EEG 101: EEG Terminology

Course Goals
The goal of this course is to provide the learner with a comprehensive vocabulary of terms commonly used to describe EEG findings, the structures of the central nervous system and the disease states frequently seen in the EEG lab. The learner will be able to listen to each term introduced in the course, to ensure proper pronunciation.

Learning Objectives
On successful completion the student will be able to:

Lesson 1
• Explain the difference between “encephalography”, “encephalogram”, and “encephalograph”

Lesson 2
• List the major anatomical structures of the brain
• Describe the chemical process which creates a nerve impulse

Lesson 3
• List the terms used to describe waveform frequencies
• Explain the location of EEG waveforms over the surface of the brain, using appropriate terms
• Explain the morphology of EEG waveforms using correct terminology
• List commonly used terms to describe normal wake and sleep EEG patterns

Lesson 4
• Describe neurological symptoms using appropriate medical terms

Lesson 5
• Describe common neurological disease states using appropriate medical terms

Lesson 6
• Explain EEG instrumentation concepts using correct terms

Quizzes
How to speak EEG 5%
Intro to Anatomical Structures 5%
Patterns and Waveforms 5%
Signs and Symptoms 5%
Neurological Disorders 5%
Instrumentation and Procedure Terms 5%
Final Exam 70%

Outcomes:
NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

Electroencephalographic (EEG) providers practice in accordance with the facility policy and procedure manual which details every aspect and type of recording.

The ASET - The Neurodiagnostic Society, Inc. presents this document to provide the national criteria for evaluating competencies for technologists performing an electroencephalogram.
These competencies were established following a survey of the membership in the Fall of 1996. The Professional Testing Corporation (PTC) in New York City completed the survey process and provided the analysis. The ASET Board of Trustees approved this document August 11, 1997. This document was updated in the Spring of 2010 according to nationally recognized and accepted criteria and approved by ASET’s Board of Trustees in March 2011.

The elements for quality patient care and interaction as well as basic knowledge and technical performance were considered. The technical components include those defined in the American Clinical Neurophysiology Society (ACNS) 2006 Revisions to the EEG Guidelines published in the Journal of Clinical Neurophysiology, Volume 23, Number 2, April 2006.

Section IV: Knowledge Base Statements
The EEG technologist understands (has a working knowledge of):
• medical terminology and accepted abbreviations

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES

The following graduate competencies for performing an electroencephalogram (EEG) and additional electroneurodiagnostic procedures, including introductory level Evoked Potential Studies (EP), Polysomnography Studies (PSG), Nerve Conduction Studies (NCS), Intraoperative Neurophysiological Monitoring (IONM), and Long Term Monitoring (LTM) are recommended as standards for the education of post-secondary students in electroneurodiagnostic (END) programs. Employers can expect the graduates of CAAHEP-accredited END programs to be competent in the areas defined below.

I. ELECTROENCEPHALOGRAM (EEG)
M. The graduate understands (has a working knowledge of):
   3. medical terminology and accepted abbreviations;
   4. signs, symptoms, and EEG correlates for adult neurological disorders; (Introduced as terms in EEG 101, also see EEG 110)
   5. signs, symptoms, and EEG correlates for pediatric neurological disorders; (Introduced as terms in EEG 101, also see EEG 111)
   6. seizure manifestations, classifications, and EEG correlates; (Introduced as terms, also see EEG 108)

N. The graduate maintains and improves knowledge and skills by:
   1. reviewing EEG tracings with EEGer on a regular basis;
   2. reading journal articles;
   3. studying text books related to the field; and
   4. attending continuing education courses in electroneurodiagnostics.

Reference: National Competency Skill Standards for Performing an Electroencephalogram Page 5 The ASET - The Neurodiagnostic Society, Inc. 402 East Bannister Road, Suite A, Kansas City, MO 64131-3019 816.931.1120 phone  816.931.1145 fax  www.aset.org  info@aset.org
EEG 102: The International 10-20 System: Measurement and Application Methods

Course Goals
During this course, the learner develops the basic skills necessary to measure a head using the International 10/20 System of Electrode Placement and accurately apply a standard set of electrodes to a mannequin or human head.

Learning Objectives
On successful completion the student will be able to:

Lesson 1
- Explain the importance of the International 10/20 System, and the theory behind it
- Correctly identify each of the anatomical landmarks used to measure a head for the 10/20 system
- List the name of each electrode location designated in the 10/20 system

Lesson 2
- List the supplies needed to measure a mannequin or human head
- Use a tape measure to measure the distance between the nasion and the inion and correctly mark the appropriate 10% and 20% increments
- Use the tape measure to measure the distance between the left and right pre-auricular points and correctly mark the appropriate 10% and 20% increments
- Accurately place a tape measure to measure the head circumference, intersecting the 10% marks above the nasion, inion and preauricular points
- Correctly calculate 10% of the full circumference, and mark the 10% segments from the front to the back of the head.
- Accurately place a tape measure on the frontal polar electrode site to the occipital electrode site, measure the full distance, and calculate and mark the 20% increments
- Accurately place a tape measure from one anterior temporal electrode site to the other, measure the full distance and calculate and mark the 20% increments
- Accurately place a tape measure from one posterior temporal electrode site, to the other, measure the full distance and calculate and mark the 20% increments
- Explain various techniques to prevent hair from getting in the way of accurate measurements and ensure good visibility of marks.

Lesson 3
- Describe the measurement technique for T1 and T2 electrodes
- Explain new nomenclature for specific 10/20 system electrodes, including T7, T8 and P7, P8
- Identify the electrode names for the expanded 10/10 system
- Explain how to modify electrode locations to accommodate skull defects, swelling, wounds and I.Vs.
- Describe special montages to incorporate the double interelectrode distance mandated for the recording of Electrocerebral Silence EEG recordings.

Lesson 4
- Use an interelectrode distance chart to document the distance between each electrode placed on a mannequin or human head, according to the 10/20 system
- Calculate the difference between homologous electrodes using the completed chart, to determine the accuracy of electrode placement
- Explain commonly made errors in head measurement, that can cause inaccurate lead placement

Lesson 5
• Explain important patient preparation education instructions to ensure that the head is properly cleaned and prepared for lead placement
• List the products used for electrode placement, and the proper use of each product
• Explain the importance of balanced, low impedances when applying electrodes
• Identify signs of unbalanced electrode impedences and electrodes that are not securely attached.
• Describe techniques to ensure that electrodes remain secure as the patient moves during the recording

Lesson 6
• Explain the advantages of using the pony tail method to prepare the head for electrode application
• Explain how to divide up the hair, in segments, and secure with elastics to increase visibility and accessibility of key areas of the scalp
• Describe the technique of placing electrodes and positioning the electrode wires to maximize electrode security
• Describe the use of gauze to wrap the head to prevent electrodes from becoming loose

Lesson 7
• List the various electrode application techniques and the advantages and disadvantages of each method of placement
• Describe paste application technique, using paste covered with gauze squares
• Describe collodion application technique, using an air compressor to dry the collodion-saturated gauze
• List concerns and risk factors to be considered when applying electrodes to ensure patient safety
• List the chemical compound that makes up collodion, and the standard safety recommendations when handling collodion

Lesson 8
• Describe a variety of common electrode types
• Explain how to select electrodes to ensure an artifact-free recording
• Explain the concept of common mode rejection and the relationship between electrodes, CMMR and an artifact-free recording

Lesson 9
• Describe specific measures to make a child more comfortable in the EEG lab, in preparation for head measurement and lead placement
• Explain lead placement techniques to ensure good lead placement without injury to the child
• List the pros and cons of using sedation for lead placement for the pediatric patient, and alternatives to sedation that can be employed
• Describe techniques for lead placement in the neonate and premature infant

Lesson 10
• List ten common errors in technique that cause problems with accurate lead placement
• Describe proper hand placement to secure tape measure and prevent slippage
• Explain methods to check for errors and remedy inaccurate placements

Lesson 11
• Explain the utilization of mannequin heads for the ABRET Part II EEG Registry Exam
• Describe the advantages of using a “Sam” head to practice measuring and applying electrodes in preparation for the ABRET exam.

Quizzes
The International 10-20 System of Electrode Placement 5%
Step by Step Measurement 5%
Modifications to the 10-20 System 5%
Outcomes:

NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

Electroencephalographic (EEG) providers practice in accordance with the facility policy and procedure manual which details every aspect and type of recording.

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The elements for quality patient care and interaction as well as basic knowledge and technical performance were considered. The technical components include those defined in the American Clinical Neurophysiology Society (ACNS) 2006 Revisions to the EEG Guidelines published in the Journal of Clinical Neurophysiology, Volume 23, Number 2, April 2006.

The EEG technologist’s electrode application follows a method that includes:

- ensuring accurate electrode placement according to the International 10–20 System or modified 10–10 System
- adjusting electrode placement for anatomical defects or anomalies
- cleaning the electrode site to reduce skin impedance prior to scalp electrode application
- applying surface electrodes with EEG conductive paste or with collodion and electrolyte
- verifying surface electrode impedances measure below 5,000 Ohms
- verifying when sterile, disposable subdermal needle electrodes are used, impedances measure below 10,000 Ohms
- applying electrodes to record ECG.

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES

The following graduate competencies for performing an electroencephalogram (EEG) and additional electroneurodiagnostic procedures, including introductory level Evoked Potential Studies (EP), Polysomnography Studies (PSG), Nerve Conduction Studies (NCS), Intraoperative Neurophysiological Monitoring (IONM), and Long Term Monitoring (LTM) are recommended as standards for the education of post-secondary students in electroneurodiagnostic (END) programs. Employers can expect the graduates of CAAHEP-accredited END programs to be competent in the areas defined below.

I. ELECTROENCEPHALOGRAM (EEG)
E. The graduate's electrode application follows a method that includes:
   1. measuring and marking the head following the 10/20 measurement system;
   2. adjusting electrode placement for anatomical defects or anomalies;
   3. prepping patient’s scalp prior to electrode application;
   4. applying electrodes with paste or with collodion and electrolyte; and
   5. verifying electrode impedances are balanced and below 5,000 Ohms.

L. When the EEG recording is finished the graduate:
   1. removes electrode paste/glue from the patient's scalp and hair;

Reference: National Competency Skill Standards for Performing an Electroencephalogram Page 5 The
ASET - The Neurodiagnostic Society, Inc. 402 East Bannister Road, Suite A, Kansas City, MO
64131-3019 816.931.1120 phone 816.931.1145 fax www.aset.org info@aset.org
EEG 103: Polarity

Course Goals
This course is a brief tutorial, designed to provide a focused study session on the concept of EEG waveform polarity. This course builds a foundation of basic information about the differential amplifier and how EEG signals of various voltages and electrical charges, will be displayed. Upon completion of this course, the learner will be able to analyze EEG samples and determine the polarity of waveforms.

Learning Objectives
On successful completion the student will be able to:

Lesson 1
- Define the term “differential amplifier
- State the polarity convention rule
- State the mathematical formula for calculating voltage, sensitivity and deflection of an EEG waveform
- Explain the concept of “summation” to calculate the voltage when one amplifier input is positive and one is negative
- Explain the concept of “in-phase cancellation” when amplifier inputs have similar voltages
- Define the term “common mode rejection” and explain why it is an important feature of EEG instrumentation
- Define the terms “bipolar montage and “referential montage” and list commonly used reference montages.

Lesson 2
- List commonly used bipolar montages
- Explain how to localize an electrical event displayed with a bipolar and referential montage
- Recognize an electrical focus illustrated by an electrical field map and explain how this event would be displayed on an EEG
- Define the term “horizontal dipole”
- Explain the polarity of the eye: cornea vs. retina
- Describe the EEG display in vertical and horizontal eye movements
- Using EEG samples, localize an electrical event and determine the polarity of the event

Quizzes
Practice exam  Review Only - No Credit
Final exam  100%

Outcomes:
NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

Electroencephalographic (EEG) providers practice in accordance with the facility policy and procedure manual which details every aspect and type of recording.

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Section II: Instrumentation
The EEG technologist documents the working condition of a digital EEG instrument by:

- verifying sensitivity settings

The EEG technologist applies the principles of electronics and mathematics to recording by:

- knowing how differential amplifiers work
- understanding the polarity of waveforms

The EEG technologist knows how digital waveforms are affected by:

- filter settings
- digital filters
- sensitivity settings
- referential and bipolar montages

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES

The following graduate competencies for performing an electroencephalogram (EEG) and additional electroneurodiagnostic procedures, including introductory level Evoked Potential Studies (EP), Polysomnography Studies (PSG), Nerve Conduction Studies (NCS), Intraoperative Neurophysiological Monitoring (IONM), and Long Term Monitoring (LTM) are recommended as standards for the education of post-secondary students in electroneurodiagnostic (END) programs. Employers can expect the graduates of CAAHEP-accredited END programs to be competent in the areas defined below.

I. ELECTROENCEPHALOGRAM (EEG)

O. The EEG graduate applies the principles of electronics and mathematics to recording by:

1. knowing how differential amplifiers work;

4. understanding the polarity of the waveforms;

P. The graduate knows how waveform displays are affected by:

5. referential and bipolar montages;

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EEG 104: Digital EEG

Course Goals
This course will introduce the learner to key concepts of digital technology and how digital EEG instruments record and display EEG signals. The learner will become familiar with common computer terminology and features of digital EEG equipment, to enable the technologist to become an informed consumer when purchasing and using digital EEG equipment.

Learning Objectives
On successful completion the student will be able to:

Lesson 1
• Compare and contrast digital and analog EEG equipment properties
• Define key features of digital EEG equipment: Central Processing Unit, Monitor, Analog to Digital Converter
• Explain the process of converting an analog signal to a digital signal through the A to D converter
• Define the Nyquist Theory in relationship to the sample rate of the A to D converter
• List various storage media that can be used to archive digital EEG recordings
• Explain manufacturer specific software features of digital equipment

Lesson 2
Identify the basic computer components and explain their purpose
List devices that are commonly connected to the computerized EEG system and identify devices on a schematic drawing of a digital system.
• Define the terms “Computer Power Supply” and “Motherboard”
• Explain the process of connecting a digital EEG system to a network

Lesson 3
Define terms related to digital EEG function: aliasing, sample skew, horizontal and vertical display resolution, and properties of the digital EEG amplifier.

Lesson 4
Demonstrate skills related to Digital Recording Techniques and recording a Digital EEG:
• System Calibration
• Montage Selection
• Using sensitivity, filter and timebase controls to manipulate the display of waveforms
• Making notations and descriptive comments on the EEG

Lesson 5
Demonstrate post recording review skills, including:
• Reformatting Montages
• Changing Display Sensitivity
• Changing Display Duration or Epoch
• Archiving EEG recording
• Retrieving archived EEG

Lesson 6
Explain how to use digital EEG equipment to record Electrocerebral Silence EEG Recordings.

Lesson 7
Identify artifacts on the EEG, from biologic, electrical and environmental sources.

Lesson 8
Demonstrate troubleshooting and basic maintenance skills for digital equipment, including:
• Equipment set up and problems with the system prior to acquisition
• Malfunctions that may occur during a recording
• Problems with networking and transfer of data to storage
• Basic maintenance of the system
Lesson 9
Describe diverse applications for computer technology in neurodiagnostics, including:

- Ambulatory EEG
- Continuous EEG monitoring in ICU
- Intraoperative Monitoring
- Polysomnography (PSG)
- Digital Video recording
- Fast Fourier Transformation
- Processed Quantitative EEG (QEEG)
- EEG and 3D Modeling
- Transcranial Doppler

Lesson 10
- Explain how to prepare digital EEG records for Board Exams, including
  - Using Digital terminology correctly
  - Describing how to review printouts that are not to scale, and calculate timebase

Quizzes
Practice Exam 30%
Final Exam 70%

Outcomes:
NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

Electroencephalographic (EEG) providers practice in accordance with the facility policy and procedure manual which details every aspect and type of recording.

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Section II: Instrumentation
The EEG technologist documents the working condition of a digital EEG instrument by:

- calibrating system amplifiers
- verifying standard filter settings
- verifying sensitivity settings
- inputing a biological (bio-cal) signal to all channels
- observing the first 30 seconds of the recording from the primary system-reference montage when instrumental and biological calibration cannot be performed
- correcting or reporting deviations per facility policy and procedure.

The EEG technologist applies the principles of electronics and mathematics to recording by:
• knowing how differential amplifiers work
• computing voltage and frequency of waveforms
• calculating the duration of waveforms
• understanding the polarity of waveforms
• understanding impedance
• understanding analog to digital conversion.

The EEG technologist knows how digital waveforms are affected by:
• 60 hertz filter
• filter settings
• digital filters
• sensitivity settings
• referential and bipolar montages
• electrodes type and electrode material composition
• malfunctioning equipment
• printer conversion of data.

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES
The following graduate competencies for performing an electroencephalogram (EEG) and additional electroneurodiagnostic procedures, including introductory level Evoked Potential Studies (EP), Polysomnography Studies (PSG), Nerve Conduction Studies (NCS), Intraoperative Neurophysiological Monitoring (IONM), and Long Term Monitoring (LTM) are recommended as standards for the education of post-secondary students in electroneurodiagnostic (END) programs. Employers can expect the graduates of CAAHEP-accredited END programs to be competent in the areas defined below.

I. ELECTROENCEPHALOGRAM (EEG)
G. The graduate documents the working condition of a digital EEG instrument by:
1. calibrating system amplifiers;
2. verify standard filter settings;
3. verify sensitivity settings;
4. inputting a biological (bio-cal) signal to all channels; and
5. corrects or reports deviations as appropriate.

O. The EEG graduate applies the principles of electronics and mathematics to recording by:
1. knowing how differential amplifiers work;
2. computing voltage and frequency of waveforms;
3. calculating the duration of waveforms;
4. understanding the polarity of the waveforms;
5. understanding impedance; and
6. understanding analog to digital conversion.

P. The graduate knows how waveform displays are affected by:
1. 60 Hertz filter;
2. filter settings;
3. sensitivity settings;
4. paper speed;
5. referential and bipolar montages;
6. digital filters;
7. electrode types and electrode material composition; and
8. malfunctioning equipment.

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EEG 105: Normal Adult EEG and Normal Variants

Course Goals
This course provides an overview of normal EEG patterns seen in the adult, during the waking and sleep states, and explains the features of the EEG that are essential to the visual analysis and verbal description of the EEG.

Learning Objectives
On successful completion the student will be able to:

Lesson 1
• Explain the history of the discovery of the human EEG signal

Lesson 2
• List and define the five basic terms used to describe EEG waveforms
• Correctly use the descriptive terminology to analyze EEG patterns
• Recognize basic EEG artifacts
• Explain the electrical charge of the eyeball and the polarity of eye movements on the EEG

Lesson 3
• Recognize key structures in the human brain
• List the cranial nerves and their functions
• Identify the major blood vessels in the brain, and explain the blood supply to the brain

Lesson 4
• List the frequency bands of EEG waveforms and correctly identify EEG samples of various frequencies

Lesson 5
• List the stages of adult sleep
• Identify the EEG patterns seen in each stage of sleep

Lesson 6
• Define the term “normal”
• Explain the criteria used to determine normal EEG patterns
• Identify typical “Normal Variant” EEG patterns

Lesson 7
• Define the term “Benign Variant”
• Identify commonly seen benign variant patterns

Quizzes
Neuroanatomy and Cranial Nerves 10%
Mid Term Exam 10%
Sample Identification 10%
Practice Exam Review no credit
Final Exam 70%

Outcomes:
NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

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Section III: Recording Principles
The EEG technologist obtains a standard EEG that includes:
- eye opening and closing to check effects of stimuli on EEG
- hyperventilation for a minimum of 3 minutes
- photic stimulation at frequencies appropriate for history and reactivity
- minimum recording of one minute post hyperventilation/photic stimulation
- mental stimulation/assessment procedures
- periodic checks of electrode impedance
- natural drowsiness and sleep, if possible
- notes of observed behavior, clinical seizure manifestations, etc.

The EEG technologist customizes the recording procedure by:
- evaluating reason for referral, history, and observed waveforms
- selecting montages appropriate for abnormalities seen and/or expected
- selecting appropriate instrument settings, i.e., filters, sensitivity, timebase
- encouraging drowsiness and sleep
- applying additional electrodes and adjusting montage, if needed, to localize abnormal activity

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES
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I. ELECTROENCEPHALOGRAM (EEG)
M. The graduate understands (has a working knowledge of):
   1. functional neuroanatomy and neurophysiology;

Q. The graduate recognizes:
   1. normal and normal variant awake and asleep patterns for each age range;
   2. abnormal awake and asleep patterns for each age range;
   3. EEG patterns for levels of consciousness;

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EEG 106A: EEG Instrumentation

Course Goals
This course provides a comprehensive foundation in all of the subjects related to the instrumentation of the EEG recording system including electronics, computer components, and differential amplifier. Proper use and care of the equipment is explained, including electrical safety, maintenance and troubleshooting for malfunctions.

Learning Objectives
On successful completion the student will be able to:

Lesson 1
- Describe the structure of atoms and ions.
- List four characteristics of electrical charge.
- Define voltage, resistance, and current and how they are related according to Ohms Law.
- Define conductance and list three materials that are good conductors.
- Calculate the total resistance of resistors in series and in parallel.
- Describe a capacitor.
- Define alternating and direct current.
- Describe how impedance is measured

Lesson 2
- Explain the functions of the various components of the electroencephalograph.
- Explain how to calculate voltages of EEG discharges and frequencies of waveforms.
- List and explain labeling information needed for proper interpretation of EEG recordings.
- Describe the important aspects of calibration and how to select and adjust calibrations.
- Diagram a montage and explain the important aspects of different types of montages.
- Explain the various activation procedures used to enhance the value of the EEG, and identify the types of responses which might be elicited by those procedures.
- Describe the important aspects of relating to and relaxing the patient during EEG recording sessions.
- Explain the difference between a description and an interpretation.

Lesson 3
- Explain what a montage is and how it functions to examine EEG and localize activity
- Define the various types of montages, their usefulness, and localization methods
- List the types of references and the advantages/disadvantages of each
- Design a referential montage that complies with ACNS Guidelines in EEG
- Design a linked bipolar chain montage that complies with ACNS Guidelines in EEG
- Describe the usefulness of A-P Longitudinal, Transverse, and Circumferential bipolar montages
- Describe the rules of localizing a focus
- Explain “common mode rejection ratio”
- Describe the function of the high and low frequency filters and how they affect waveforms at specific frequencies, using the frequency response curves
- Calculate time base
- Calculate the duration, and voltage of a waveform
- Describe square wave and biological calibration
- Explain digital calibration or system check

Lesson 4
- Understand the minimum standards for both horizontal and vertical resolution,
- Calculate acceptable settings for EEG data collection.
• Distinguish between calibration methods appropriate for analog and digital EEG.
• Identify the post-hoc manipulation options with digital EEG recording.
• Given descriptions for storage and retrieval media, identify appropriate means of storage of an EEG.
• Identify the interpretation skills necessary to select EEG segments for Fast Fourier Transform (FFT).
• Distinguish the primary advantages Topographic Brain Mapping offers over routine analog EEG

Lesson 5
• Use the correct EEG terminology to describe the morphology, frequency, amplitude, topography, occurrence, dominance, focality, laterality, polarity, background rhythms, periodicity, symmetry, synchrony, reactivity, and specific patterns present.
• Describe the difference between a technical description and an interpretation
• Assist the interpreting physician by using technical terms to describe waveforms

Lesson 6
• Describe the type of injuries caused by electricity.
• Describe how voltage, resistance, and current affect the severity of injuries.
• Describe how the path of the electrical current affects the severity of injuries.
• Define micro-shock; explain which patients are susceptible to micro-shock and why.
• Describe the function of the three holes in a three-prong outlet.
• List three sources of current in the chassis of an electrical instrument.
• Define a ground loop; describe how it can injure a patient and how it can be prevented.
• State the maximum allowable leakage current a) at the instrument chassis, b) at the patient, electrode, and c) at the electrodes on electrically susceptible patients.
• List at least five extra safety measures to be used with bedside recordings

Lesson 7
• Perform basic equipment maintenance and troubleshooting
• Recognize common equipment malfunctions and take steps to remedy them
• Identify conditions that should be addressed by a professional biomedical engineer

Lesson 8
• Understand frequency and filters used in diagnostics display frequency
• Explain sources of unwanted signal contamination
• Describe the basic electronics that comprise the analog filters
• Demonstrate the correct use of filters to enhance or modify waveforms
• Use a frequency response curve to calculate how much a specific filter setting will alter the display of a waveform at any given frequency

Quizzes
Basic Electrical Concepts 5%
The Electroencephalograph 10%
Basic Montages: Localization, CMR, Cancellation 5%
Digital EEG 5%
Technical Descriptions 5%
Electrical Safety 5%
Maintenance and Troubleshooting 5%
Understanding Filters 10%
Filters and Frequency Response Curves 5%
Polarity and Digital EEG 5%
Practice Exam Review no credit
Final Exam 40%
Outcomes:
NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

Electroencephalographic (EEG) providers practice in accordance with the facility policy and procedure manual which details every aspect and type of recording. The American Society of Electroneurodiagnostic Technologists, Inc. presents this document to provide the national criteria for evaluating competencies for technologists performing an electroencephalogram (EEG). These competencies were established following a survey of the membership in the Fall of 1996. The Professional Testing Corporation (PTC) in New York City completed the survey process and provided the analysis. The ASET Board of Trustees approved this document August 11, 1997. This document was updated in the Spring of 2010 according to nationally recognized and accepted criteria and approved by ASET’s Board of Trustees in March 2011.

The elements for quality patient care and interaction as well as basic knowledge and technical performance were considered. The technical components include those defined in the American Clinical Neurophysiology Society (ACNS) 2006 Revisions to the EEG Guidelines published in the Journal of Clinical Neurophysiology, Volume 23, Number 2, April 2006.

Section II: Instrumentation
The EEG technologist documents the working condition of a digital EEG instrument by:

- calibrating system amplifiers
- verifying standard filter settings
- verifying sensitivity settings
- inputing a biological (bio-cal) signal to all channels
- observing the first 30 seconds of the recording from the primary system-reference montage when instrumental and biological calibration cannot be performed
- correcting or reporting deviations per facility policy and procedure.

The EEG technologist applies the principles of electronics and mathematics to recording by:

- knowing how differential amplifiers work
- computing voltage and frequency of waveforms
- calculating the duration of waveforms
- understanding the polarity of waveforms
- understanding impedance
- understanding analog to digital conversion.

The EEG technologist knows how digital waveforms are affected by:

- 60 hertz filter
- filter settings
- digital filters
- sensitivity settings
- referential and bipolar montages
- electrodes type and electrode material composition
- malfunctioning equipment
- printer conversion of data.

Section III: Recording Principles
The EEG technologist customizes the recording procedure by:

- utilizing techniques to bring out or enhance clinical symptoms
- selecting montages appropriate for abnormalities seen and/or expected
• selecting appropriate instrument settings, i.e., filters, sensitivity, timebase
including applying additional electrodes and adjusting montage, if needed, to localize
abnormal activity

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES
The following graduate competencies for performing an electroencephalogram (EEG) and additional
electroneurodiagnostic procedures, including introductory level Evoked Potential Studies (EP),
Polysomnography Studies (PSG), Nerve Conduction Studies (NCS), Intraoperative Neurophysiological
Monitoring (IONM), and Long Term Monitoring (LTM) are recommended as standards for the education
of post-secondary students in electroneurodiagnostic (END) programs. Employers can expect the
graduates of CAAHEP-accredited END programs to be competent in the areas defined below.

I. ELECTROENCEPHALOGRAM (EEG)

G. The graduate documents the working condition of a digital EEG instrument by:
1. calibrating system amplifiers;
2. verify standard filter settings;
3. verify sensitivity settings;
4. inputting a biological (bio-cal) signal to all channels; and
5. corrects or reports deviations as appropriate

H. The graduate obtains a standard EEG that includes:
1. at least 20 minutes of technically acceptable recording (120 pages);
2. eye opening and closing to check effects of stimuli on EEG;
3. hyperventilation for a minimum of 3 minutes;
4. photic stimulation at frequencies appropriate for history & reactivity;
5. mental stimulation/assessment procedures;
6. periodic checks of electrode impedance;
7. natural drowsiness and sleep, if possible;
8. notations of montage, filters, paper speed, & sensitivity setting changes; and
9. notes on observed behavior, clinical seizure manifestations, etc.

I. The graduate customizes the recording procedure by:
1. evaluating reason for referral, history, and observed waveforms;
2. utilizing techniques to bring out or enhance clinical symptoms;
3. selecting montages appropriate for abnormalities seen and/or expected;
4. selecting appropriate instrument settings;
5. encouraging drowsiness and sleep;
6. applying additional electrodes to localize abnormal activity;
7. monitoring respiration if appropriate; and
8. monitoring ECG rhythms for abnormality.

O. The EEG graduate applies the principles of electronics and mathematics to
recording by:
1. knowing how differential amplifiers work;
2. computing voltage and frequency of waveforms;
3. calculating the duration of waveforms;
4. understanding the polarity of the waveforms;
5. understanding impedance; and
6. understanding analog to digital conversion.

P. The graduate knows how waveform displays are affected by:
1. 60 Hertz filter;
2. filter settings;
3. sensitivity settings;
4. paper speed;
5. referential and bipolar montages;
6. digital filters;
7. electrode types and electrode material composition; and
8. malfunctioning equipment.

Reference: National Competency Skill Standards for Performing an Electroencephalogram Page 5 The
ASET - The Neurodiagnostic Society, Inc. 402 East Bannister Road, Suite A, Kansas City, MO
64131-3019 816.931.1120 phone 816.931.1145 fax www.aset.org info@aset.org
Course Goal: The purpose of this course is to familiarize professionals in neurodiagnostics with the basic principles of basic electricity as used in neurodiagnostics, physiologic aspect of current, and safety issues when dealing with patients. This course is excellent for those working in EEG, PSG, NCS, LTM and the course addresses specifically those issues facing professionals in Intraoperative Neuromonitoring.

Learning Objectives
On successful completion the student will be able to:

- Identify basic electric principles including:
  - Hot, Neutral and Ground
  - Static magnetic fields
  - Current flow of electrons
  - Voltage build up
  - Parallel pathways
  - Voltages of neurodiagnostic waveforms
    - Evoked Potentials
    - EEG
    - ECG/EKG
    - Motor EPs
    - EMG
- Identify physiologic aspects of current flow
  - How to visualize in a relative sense the voltages of neurodiagnostic waveforms
- The Body Electrical
  - Relative resistances of critical human body systems
    - Cardiovascular
    - Respiratory
    - Brain and Spinal Cord
    - Renal System
    - Sweat
    - Micro and Macro Shock
- Identify the safety issues in neurodiagnostics, especially in IONM
  - Voltage needed to do damage to critical systems
  - What causes death from electricity
  - Immediate acute injury vs latent damage
  - Electrical injury factors
  - Current Intensity
    - Current Pathway
    - Duration of Exposure
  - Sweat
  - Micro and Macro Shock
- Safety Issues
- Wall voltage
- Direct electrical shock
- DIN 42-802 metal connectors
- Ground Loops
- Electrosurgical Unit (Bovie)
- Radio Frequency energy from MRI
- Ac and DC leakage current
- DC electrochemical burns
Outcomes:
NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM
Electroencephalographic (EEG) providers practice in accordance with the facility policy and procedure manual which details every aspect and type of recording.

The American Society of Electroneurodiagnostic Technologists, Inc. presents this document to provide the national criteria for evaluating competencies for technologists performing an electroencephalogram (EEG). These competencies were established following a survey of the membership in the Fall of 1996. The Professional Testing Corporation (PTC) in New York City completed the survey process and provided the analysis. The ASET Board of Trustees approved this document August 11, 1997. This document was updated in the Spring of 2010 according to nationally recognized and accepted criteria and approved by ASET’s Board of Trustees in March 2011.

The elements for quality patient care and interaction as well as basic knowledge and technical performance were considered. The technical components include those defined in the American Clinical Neurophysiology Society (ACNS) 2006 Revisions to the EEG Guidelines published in the Journal of Clinical Neurophysiology, Volume 23, Number 2, April 2006.

Section I: EEG Core Knowledge
The EEG technologist’s electrode application follows a method that includes:
• cleaning the electrode site to reduce skin impedance prior to scalp electrode application
• applying surface electrodes with EEG conductive paste or with collodion and electrolyte
• verifying surface electrode impedances measure below 5,000 Ohms
• verifying when sterile, disposable subdermal needle electrodes are used, impedances measure below 10,000 Ohms

Section II: Instrumentation
The EEG technologist knows how digital waveforms are affected by:
• 60 hertz filter
• filter settings
• digital filters
• sensitivity settings
• electrodes type and electrode material composition
• malfunctioning equipment

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES
The following graduate competencies for performing an electroencephalogram (EEG) and additional electroneurodiagnostic procedures, including introductory level Evoked Potential Studies (EP), Polysomnography Studies (PSG), Nerve Conduction Studies (NCS), Intraoperative Neurophysiological Monitoring (IONM), and Long Term Monitoring (LTM) are recommended as standards for the education of post-secondary students in electroneurodiagnostic (END) programs. Employers can expect the graduates of CAAHEP-accredited END programs to be competent in the areas defined below.

I. ELECTROENCEPHALOGRAM (EEG)
G. The graduate documents the working condition of a digital EEG instrument by:
1. calibrating system amplifiers;
4. inputting a biological (bio-cal) signal to all channels; and
5. corrects or reports deviations as appropriate.

O. The EEG graduate applies the principles of electronics and mathematics to recording by:
1. knowing how differential amplifiers work;

5. understanding impedance; and
6. understanding analog to digital conversion.

P. The graduate knows how waveform displays are affected by:
1. 60 Hertz filter;
6. digital filters;
7. electrode types and electrode material composition; and
8. malfunctioning equipment.

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EEG 107: Technical Skills

Course goal: This course will familiarize the technologist with those skills particular to neurodiagnostic lab duties and routine EEG procedures. These duties include application of electrodes, making use of activation procedures, documenting the record appropriately, establishing patient rapport, taking a patient history, providing a technical description of EEG findings, performing ECI and bedside recordings, what to do in a medical emergency, how to use appropriate infection control techniques and an overview of neurodiagnostic lab management. Also a brief history of EEG technology is included.

Learning Objectives
On successful completion the student will be able to:

Lesson 1 EEG History
- Recognize the major contributions of the following investigators and groups:
  - Richard Caton
  - Adrian and Matthews
  - Hans Berger
  - Alexander Forbes
  - The Harvard Group
  - Frederic and Erna Gibbs
  - Albert Grass
  - The Chicago Group
  - Franklin Offner
  - The Iowa School
  - The Montreal Group
  - Herbert Jasper
  - Wilder Penfield
  - W. Grey Walter
- Describe the development of the modern EEG instrument from the instrument used by Caton.
- Describe major landmark discoveries in the clinical use of EEG.

Lesson 2 Methods of Application and Electrode Types
- Describe skin preparation techniques, and list the reasons they are performed.
- List three methods of electrode application, and explain the advantages and disadvantages of each.
- Discuss the characteristics of the metals used to make different types of electrodes.
- Describe nasopharyngeal, sphenoidal, and electrocorticographic electrodes.

Lesson 3 Activation Procedures
- Describe the various activation procedures used in EEG
- List contraindications for activation procedures
- Recognize common abnormal patterns seen during activation procedures

Lesson 4 Record Documentation
- Information on correct record documentation and reasons why documentation is important.
- Level of consciousness evaluation
- Common annotations
- Glasgow Coma Scale
- Abnormal Posturing
- HIPAA

Lesson 5 Patient Rapport
- Relaxing the patient and accommodating patients with disabilities

Lesson 6 Technical Description of EEG by Technologists
- Define a technical description
• Discriminate between an technical description and a physician interpretation

Lesson 7 Patient Histories and Expected Findings
• Explain how to obtain basic, minimal information.
• Describe how to customize patient questions to the clinical problem being evaluated.
• List what resources to use in addition to asking questions of the patient.
• Explain how having a good history helps to customize the EEG to fit this particular patient.
• Explain why different kinds of patients require different approaches to history taking.
• Describe what might be seen on the EEG recording.
• Provide the Electroencephalographer with enough information to make adequate clinical correlations with the EEG.

Lesson 8 Electrocerebral Inactivity (ECI or ECS)
• Define electrocerebral inactivity (ECI) and electrocerebral silence (ECS)
• List six pieces of essential information that must be included with ECI recordings
• Name the ten ACNS guidelines to follow for ECI recordings
• Name conditions which may result in temporary reversible ECI
• Give minimum sensitivity settings for recording ECI studies and explain how to calibrate at these sensitivities
• Give examples of physiologic and nonphysiologic artifacts most commonly encountered with ECI recordings and how to deal with them

Lesson 9 Bedside Recordings
• Explain how is doing a bedside recording different than doing the recording in the lab?
• Describe what special considerations and challenges should you be aware of when going into the patient's room?
• Describe how to be aware of the nurses and their duties
• Describe the importance of not blocking access to the patient in case of emergency

Lesson 10 Medical Emergencies
• Explain your lab's policies and procedures for responding to medical emergencies
• Identify the technologist's first responsibility during a seizure
• List the first aid steps for a patient having a generalized tonic/clonic seizure
• Explain the steps for obtaining an EEG recording at the patient’s bedside

Lesson 11 Infection Control
• Describe standard infection control
• Identify Infection Control Issues in the END Lab
• Define appropriate measures to deal with head lice
• Describe EPA and OSHA standards and the application of those standards in the END Lab

Lesson 12 Neurodiagnostic Lab Management
• List basic information needed when scheduling a patient for a procedure
• Define records management
• Identify which records need to be kept
• Identify an appropriate retention schedule for records storage in compliance with state requirements
• Identify components of a total budget
• List three steps in developing an operating budget
• Explain and give examples of fixed, variable, and semi-variable costs
• Describe effect of volume changes on fixed, variable, and semivariable costs
• Differentiate between moveable and fixed capital
• References you should review before making Lab management decisions:
  - Your own Lab/office protocol and policy and procedure manual.
  - Your state's Records Guidelines
  - Departmental or Hospital Budget Manual
  - Your supervisor
Outcomes: NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

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The elements for quality patient care and interaction as well as basic knowledge and technical performance were considered. The technical components include those defined in the American Clinical Neurophysiology Society (ACNS) 2006 Revisions to the EEG Guidelines published in the Journal of Clinical Neurophysiology, Volume 23, Number 2, April 2006.

Section I: EEG Core Knowledge
The electroencephalographic (EEG) technologist has the knowledge base to interact with the patient and obtain a quality, interpretable EEG recording that will yield information about the brain’s neuronal activity. The technologist possesses the appropriate knowledge level of diseases to correlate patient history and clinical symptoms to determine appropriate maneuvers to be performed during the EEG.

Technical Skills and Other Abilities:
The EEG technologist provides a safe recording environment by:
- verifying identity of the patient
- disinfecting electrodes after each procedure or using disposable products
- following standard precautions for infection control per facility policy and procedures
- attending to patient needs as established by facility policy and procedures
- recognizing/responding to life-threatening situations
- being certified to perform cardiopulmonary resuscitation
- following facility policy and procedures for sedation
- complying with facility policy and procedures for emergency and disaster situations
- complying with hazardous material handling procedures
• maintaining instrument/equipment in good working order
• taking appropriate precautions to ensure electrical safety.

The EEG technologist establishes rapport with the patient and the patient’s family by:
• using personal communication skills to achieve patient relaxation/cooperation
• explaining all test procedures including activation procedures
• explaining the electrode application method (paste, collodion, etc.)
• interacting on a level appropriate to patient’s age and cognitive ability
• maintaining respect and patient confidentiality.

The EEG technologist evaluates the patient to:
• determine the patient’s mental age, mental state, and comprehension level
• note the patient’s overall physical condition
• determine appropriate method of electrode application
• ascertain the patient’s capacity to cooperate with activation procedures
• determine if hyperventilation/photic stimulation is contraindicated
• accommodate for disabilities or special needs
• determine the need for additional physiological monitors
• document unusual or inappropriate behavior suggestive of seizure or psychogenic non-epileptic event
• determine the possible need for restraints or emergency intervention.

The EEG technologist prepares a basic data sheet that includes:
• patient’s information (name, age, ID number, doctor, etc.)
• recording time, date, and technologist’s name or initials
• pertinent patient history and familial medical history
• previous EEG reports
• current medication/sedation and time of last dosage
• time of last meal
• time, date, aura, and circumstances of last seizure or symptoms
• patient’s mental, behavioral, and consciousness states
• diagram of skull defects or anomalies (if any)
• diagram of any modifications in electrode placement.

Section III: Recording Principles
The EEG technologist obtains a standard EEG that includes:
• a minimum of 20 minutes of technically acceptable recording
• eye opening and closing to check effects of stimuli on EEG
• hyperventilation for a minimum of 3 minutes
• photic stimulation at frequencies appropriate for history and reactivity
• minimum recording of one minute post hyperventilation/photic stimulation
• mental stimulation/assessment procedures
• periodic checks of electrode impedance
• natural drowsiness and sleep, if possible
• notations of montage, filters, display speed, and sensitivity setting changes
• notes of observed behavior, clinical seizure manifestations, etc.
• minimum recording of 2 minutes post any questionable event.

The EEG technologist customizes the recording procedure by:
• evaluating reason for referral, history, and observed waveforms
• encouraging drowsiness and sleep
• applying additional electrodes and adjusting montage, if needed, to localize abnormal activity
• recording respiration, if appropriate
• recording ECG rhythms.
The EEG technologist differentiates artifacts from cerebral waveforms by:
- recognizing possible artifactual waveforms
- documenting (on the recording) patient movements
- applying electrodes to record eye movements
- replacing electrodes exhibiting questionable activity or contact
- troubleshooting for possible electrical interference.

The EEG technologist:
- reports critical tests results* to the interpreting physician and supervisor and documents this communication according to facility policy and procedures
- documents sedation used, dosage, and effects (if applicable)
- reviews EEG for appropriate documentation or amplifier settings and montage changes
- removes electrode paste/collodion/adhesive from the patient’s scalp and hair.

Section IV: Knowledge Base Statements
The EEG technologist understands and follows technical criteria for
- recording electrocerebral inactivity (brain death)

The EEG technologist recognizes:
- normal and normal variants awake and asleep patterns for each age range
- abnormal awake and asleep patterns for each age range
- EEG patterns for levels of consciousness
- clinical and nonconvulsive seizure patterns.

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES
The following graduate competencies for performing an electroencephalogram (EEG) and additional electroneurodiagnostic procedures, including introductory level Evoked Potential Studies (EP), Polysomnography Studies (PSG), Nerve Conduction Studies (NCS), Intraoperative Neurophysiological Monitoring (IONM), and Long Term Monitoring (LTM) are recommended as standards for the education of post-secondary students in electroneurodiagnostic (END) programs. Employers can expect the graduates of CAAHEP-accredited END programs to be competent in the areas defined below.

I. ELECTROENCEPHALOGRAM (EEG)
A. The graduate provides a safe recording environment by:
1. verifying identity of patient;
2. cleaning electrodes after each procedure;
3. following universal precautions for infection control;
4. attending to patient needs appropriately;
5. recognizing/responding to life-threatening situations;
6. being certified to perform CPR;
7. following laboratory protocols for sedation;
8. complying with lab protocols for emergency and disaster situations;
9. complying with hazardous material handling procedures;
10. maintaining instrument/equipment in good working order; and
11. taking appropriate precautions to ensure electrical safety.

B. The graduate establishes rapport with the patient and patient’s family by:
1. using personal communication skills to achieve patient relaxation/cooperation;
2. explaining all test procedures including activation procedures;
3. explaining the electrode application method (paste, collodion, etc.);
4. interacting on a level appropriate to patient's age and mental capacity; and
5. maintaining respect and patient confidentiality.
C. The graduate evaluates the patient to:
   1. determine the patient's mental age, mental state, and comprehension level;
   2. note the patient's overall physical condition;
   3. decide appropriate method of electrode application;
   4. ascertain the patient's capacity to cooperate with activation procedures;
   5. determine if hyperventilation is contraindicated;
   6. accommodate for disabilities or special needs;
   7. determine the need for additional physiological monitors;
   8. document unusual or inappropriate behavior suggestive of seizure or other event;
   and
   9. determine the possible need for restraints or emergency intervention.

D. The graduate prepares a basic data sheet ("tech sheet") that includes:
   1. patient information (name, age, ID number, doctor, etc.);
   2. recording time, date, and graduate's name or initials;
   3. noting pertinent patient history and familial medical history;
   4. listing current medications/sedation and time of last dosage;
   5. noting time of last meal;
   6. noting time, date, aura, and circumstances of last seizure or symptoms;
   7. specifying the patient's mental, behavioral, and consciousness states;
   8. diagramming skull defects or anomalies (if any); and
   9. diagramming any modifications in electrode placement.

H. The graduate obtains a standard EEG that includes:
   1. at least 20 minutes of technically acceptable recording (120 pages);
   2. eye opening and closing to check effects of stimuli on EEG;
   3. hyperventilation for a minimum of 3 minutes;
   4. photic stimulation at frequencies appropriate for history & reactivity;
   5. mental stimulation/assessment procedures;
   6. periodic checks of electrode impedance;
   7. natural drowsiness and sleep, if possible;
   8. notations of montage, filters, paper speed, & sensitivity setting changes; and
   9. notes on observed behavior, clinical seizure manifestations, etc.

I. The graduate customizes the recording procedure by:
   1. evaluating reason for referral, history, and observed waveforms;
   2. utilizing techniques to bring out or enhance clinical symptoms;
   3. selecting montages appropriate for abnormalities seen and/or expected;
   4. selecting appropriate instrument settings;
   5. encouraging drowsiness and sleep;
   6. applying additional electrodes to localize abnormal activity;
   7. monitoring respiration if appropriate; and
   8. monitoring ECG rhythms for abnormality.

L. When the EEG recording is finished the graduate:
   1. removes electrode paste/glue from the patient's scalp and hair;
   2. describes clinically significant behavior;
   3. documents sedation used, dosage, and effects (if applicable); and
   4. reviews EEG for appropriate documentation of amplifier settings & montage changes.

Reference: National Competency Skill Standards for Performing an Electroencephalogram Page 5 The
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64131-3019 816.931.1120 phone 816.931.1145 fax www.aset.org info@aset.org
EEG 108: Artifacts and Troubleshooting

Course Goal: This course is designed to provide the skills in recognizing common and some unusual artifacts seen in routine EEG recordings and troubleshooting skills for the elimination of such artifacts when possible. A brief review of the role of impedance and common mode rejection (CMR) and the role of these factors in the presence or elimination of artifacts, is also included in the course.

Learning Objectives
On successful completion the student will be able to:

- Describe and identify the common physiological and non-physiological artifacts found during EEG recordings
- Differentiate physiological artifacts such as:
  - EMG and Muscle
  - Movement
  - Chewing
  - Swallowing
  - Eyeblinks
  - EKG
  - Pacemaker
  - Vagal Nerve Stimulator
  - Pulse
  - Ballistocardiographic
  - Glossokinetic
  - Respiration
  - Respirator
  - Tics and Tremors
  - Perspiration
  - Directional Eye Movements (Polarity of the eye)
  - Bells Phenomena - Corneal Retinal Potential
  - Nystagmus
  - Eye Flutter
- Differentiate non-physiologic artifacts, including chemical, physical, high impedance, artifacts caused by electrode distance errors, and external artifacts such as:
  - Electrode Pops
  - Perspiration
  - Photocell or Photoelectric
  - Unsecured attachment of electrodes
  - 60 Hz room noise and noise from the Instrument
  - High Impedance causing increased 60 Hz or low amplitude signal
  - Ground lead recording artifact
  - Static Electricity
- Indicate and demonstrate the technique/s necessary to rid the EEG of these artifacts
- Indicate and demonstrate the technique/s of monitoring artifacts both visually and electrographically when possible
  - Eye monitors (electroocculogram)
  - Infraorbital eye leads and lateral eye leads (outer canthus) for lateral movements
- Describe the role that CMR (Common Mode Rejection) plays in the presence or elimination of artifact and the antenna like properties of electrodes
- Explain the importance of keeping the instrument clean
- Describe the role calibration plays in digital EEG instrumentation
• List the basic approaches to troubleshooting problems and compile a “Troubleshooting List”
• Perform at least initial trouble shooting exercises so that the problem can be described and somewhat isolated
• Identify when to consult the instrument manual and/or more experienced technical personnel either within your facility or at the manufacturer’s technical support center.

This is a self-paced course and is open for registration at any time. The course contains an 85 page text document on artifact recognition and a 30 page text document on troubleshooting, both available for viewing online or download. Forty EEG samples are included in an assignment to identify as normal or abnormal, identify any artifact content, and classify the pattern by identifying it. Also there are seven articles included for download, including topics such as EKG, eye movement artifact and monitoring, the importance of impedance, artifacts in ICU, resuscitation artifacts during CPR, and cell phone artifacts. It is also recommended that participants also purchase the ASET reprint book, "EEG Artifacts" which contains eleven articles addressing artifacts in EEG, eight of which are not included in the course. The EEG artifact reprint book can be purchased through the ASET website: www.aset.org, click "Education", then "Educational Products" then "EEG". The EEG Artifact reprint book was revised in May of 2008. The course contains two exams and an assignment. Twenty ACE credits are awarded on successful completion of the course. This is a Level II course, for technologists who have completed EEG 101-107 or for qualified/credentialed technologists seeking continuing education. This course gives instruction in the higher skills of recognizing artifacts within the EEG recording, identifying and monitoring artifacts, and troubleshooting technical problems. Successful completion of this course awards 20 ACE credits.

Quizzes
Artifact Recognition 10%
Reading Assignments 10%
Troubleshooting 10%
Practice Exam Review no credit
Final Exam 70%

Outcomes: NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

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Section III: Recording Principles
The EEG technologist customizes the recording procedure by:
- applying additional electrodes and adjusting montage, if needed, to localize abnormal activity
- recording respiration, if appropriate
- recording ECG rhythms.

The EEG technologist differentiates artifacts from cerebral waveforms by:
- recognizing possible artifactual waveforms
- documenting (on the recording) patient movements
- applying electrodes to record eye movements
- replacing electrodes exhibiting questionable activity or contact

Section IV: Knowledge Base Statements
The EEG technologist understands (has a working knowledge of):
- medication effects on the EEG background and waveforms

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES
The following graduate competencies for performing an electroencephalogram (EEG) and additional electroneurodiagnostic procedures, including introductory level Evoked Potential Studies (EP), Polysomnography Studies (PSG), Nerve Conduction Studies (NCS), Intraoperative Neurophysiological Monitoring (IONM), and Long Term Monitoring (LTM) are recommended as standards for the education of post-secondary students in electroneurodiagnostic (END) programs. Employers can expect the graduates of CAAHEP-accredited END programs to be competent in the areas defined below.

I. ELECTROENCEPHALOGRAM (EEG)
K. The graduate differentiates artifacts from cerebral waveforms by:
   1. recognizing possible artifactual waveforms;
   2. documenting (on the recording) patient movements;
   3. applying/recording leads for eye potentials or other physiological potentials (ie. respiration, EMG);
   4. applying/recording leads for ECG;
   5. replacing electrodes exhibiting questionable activity or contact; and
   6. troubleshooting for possible electrical interference.

Reference: National Competency Skill Standards for Performing an Electroencephalogram Page 5 The ASET - The Neurodiagnostic Society, Inc. 402 East Bannister Road, Suite A, Kansas City, MO 64131-3019 816.931.1120 phone 816.931.1145 fax www.aset.org info@aset.org
EEG 109: Epilepsy

Course Goal: This course is designed to provide the skills in recognizing seizures both clinically and electrographically.

Learning Objectives
On successful completion the student will be able to:

Lesson 1 What is Epilepsy?
- Define terms dealing with seizures, seizure classifications, and types of epilepsy
- Recognize commonly used abbreviations in classifications of epilepsy including:
  - ACTH – adrenocorticotropin hormone
  - AED – antiepileptic drug
  - BECTS – benign epilepsy of childhood with centrotemporal spikes
  - CAE – childhood absence epilepsy
  - CPS – complex partial seizure
  - CSWS – continuous spikes and waves during slow-wave sleep
  - FLE – frontal lobe epilepsy
  - GABA – gamma-aminobutyric acid
  - GTCS – generalized tonic clonic seizure
  - HV - hyperventilation
  - IPS – intermittent photic stimulation
  - JME – juvenile myoclonic epilepsy
  - LGS – Lennox-Gastaut Syndrome
  - PGE – primary generalized epilepsy
  - MTLE – mesial temporal lobe epilepsy
  - MTS – mesial temporal sclerosis
  - PNES – psychogenic nonepileptic seizures
  - TIRDA – temporal intermittent rhythmic delta activity
  - TLE – temporal lobe epilepsy
  - VNS – vagal nerve stimulation
- Relate the highlights of the evolution of theories about epilepsy from early recorded time till present day
- Recognize the incidence and prevalence of seizures and epilepsy in the US
- Define epileptogenesis
- Describe the role that technologists play in epilepsy patient advocacy

Lesson 2 Classification of Seizures
- Explain the role of the Epilepsy Foundation
- Explain the International Classification of Seizures and Epilepsies
- Define status epilepticus
- List typical clinical manifestations of the various types of seizures
- Anticipate the expected electrographic patterns see with various seizure types, from the information provided in the patient’s dictated exam and clinical history taken by the technologist at the time of the recording
- Define the difference between ictal, post-ictal and inter-ictal patterns on EEG recordings
- Differentiate focal, lateralized, generalized and initially focal with secondary generalization onsets of epileptiform activity
- Localize epileptiform activity
- Recognize the various patterns of neonatal seizures and the difference in clinical manifestations of seizures in neonates, infants and pediatric patients.
- Define febrile seizures
- Recognize the incidents of SUDEP (Sudden Unexpected Death in Epilepsy Patients)
• Define Psychogenic Nonepileptic Seizures and appropriate compassionate care patients with such events
• Develop through reading, interviews and posted discussion, a sense of what it is like to have epilepsy
• Recognize symptoms of Nonepileptic events such as syncope, transient ischemic attacks (TIAs), ischemic events, hypotension, and heart attacks

Lesson 4 Treatment for Epilepsy
• Identify common Antiepileptic Drugs (AEDs)
• Explain the function of a Vagus Nerve Stimulator
• Outline the Ketogenic Diet
• Recognize the criteria for patients who may benefit from epilepsy surgery and the testing process to help select patients who have potential of benefit

Lesson 5 Seizure First Aid

EEG Show and Tell with Selim Benbadis, MD

EEG Record Review sessions, 1, 2, and 3 with Richard Brenner, MD

Update on Medication Effects and Antiepileptic Drugs by William Tatum, DO

Lesson 6 Introduction to Long Term Monitoring

Quizzes:
Lesson 1 5%
Lesson 2 5%
Lesson 3 5%
Lesson 4 5%
Lesson 5 5%
Lesson 6 5%

Practice Exam 10% of grade
Final Exam 60% of grade

Outcomes: NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

Electroencephalographic (EEG) providers practice in accordance with the facility policy and procedure manual which details every aspect and type of recording.

The American Society of Electroneurodiagnostic Technologists, Inc. presents this document to provide the national criteria for evaluating competencies for technologists performing an electroencephalogram (EEG). These competencies were established following a survey of the membership in the Fall of 1996. The Professional Testing Corporation (PTC) in New York City completed the survey process and provided the analysis. The ASET Board of Trustees approved this document August 11, 1997. This document was updated in the Spring of 2010 according to nationally recognized and accepted criteria and approved by ASET’s Board of Trustees in March 2011.

The elements for quality patient care and interaction as well as basic knowledge and technical performance were considered. The technical components include those defined in the American Clinical Neurophysiology Society (ACNS) 2006 Revisions to the EEG Guidelines published in the Journal of Clinical Neurophysiology, Volume 23, Number 2, April 2006.

Section IV: Knowledge Base Statements
The EEG technologist possesses the knowledge base necessary to correlate patient history and clinical symptoms in order to determine the appropriate electrode application and recording parameters in the following disease processes:

- seizure classification
- stroke
- trauma
- encephalopathy
- altered consciousness.

**Section IV: Knowledge Base Statements**
The EEG technologist understands (has a working knowledge of):

- signs, symptoms, and EEG correlates for adult neurological disorders
- signs, symptoms, and EEG correlates for pediatric neurological disorders
- seizure manifestations, classifications, and EEG correlates
- psychiatric and psychological disorders and EEG correlates.

The EEG technologist maintains and improves knowledge and skills by:

- reviewing EEG records with the electroencephalographer on a regular basis
- reading journal articles
- studying textbooks related to the field
- attending continuing education courses in clinical neurophysiology
- completing online EEG courses
- participating in quality assurance/improvement reviews
- participating in professional organizations for neurodiagnostics
- achieving EEG certification and meeting recertification requirements.

**ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES**
The following graduate competencies for performing an electroencephalogram (EEG) and additional electroneurodiagnostic procedures, including introductory level Evoked Potential Studies (EP), Polysomnography Studies (PSG), Nerve Conduction Studies (NCS), Intraoperative Neurophysiological Monitoring (IONM), and Long Term Monitoring (LTM) are recommended as standards for the education of post-secondary students in electroneurodiagnostic (END) programs. Employers can expect the graduates of CAAHEP-accredited END programs to be competent in the areas defined below.

**I. ELECTROENCEPHALOGRAM (EEG)**

M. The graduate understands (has a working knowledge of):

1. functional neuroanatomy and neurophysiology;
2. medication effects on the EEG background and waveforms;
3. medical terminology and accepted abbreviations;
4. signs, symptoms, and EEG correlates for adult neurological disorders;
5. signs, symptoms, and EEG correlates for pediatric neurological disorders;
6. seizure manifestations, classifications, and EEG correlates;
7. psychiatric and psychological disorders; and
8. other knowledge as detailed in the ABRET Electroencephalographic Technology Practice Analysis.

**Reference:** National Competency Skill Standards for Performing an Electroencephalogram Page 5 The ASET - The Neurodiagnostic Society, Inc. 402 East Bannister Road, Suite A, Kansas City, MO 64131-3019 816.931.1120 phone 816.931.1145 fax www.aset.org info@aset.org


EEG 110: EEG in Neurological Disorders

Course Goals:
The goal of this course is to familiarize neurodiagnostic technologists with the diagnostic process with which physicians evaluate patients with neurological disorders, diagnostic procedures other than EEG, common neurological disorders, signs and symptoms, and EEG patterns commonly associated with neurological disorders and injuries.

Learning Objectives
On successful completion the student will be able to:

Lesson 1
- Describe the difference between signs and symptoms
- Explain differential diagnosis
- Give examples of procedures for testing mental, cranial nerve motor and sensory functions and higher sensory and nerve processes
- Define pathognomonic finding
- List the three steps involved in lab testing
- Contrast prevalence and incidence
- Define sensitivity, specificity and predictive value
- Define positive, negative and false positive and false negative test results
- List and briefly describe test developed to measure brain function from the earliest to the most modern

Lesson 2
- List the common neurological diseases and describe major characteristics of each
- Define the terms epilepsy and seizure
- Describe generalized, convulsive, absence, tonic, clonic, simple partial, and complex partial seizures
- List and describe four types of strokes
- Define Alzheimers disease and describe how it differs from other dementias
- List four categories of microorganisms that can cause neurological problems

Lesson 3
- Explain the difference between "abnormal" and "normal"
- Describe abnormal EEG features
- Correlate EEG abnormalities with clinical conditions and anatomical lesions
- Explain the difference between a physiological test (i.e., EEG) and a structural imaging test (i.e., CT, MRI)
- Describe how the concept of electrical fields reflect the extent of structural damage
- Explain the non-specificity of the EEG as a diagnostic test
- Demonstrate how the EEG can be used as a prognostic (as well as diagnostic) tool
- Recognize and explain the difference between normal changes in EEG patterns and changes caused by abnormal disease processes
- Describe the mechanism responsible for epileptic discharges
- List and explain at least in an abbreviated form the classification of seizure types
- Describe why the EEG sometimes does and sometimes does not reveal underlying disease processes
- List and explain the EEG effects of commonly prescribed medications

Lesson 4 Aphasia

Lesson 5-6 Pattern Recognition

Lesson 7 Updates on Electrocerebral Inactivity (ECI/ECS)

Quizzes
Pattern Recognitions Skills 10%
How Not to Read EEG 10%
ECI/ECS Updates 10%
Practice Exam Review no credit
Final Exam 70%

Outcomes: NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

Electroencephalographic (EEG) providers practice in accordance with the facility policy and procedure manual which details every aspect and type of recording.

The American Society of Electroneurodiagnostic Technologists, Inc. presents this document to provide the national criteria for evaluating competencies for technologists performing an electroencephalogram (EEG). These competencies were established following a survey of the membership in the Fall of 1996. The Professional Testing Corporation (PTC) in New York City completed the survey process and provided the analysis. The ASET Board of Trustees approved this document August 11, 1997. This document was updated in the Spring of 2010 according to nationally recognized and accepted criteria and approved by ASET’s Board of Trustees in March 2011.

The elements for quality patient care and interaction as well as basic knowledge and technical performance were considered. The technical components include those defined in the American Clinical Neurophysiology Society (ACNS) 2006 Revisions to the EEG Guidelines published in the Journal of Clinical Neurophysiology, Volume 23, Number 2, April 2006.

Section IV: Knowledge Base Statements
The EEG technologist understands (has a working knowledge of):
• signs, symptoms, and EEG correlates for adult neurological disorders
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• seizure manifestations, classifications, and EEG correlates
• psychiatric and psychological disorders and EEG correlates.

The EEG technologist possesses the knowledge base necessary to correlate patient history and clinical symptoms in order to determine the appropriate electrode application and recording parameters in the following disease processes:
• seizure classification
• stroke
• trauma
• encephalopathy
• altered consciousness

The EEG technologist maintains and improves knowledge and skills by:
• reviewing EEG records with the electroencephalographer on a regular basis
• reading journal articles
• studying textbooks related to the field
• attending continuing education courses in clinical neurophysiology
• completing online EEG courses
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• participating in professional organizations for neurodiagnostics
• achieving EEG certification and meeting recertification requirements.

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES
The following graduate competencies for performing an electroencephalogram (EEG) and additional electroneurodiagnostic procedures, including introductory level Evoked Potential Studies (EP), Polysomnography Studies (PSG), Nerve Conduction Studies (NCS), Intraoperative Neurophysiological Monitoring (IONM), and Long Term Monitoring (LTM) are recommended as standards for the education of post-secondary students in electroneurodiagnostic (END) programs. Employers can expect the graduates of CAAHEP-accredited END programs to be competent in the areas defined below.

I. ELECTROENCEPHALOGRAM (EEG)
M. The graduate understands (has a working knowledge of):
   1. functional neuroanatomy and neurophysiology;
   2. medication effects on the EEG background and waveforms;
   3. medical terminology and accepted abbreviations;
   4. signs, symptoms, and EEG correlates for adult neurological disorders;
   5. signs, symptoms, and EEG correlates for pediatric neurological disorders;
   6. seizure manifestations, classifications, and EEG correlates;
   7. psychiatric and psychological disorders; and
   8. other knowledge as detailed in the ABRET Electroencephalographic Technology Practice Analysis.

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EEG 111: Pediatric and Neonatal EEG

Course Goals: The goal of this course is to familiarize the technologist with terms used in neonatal and pediatric EEG and provide training in recognition skills for normal and abnormal patterns seen in this group of patients as well is provide technical skills for the challenges in recording quality EEG in the NICU environment, working with neonates and children in the hospital and outpatient neurodiagnostic lab.

Learning Objectives
On successful completion the student will be able to:

Lesson 1 The Normal Waking EEG of a Child
- Identify normal awake patterns in children 3 months to 18 years
  - Identify usefulness of passive eye closure to activate background
  - List the basic milestones which can vary slightly
  - Recognize Occipital reactive rhythm
  - Recognize Posterior Slow Waves of Youth
  - Chart the development of normal awake background rhythms
    - 3 months - 3-4 Hz
    - 6 months - 5 Hz
    - 9-18 months - 6-7 Hz
    - 2 years - 7-8 Hz
    - 7 years - 9 Hz
    - 15 years - 10 Hz+
- Describe activation procedures such as sleep, Photic Stimulation and Hyperventilation
- Recognize Photic driving in infants
- Recognize HV Buildup in children
- Identify normal variants commonly seen in children such as:
  - Lambda
  - Mu Rhythm

Lesson 2 The Normal Sleep of a Child
- Recognize the Normal Sleep EEG of a Child: 3 months to 18 years including:
  - Infant spindles
  - Hypnagogic Hypersynchrony
  - Vertex Sharp Waves
  - 14 and 6 Hz Positive spikes
  - POSTS (Positive Occipital Sharp Transients of Sleep)
- Identify Normal Variants seen in Children during sleep such as:
  - RMTD (Rhythmic Mid-temporal Theta Discharges)
  - 14 and 6 Hz Positive spikes

Lesson 3 The Abnormal Pediatric EEG in Epilepsy
- Recognize the Abnormal Pediatric EEG of Epilepsy such as:
  - Infantile Spasms
  - West’s Syndrome
  - Interictal Hypsarrhythmia
  - Ictal Electrodecremental
  - Lennox-Gastaut Syndrome
  - Developmental delay and multiple seizure types
  - Bursts of slow spike and wave
  - Absence Seizure
  - Hyperventilation activation
  - Generalized high voltage 3/sec spike and wave
  - Benign Juvenile Myoclonic Epilepsy
• Sleep deprivation activation
• Brief run of generalized spikes/polyspikes and myoclonic jerks
• Benign Rolandoic Epilepsy
• Focal central-temporal spike unilaterally or bilaterally
• Benign Occipital Epilepsy
• Runs of 3 Hz occipital spikes and wave, bilateral or unilateral

Lesson 4 Abnormal Pediatric EEG in Neurological Disorders
• Recognize the abnormal pediatric EEG in pediatric and neonatal patients with neurological disorders associated with different types of pathologies such as:
  ◦ Cerebrovascular
  ◦ Traumatic
  ◦ Infectious
  ◦ Metabolic
  ◦ Neoplastic
  ◦ Degenerative/structural
  ◦ Identify symptoms and patterns seen in the following:
    ◦ Neoplastic Disorders - mass lesions in the brain
    ◦ Cerebrovascular Disorders
    ◦ Moya Moya Disease
    ◦ Alternating Hemiplegia
    ◦ Breath-Holding and Syncope
    ◦ Traumatic Disorders
    ◦ Postnatal trauma
    ◦ Childhood head traumas
    ◦ Contre-coupe
    ◦ Infections of the Central Nervous System
    ◦ Meningitis and Encephalitis
    ◦ Congenital Herpes Encephalitis
    ◦ Congenital Cytomegalic Virus
    ◦ Congenital toxoplasmosis
    ◦ Rasmussens Encephalitis
    ◦ Metabolic Disorders
    ◦ Mitochondrial Disease
    ◦ MELAS
    ◦ Pryadoxine Deficiency
    ◦ Structural Disorders
    ◦ Agenesis of the Corpus Callosum
    ◦ Tuberous Sclerosis
    ◦ Most common seizure types in T.S.
    ◦ Infantile Spasms
    ◦ Generalized Tonic
    ◦ Generalized Atonic
    ◦ Atypical Absence
    ◦ Simple and Complex Partial Seizures
• Identify Pediatric Sleep Disorders that resemble seizures
  ◦ Parasomnias
  ◦ Night terrors
  ◦ Sleep walking
• Lesson 5 How to work with Pediatric Patients
• Recognize the elements and usefulness of pediatric age appropriate care such as:
  ◦ Identify the needs for age appropriate care
  ◦ Acknowledge the JCAHO requirement to provide age appropriate care
  ◦ Acknowledge the improvement it provides in care for patients and improved work experience for staff
• Identify the ages/stages of development with best practices for technologists:
  ◦ Infant: Birth to 1 year “Trust vs. Mistrust”
  ◦ Toddler 1-3 years “Autonomy vs. Shame and Doubt”
  ◦ Pre-school 4-7 years “Initiative vs. Guilt”
  ◦ School age 8-12 years “Industry vs. Inferiority”
  ◦ Adolescence 13 to 18 years “Identity vs. Role Confusion”
  ◦ List items in a “Fun Box” to help make patients feel comfortable

• Describe the importance of “language” used with patients

• Describe behavioral distraction techniques

• Describe the use of visual objects to distract the patient

• Describe ways to make HV fun

• Recognize measures that add to patient comfort

• Make use of techniques to divert attention

Lesson 6 Pediatric EEG by Michael Goodman, MD

• Recognize definitions of terms used in Pediatric Epilepsy such as:
  ◦ Seizure
  ◦ Epilepsy
  ◦ Pervalence
  ◦ Etiology
  ◦ Symptomatic
  ◦ Ideopathic

• Recognize diagnostic symptoms of pediatric epileptic patients such as:
  ◦ Description by witness and patient
  ◦ Physical and neurologic exam
  ◦ EEG (Routine w/HV & Photic, Sleep deprived, Ambulatory, LTM)
  ◦ Anatomic studies such as CT, MRI, SPECT, PET, fMRI
  ◦ Identify the classification of pediatric seizures and syndromes including:
    ◦ Partial vs Generalized
    ◦ Simple Partial
    ◦ Focal motor or sensory seizures
    ◦ Complex Partial
    ◦ Temporal lobe seizures
    ◦ (formerly: Psychomotor seizures)
    ◦ Secondarily generalized
    ◦ Generalized Seizures
    ◦ Absence
    ◦ Clonic
    ◦ Tonic (Tonic-Clonic)
    ◦ Myoclonic
    ◦ Atonic

• Recognize Pediatric Epilepsy Syndromes such as:
  ◦ Infantile Spasms - West’s Syndrome
  ◦ Dravet Syndrome - Severe Myoclonic Epilepsy of Infancy
  ◦ Lennox-Gastaut Syndrome
  ◦ Childhood & Juvenile Absence Epilepsy
  ◦ Benign Focal Epilepsy with Centroteemporal Spikes
  ◦ Benign Focal Epilepsy with Occipital Spikes
  ◦ Acquired Epileptic Aphasia (Landau-Kleffner Syndrome)
  ◦ Juvenile Myoclonic Epilepsy
  ◦ Epilepsia Partialis Continua
  ◦ Recognize treatment options for pediatric patients
  ◦ Anticonvulsant Medication
  ◦ Conditions associated with refractory epilepsy
  ◦ Ketogenic Diet
Vagus Nerve Stimulation
Surgery

Mid Term Exam

Lesson 8 Introduction to Neonatal EEG: Terminology and Conditions of the Nursery
- Define Terminology:
  - Gestational and Conceptional Age
  - Perinatal period, Premature, Term and Post term Infant
  - SGA and LGA
  - Apgar Score
  - Apneas and Bradycardias
  - Reflux
  - High Risk Infant

Lesson 9 Techniques of Neonatal EEG
- Recognize the need for planning in the NICU environment
- Identify elements of taking a history and calculating age
- Identify techniques for lead placement
- Recognize usefulness of various polygraphic monitors
- Identify neonatal specific recording techniques
- Recognize typical EEG findings (Preemie to term)
- Identify common abnormal neonatal EEG findings

Lesson 10 The Normal EEG of the Neonate
- Identify the Normal EEG of a Neonate including the following patterns:
  - Active Sleep
  - Quiet Sleep
  - Trace Discontinu (TD) (24-29 weeks conceptional age)
  - Trace Alternant (TA) (30-34 weeks conceptional age)
  - Delta Brush
  - Describe the following Normal Patterns at full term:
    - Normal awake
    - Normal sleep
- Recognize the following characteristics:
  - Amplitude
  - Continuity
  - Frequency
  - Symmetry
  - Synchrony
  - Sleep-state transitions
  - Maturation patterns
  - Paroxysmal patterns
  - Differentiate Normal vs. Discontinuous Patterns
  - Recognize Multifocal Sharp Transients

Lesson 11 Abnormal Neonatal Findings

Review of Neonatal EEG (Article by Aatif Husain, MD)
- Identify specific neonatal best practices for:
  - Neonatal Montages
  - Recording Time
  - Notations
- List elements of evaluation of Neonatal EEG Patterns such as:
  - Continuity
  - Bilateral Synchrony
  - Symmetry
  - Trace Discontinu
  - Trace Alternant
  - Continuous Slow Wave Sleep
- Activite Moyenne (low voltage irregular pattern)
- Sleep Spindles
- Delta Brushes
- Monomorphic Occipital Delta Activity
- Rhythmic Occipital Theta Activity
- Rhythmic Temporal Theta Activity
- Centrotemporal Delta Activity
- Anterior Slow Dysrhythmia
- Encoches Frontales
- Focal Sharp Waves

- Recognize EEG Patterns present at various conceptional ages:
  - Less than 29 weeks CA
  - 30-32 weeks CA
  - 33-34 weeks CA
  - 35-36 weeks CA
  - 37-40 weeks CA
  - 41-44 weeks CA
  - 44-48 weeks CA

- Recognize abnormal patterns in neonates such as:
  - Burst-Suppression
  - Low Voltage
  - Excessive Discontinuity
  - Depressed and Undifferentiated Background
  - Abnormal Asymmetry or Asynchrony
  - Abnormalities of Maturation
  - Abnormal Sharp waves and spikes
  - Neonatal Seizures

**Neonatal Seizures**

*Article by Gregory Holmes, MD, and Lewis Kull, R. EEG/EP T., CLTM, MS.*

- Recognize the clinical manifestations of neonatal seizures including:
  - Subtle manifestations
  - Tonic seizures
  - Clonic seizures
  - Myoclonic seizures

- List various etiology of neonatal seizure disorders such as:
  - Asphyxia
  - Hypocalcemia
  - Hypoglycemia
  - Hyponatremia/Hypernatremia
  - Intracranial hemorrhages
  - Infection
  - Congenital CNS malformations
  - Inborn errors of metabolism
  - Drug withdrawal
  - Local anesthetic intoxication
  - Identify neonatal epilepsy syndromes
  - Benign Familial Neonatal Seizures (BFNS)
  - Benign Idiopathic Neonatal Seizures (BINS)
  - Differential diagnosis and evaluation

- Identify the usefulness of Electroencephalography (EEG) in identifying:
  - Interictal abnormalities
  - Ictal discharges
Multifocal patterns
- Pseudo-alpha pattern
- Prognostic implications of the neonatal EEG and treatments

Neonatal EEG Exam

Case Studies in Pediatric Classification of Seizures by Cale Wilcox, R.EEG T., CLTM
Classification of Seizures and Pediatric Syndromes by Susan Arnold, MD

Quizzes
Mid Term  30%
Neonatal exam  10%
Practice exam  10%
Final exam   50%

Outcomes:

NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING AN ELECTROENCEPHALOGRAM

Electroencephalographic (EEG) providers practice in accordance with the facility policy and procedure manual which details every aspect and type of recording.

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Section IV: Knowledge Base Statements
The EEG technologist understands (has a working knowledge of):
- signs, symptoms, and EEG correlates for pediatric neurological disorders

The EEG technologist understands and follows technical criteria for
- recording neonatal EEG
- recording pediatric EEG.

ELECTRONEURODIAGNOSTIC PROGRAM GRADUATE COMPETENCIES
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I. ELECTROENCEPHALOGRAM (EEG)

C. The graduate evaluates the patient to:
1. determine the patient’s mental age, mental state, and comprehension level;
2. note the patient’s overall physical condition;
3. decide appropriate method of electrode application;
4. ascertain the patient's capacity to cooperate with activation procedures;
5. determine if hyperventilation is contraindicated;
6. accommodate for disabilities or special needs;
7. determine the need for additional physiological monitors;
8. document unusual or inappropriate behavior suggestive of seizure or other

M. The graduate understands (has a working knowledge of):
1. functional neuroanatomy and neurophysiology;
2. medication effects on the EEG background and waveforms;
3. medical terminology and accepted abbreviations;
4. signs, symptoms, and EEG correlates for adult neurological disorders;
5. signs, symptoms, and EEG correlates for pediatric neurological disorders;
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Course Goal

This course is intended to help the learner prepare to take the credentialing exam (successful completion of this course does not guarantee the learner will pass the credentialing exam). Extensive study is required to prepare for the ABRET EEG Registry Exam, and the learner should set aside several hours a week for six months to one year to adequately prepare for the exam. The questions (500 study questions with the answer sheet and 1500+ in a database for practice exams) and review material (20 handouts) included in this course will help guide the learner in the appropriate areas of study, and the questions in this review fall under the general topic outline of subjects covered in the credentialing exam. Passing the credentialing exam requires the development of a knowledge base of EEG Technology as well as the development of critical thinking skills and pattern recognition skills. A credentialed supervisor, tutor, or mentor can help greatly in the preparation of a technologist for credentialing exams, and such a person, or an ACNS certified electroencephalographer should be sought and their help enlisted if at all possible.

IMPORTANT NOTE: Purchase of this course is for a limited period. The course begins a one year timer when the purchase is processed.

It contains over 1500 review questions and 3 phases of interactive practice exams, which allows the learner to simulate a timed 250-questions exam in preparation for taking the credentialing exam. Also included are study aids and guides to help study and prepare for the credentialing exam. From the time of the first log on, the participants will have 365 days of access to the questions. Study material is in the form of PDF downloads which can be printed or kept on a computer desktop for study. No credit is given since there is no final grade and no new material is introduced. This is a board preparation review tool, and practice exam and should be used as a self awareness tool to help the learner define weaknesses in understanding. During the practice exam, the learner should make note of the questions that are difficult or challenging, and use this information to focus his or her study in preparation for the board exam.

Review Materials

Exam Information:
- Exam tips
- Information for Candidates for the written exam
- Oral Exam Tips
- Mock Oral Questions
- Record Review Exam Tips

Terminology Review:
- EEG Terminology
- PLED Terms

Mathematics for EEG Technologists
- Math Basics for Neurodiagnostic Technologists

How to Check Measurements Like the Examiners Will
- Head Measurement Check Sheet
Neuroanatomy Study Guide
- Neuroanatomy Study Guide
- Test Your Knowledge of the CNS

Electrical Safety
- Electrode Injury Part 1, 2, and 3

Infection Control and ACNS Guidelines
- Infection Control
- American Clinical Neurophysiology Society Guidelines in EEG

Technical Tips
- Eye Monitors
- Impedance/Digital EEG
- Polarity and Localization
- Calculating Frequency and Duration in Digital EEG
- Re-montaging
- Laplacian Montage
- Static Electricity
- Artifacts
- Instrumentation Worksheet

Review Materials
- What is Normal?
- Normal Variants
- EKG
- Periodic Patterns
- EEG in Encephalopathy and Coma
- Recording Death during EEG
- Drug Affects in EEG
- Quality Assurance in Determination of Brain Death
- Semiology: Witness to a Seizure - What to note and report
- Burst-Suppression
- Triphasic Waves
- EEG in the Differential Diagnosis of Adults with Acute Alterations of Mental Status
- Waveform Window
- Reflex Epilepsy

Review Questions (500+) for download with answer sheet

EEG Illustrations for Study

Practice Exam:
Phase 1 - A total of 508 Questions from the Review Questions study sheet in an untimed online exam

Phase 2 - From the same set of questions above, a timed exam of 250 randomly selected questions

Phase 3 - Added to the questions above are another 1000+ questions from the final exams of the EEG courses EEG 101-111 and some from webinars on EEG topics. This exam is weighted (predefined numbers of questions on specific topics) so there will always be a similar percentage of questions from topics addressed in the courses. It will take the participant several attempts to view all the questions in the
database. The answers are not given in this phase of the practice exam but upon completion the participant can re-enter the exam and see which questions were incorrect. This can be accessed by clicking the “Grades” and then the exam from the list of course exams, then clicking the exam grade. This re-opens the exam for viewing the correct, incorrect and partially correct questions.

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