERFORMING SPECIAL PROCEDURES

PAP (positive airway pressure) Delivery Devices.

- SofPAP.
- Apply Bi- level PAP device.
- Assure proper function of PAP unit.
- Calibrate pressure monitoring device (e.g. water colunm manometer, pressure transducer).
- Explain procedure to patient, determine appropriate mask size, apply mask, and check for leaks.
- Monitor beginning at lowest PAP with patient in supine position and record.
- Increase and document PAP to achieve therapeuidentify indications, contraindications and/or side effectic level (e.g. decrease associated respiratory events, desaturation cardiac dysrhythmias, arousals).
- Apply supplemental o2 with PAP to correct for low o2 baseline (when not corrected by PAP alone) and
  frequency/severity of o2 desaturation after optimal PAP is established
- End recording per usual protocol and document type of PAP unit/mask size used, optimal pressure setting, patient response to PAP, etc.
- Arrange for home PAP unit per physician order.
- Introduce laboratory follow- up program and sleep verify that optimal pressure has been achieved by monitoring patient at that pressure while in supine during REM.
- Disorder support group.
- Educate home PAP patient regarding:
  - Use and possible side effects of PAP.
  - Cleaning/disinfecting of equipment.
  - Who to notify regarding equipment.
  - Availabifity of support groups.
- Educate home care company personnel regarding:
- Obstructive sleep apnea. 2b.proper setup, use and maintenance of PAP.
- Expected patient follow-up and documentation of home visits.

SUPPLEMENTAL OXYGEN ADMINISTRATION.

- Verify order (specific or standing).
- Select and check appropriate equipment.
- Explain procedure and orient patient to method of administration (e.g. cannula, mask).
- Apply oxygen delivery device insuring proper fit and comfort.
- Recognize complications and contraindications of oxygen therapy.

- Adjust and document oxygen flow via flow meter.
    - a. according to physician order.
    - b. based on severity of o2 desaturation.
- Arrange for home oxygen per physician’s order.