

Objectives

- Introduction
- Brief Overview with Statistics
- Anatomy and Physiology of Head Injury
- Assessment
- Common TBI, Skull Fractures, Facial Fractures

What Is A Traumatic Brian Injury?

- “... a nondegenerative, noncongenital insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairments of cognitive, physical and psychosocial functions with an associated diminished or altered state of consciousness”

- Traumatic Brain Injury (TBI)
 - Accounts for 51.6% of mortality amongst trauma patients
- Majority (75 to 90%) recover quickly
 - “Mild” = 90%
- 10 to 25% have long-term deficit
- 2% of Americans living with TBI-related disabilities
 - (313.9 Million x .02 =6.3 Million) 2012 census
- The ‘Hidden’ TBI patient
 - Emotional distress/cognitive issues

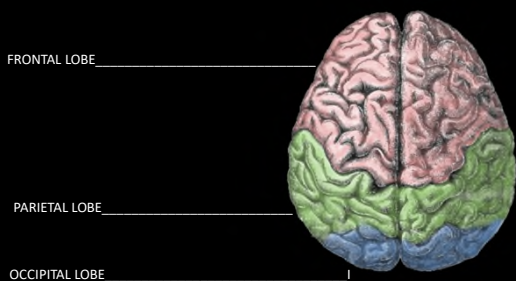


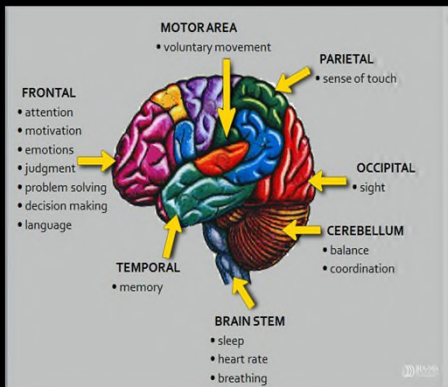
- ### Risk Groups
- Males are more likely to incur TBI compared to females. (3.4:1)
 - GSW 6:1
 - MVC 2.4:1
 - Highest rate of injury: 15-24 years old.
 - Also at higher risk:
 - Children <5 years old
 - Elderly > 75 years old

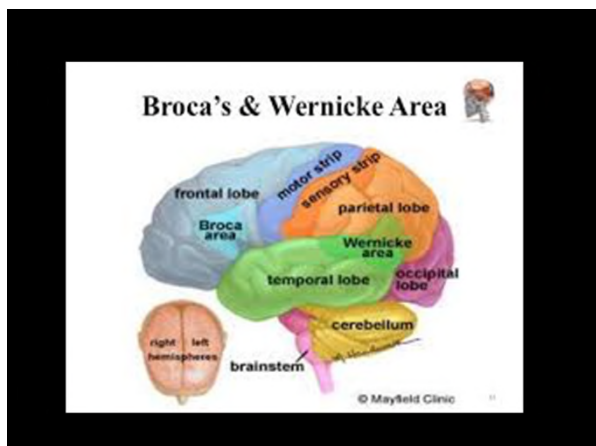
Mechanisms

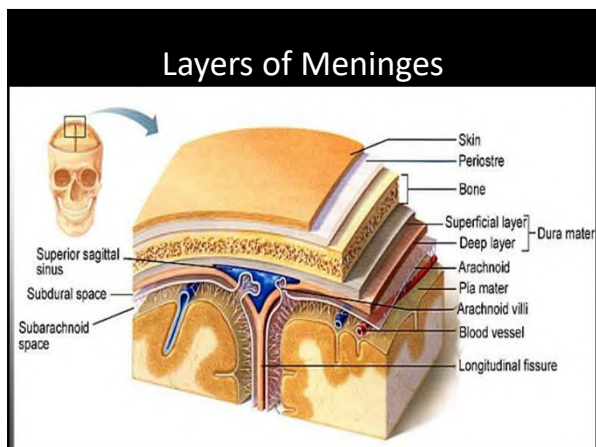
- Leading causes of TBI:
 - Falls: 35%
 - Half of children (<14 yrs) eval in ED
 - Two-thirds >65y
 - MVC: 17%
 - Leading cause of TBI-death (32%)
 - Struck (auto-ped): 17%
 - Assault: 10%

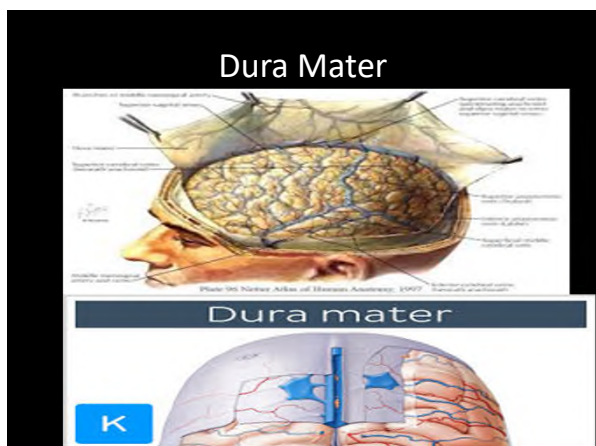
Anatomy







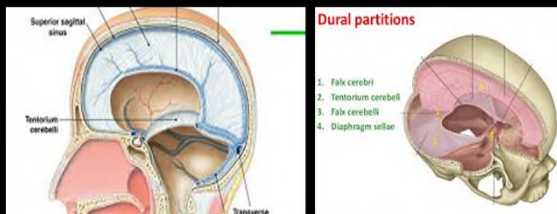




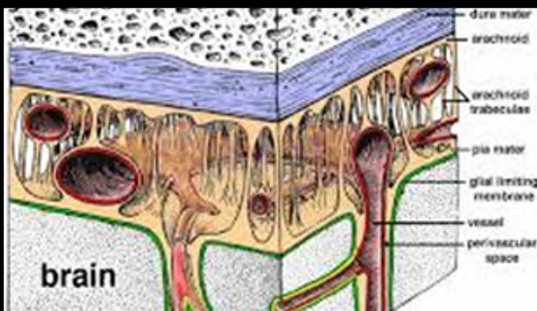
Dura Mater

- Dual Layer
 - Outer layer Adheres to the skull lining (very tough membrane)
 - Epidural Space is Potential Space Between the Skull and the Dura Mater
 - Inner layer Divides the cranial vault into two areas, separating the upper brain and the lower brain through the “Tentorium Incisura” via the “Uncus”
 - Subdural Space is Potential Space Between Dura Mater and the Arachnoid

Tentorium Partitions

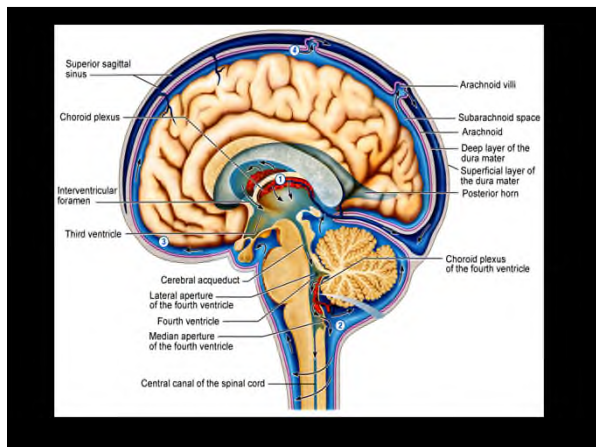


Arachnoid Mater



SUB ARACHNOID SPACE

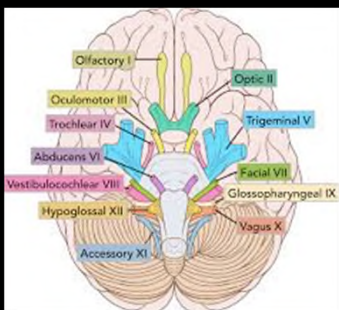
- Potential Space Between Arachnoid Mater and Pia Mater
- Vascular Area with CSF Located Here
- CSF is Made in the Choroid Plexus and Reabsorbed in the Arachnoid Villa
 - 600-700cc of CSF Produced Each Day
 - Rate of 0.2-0.7cc/min
 - This is enough to Cycle CSF 3x per Day



Cranial Pia Mater

- Innermost Layer of the Meninges Enveloping Brain
 - Delicate Membrane
 - Impermeable to Fluid
 - Blood Vessels Pass through and Nourish the Brain
 - Irritation Causes Inflammation (Meningitis)

Cranial Nerves



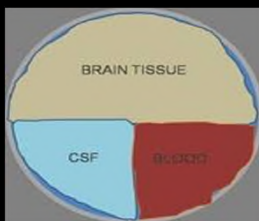
Cranial nerves

<i>Number</i>	<i>Name</i>	<i>Function</i>
I	olfactory	smell
II	optic	Sight
III	oculomotor	moves eye, pupil
IV	trochlear	moves eye
V	trigeminal	face sensation
VI	abducens	moves eye
VII	facial	moves face, salivate
VIII	vestibulocochlear	hearing, balance
IX	glossopharyngeal	taste, swallow
X	vagus	heart rate, digestion
XI	accessory	moves head
XII	hypoglossal	moves tongue

Cerebral Perfusion Pressure

- Normal Pressure inside the Cranial Vault
 - Normal Goal is >60mmHG
 - MAP-ICP=CPP

- Monroe Kelli Doctrine
 - States the Cranial Vault is
 - 80% Brain Matter
 - 10% Blood
 - 10% CSF



Any Change to the Given Percentages Always Causes A Rise in ICP

Cerebral Blood Flow

- Brain Uses Approx 15% of Ejection Fraction
- 750 ml/min
- Venules and Arterioles Dialate and Constrict to Maintain CBF and Therefore CPP
- Cerebral Blood Flow Ceases at a MAP of 20mmHg

Intracranial Pressure (ICP)

- Normally 0-10mmHg
- Increased ICP is Anything over 15mmHg

Causes of ICP Elevation

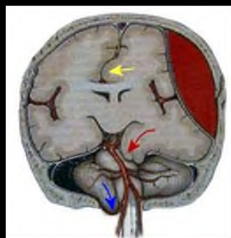
- Mass Effect
- Generalized Brain Swelling
 - Encephalopathy, Liver Failure, Hypercarbia
 - Any ischemic-anoxia states
- Elevated Venous Pressure
 - Heart Failure, Pulmonary HTN, Jugular Stenosis Etc
- Obstruction of CSF Flow/Reabsorbtion
 - Hydrocephalus

Signs and Symptoms of Elevated ICP

- #1 is a Change in LOC
- Change in Pupil Size and Reaction
- Abnormal Motor Response
- Increased Muscle Tone
- Abnormal Respirations
- Vision Changes
- Drop in GCS

Signs and Symptoms of Herniation

- Types of Brain Herniation
 - Transtentorial Herniation
 - Supratentorial herniation
 - Infratentorial herniation
 - Uncal herniation
 - Foramen Magnum herniation

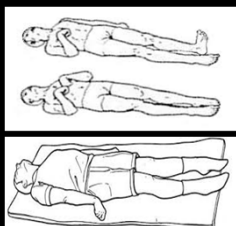


Cushings Triad

- Hypertension-
 - Body Attempts to Send More Blood to Brain to Reverse Hypoxia
- Bradycardia
 - Compression the Vagus Nerve
- Respiratory Changes
 - Compression of the Medulla Oblangata
 - Cheynne Stokes

Motor Signs of Herniation

- Decorticate Posturing
 - Supratentorial Damage
- Decerebrate Posturing
 - Infratentorial with Compression of Thalamus And Brainstem
- Loss of Babinski Reflex



Treatment of Elevated ICP

- Goals: Maintain CPP #1
 - Reduce Ischemia and Focal Brain Compression
- Management
 - Maintain Midline Neutral Head Positioning
 - Head of Bed 15-45 Degrees
 - Limit Suctioning, Gagging, STRAINING*
 - Limit Noxious Stimuli- Ear Plugs, Dim Lights, Etc
 - Watch Atmospheric Pressure Changes

- Maintain Euvolemia
 - Carefully Monitor I/O Ratios if Foley in Place
 - Maintain Electrolytes Balance (Labwork)

Prehospital

- Fault on initial aggressive fluid administration
- A Dry Shocky Head Injury Will do Poorly
- 200% Rise in Morbidity/Mortality with Just 1 Episode of Hypotension

Pharmacology

- Sedation
 - Benzodiazepines
 - Propofol
 - Please Sedate Agitation!
- Analgesia
 - Fentanyl
 - Don't Forget Ketamine!!



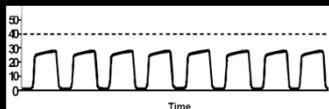
Pharm Continued

- Anticonvulsant Therapy for Seizure
- Monitor Glucose Carefully and Administer
 - D-10 infusion/D-50 bolus to correct

Systemic Approach to Herniation Prehospital to ICU

1. Intubate & Slightly Hyperventilate

1. Hyperventilation to Maintain CO₂ Levels at 27-32 mmHg ETCO₂ to Prevent Vasodilation
 - PACO₂ of 32-35 (Gradient Correction 3-5)



What Happens To Cerebral Vasculature in Hypoventilation?

- Injured Area is Vasodilated and Vasculature is Unresponsive
 - Body Trying to Maximize Oxygenated Blood

- Uninjured Area is Vasoconstricted
 - Body Trying to Push Blood into Injured Area

- Hypoventilation Causes Uninjured Vasodilation-Stealing

- Robin Hood Effect (Reverse Steal)
 - Slight Hyperventilation keeps uninjured Vasoconstriction, and increases CPP to injured Area

3. Assure Adequate O₂ Delivery
 - 100% on NRB/BVM - Let Neuro Sort Em Out
 - Don't Worry About Free Radicals Etc

4. Assure Adequate Fluid Resuscitation First
 - Then Mannitol- Preferred in ICP
 - Hypertonic Saline

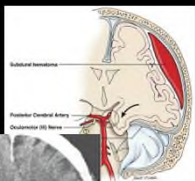
5. Barbituate Coma
 - Thiopental
 - Phenobarbital

6. Surgical Decompression

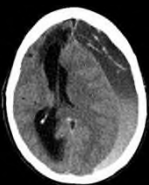
7. Placement of Camino, IVM, Drain, Shunt Etc.

Subdural Hematoma

- Blood Between the Dura and Arachnoid Membrane
 - Usually Venous in Nature
 - High Morbidity and Mortality
 - Elderly- Larger & More Chronic
 - Brain Atrophy=Larger Space
 - Children- Rapidly Acute

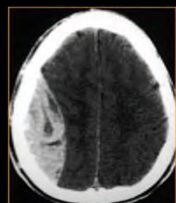


- 3 Types of SDH
 - Acute
 - Symptomatic W/ 24 Hrs.
 - Subacute
 - Symptomatic W/ 2-10 Days
 - Chronic
 - Symptomatic in > 2 Weeks
- ACUTE ON CHRONIC =>



Epidural Hematoma


- Bleeding Between the Skull and the Dura Mater
 - High Pressure Arterial Bleed
 - High Potential Of Middle Meningeal Artery Rupture



- Most Common Cause of Uncal Herniation
- Typical Symptomology
 - Insult Followed by Loss of Consciousness
 - Lucid Period (Lucid Interval)
 - Deteriorization (Decline of GCS, Death)
- Signs and Symptoms of Uncal Herniation
 - Ipsilateral Pupil Dilation
 - Contralateral Neuro Deficits and Posturing

Subarachnoid Hemorrhage

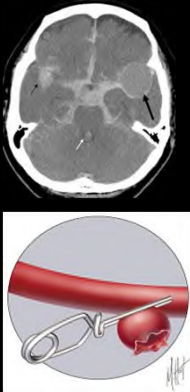
- Bleeding Between the Arachnoid Membrane and the Pia Mater
- #1 Cause is Trauma
- #2 Cause is a Berri Aneurysm Secondary to HTN
- “Worst Headache of my Life”

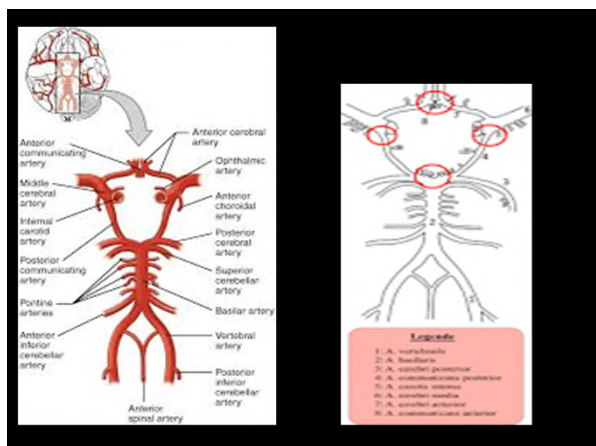


- Nausea
- Vomiting
- Stiff Neck
- Vision Disturbances
- ALOC

Sound Familiar?

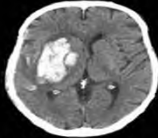
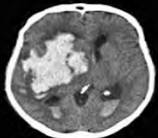
Do Not Lumbar Puncture!!





Intracerebral Hematoma

- Hemorrhage in the Brain Parenchyma
- Produced From Shearing and Tensile Forces

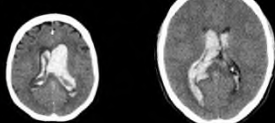
2.0 hours after onset
6.5 hours after onset

- Frequently Occur in Frontal and Temporal Lobes in White Matter

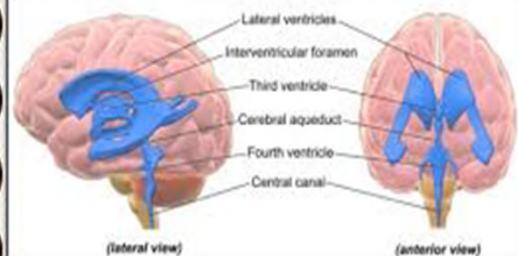
- Twice as Likely for Death and Permanent Disability than Other Head Injury
- Secondary Damage Occurs
 - Cerebral Edema
 - Ischemia
- 80 ml Blood in Hematoma Expansion Considered Fatal

Intraventricular Hemorrhage

- Bleeding into Ventricles as a Result of Severe Brain Trauma
- IVH Occurs in 40% of ICH
- Mortality Rate of ICH with IVH 50-70%
- 20 ML of Blood is Considered "Lethal Volume"
- Long Term Disability



BASIC ANATOMY OF VENTRICULAR SYSTEM



Types of Intraventricular Monitoring

- Intraventricular Catheter
 - Most Accurate
 - CSF/Blood can be Drained from Ventricle
- Subdural Screw (Camino)
 - Quick
 - Not as Invasive as IVC
- Epidural Sensor
 - Least Invasive
 - No Access to CSF

Concussions

- 3 Classification
 - Mild
 - Moderate
 - Diffuse Axonal Injury

- Mechanism-Coup Contra Coup



Mild Concussion

- Result of Roatational Force
 - Lateral of Axis Head Strike
 - NFL-Sports Injures
- * No Loss of Consciousness
- Reversible w/o Persistent Sequele
- Retrograde Amnesia for Short Duration
- Grade 1 Concussion

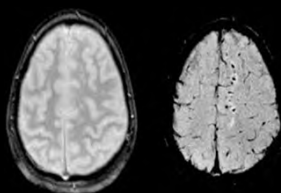
Classic (Moderate) Concussion

- Result of Rotational or Direct Force
 - Possible Loss of Consciousness
 - NOT Diagnostic!!
- Reversible with Memory and Processing Information Problems
- S/S Brief Loss of Consciousness (or None), Retrograde Amnesia, Post Traumatic Amnesia
 - Duration of Amnesia is Directly Related to Severity of Concussion
- Moderate Covers Grade 2-3 Concussion
 - Grade 3 starts with +LOC

Diffuse Axonal Injury (DIA)

- Diffuse Shearing Injury
- Most Common, Devastating, Severe Brain Trauma
- Initially Presents as Coma
- 90% of Pts Never Regain Consciousness
- Irreversible w/ Profound Neuro, Psych, & Personality Changes/Deficits if Recovery Occurs

- Rapid Acceleration or Deceleration Injury
 - MVA
 - Falls
 - Assault
 - Shaken Baby Syndrome
- MRI over CT
 - Secondary Injury
 - Takes Longer to Show on CT

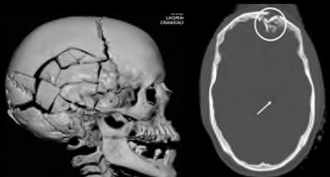


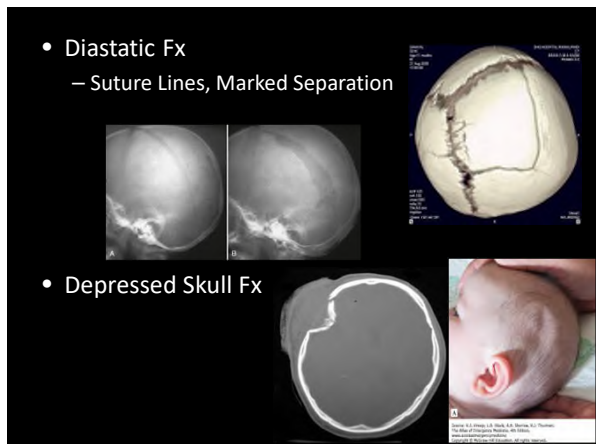
Skull Fracture

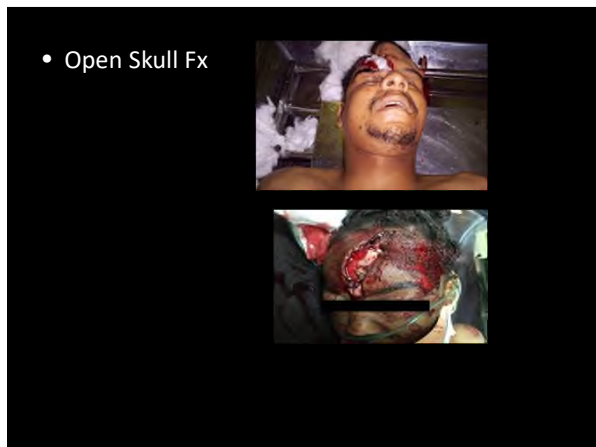
- Linear Fx

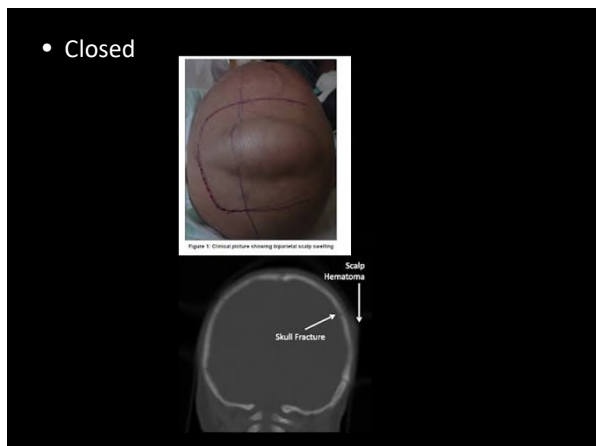


- Linear Stellate Fx

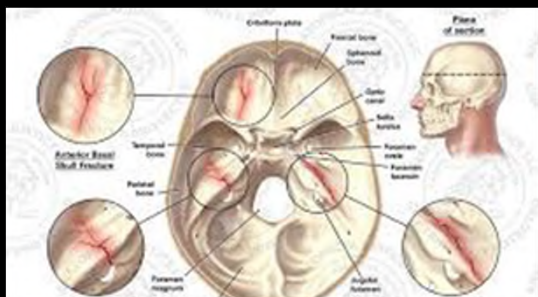








Basilar Skull Fx



- Fx involving Temporal Bone, Occipital Bone, Sphenoid Bone, and or Ethmoid Bone
- Rare, 4% of Severe Head Injury
- These Injuries Generally Cause Small Tears in the Surrounding Brain Causing Leakage of Blood and CSF

- Signs and Symptoms
 - Battles Sign (Retroauricular Ecchymosis)



- Periorbital Ecchymosis (Raccoon Eyes)



- Otorrhea



- Rhinorrhea



*Check Halo Test and Glucose

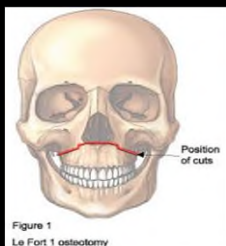
Skull Fx Complications

- Intercranial Infections
 - Meningitis Common
- Hematomas
- Meningeal & Brain Tissue Damage
- Pneumocephalus
- Associated Nerve Damage and Palsies

Maxillo-Facial Injuries

- 3 Classifications (Le Fort Fx)

- Le Fort I



- Le Fort II
– Pyramid Fx



- Le Fort III
– Trigeminal
Nerve Path Exits
@ Fx Point
Causing Trismus



- Secure Airway
- Avoid Accessing Nasal Cavity



- ANY QUESTIONS???
