



*PROGRAM EXECUTIVE OFFICE FOR
SIMULATION, TRAINING & INSTRUMENTATION*

Medical Simulation: Another Scientific Revolution

ROGER SMITH
Chief Technology Officer
US Army PEO STRI
<http://www.peostri.army.mil/CTO>

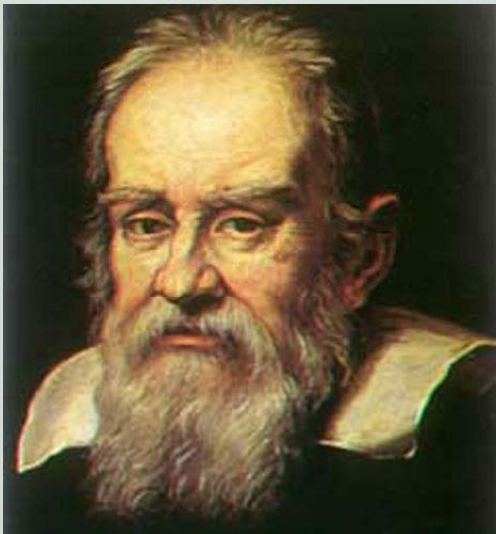
Approved for Public Release.
Security and OPSEC Review Completed: No Issues.





Scientific Evolution (Normal Phase)

“If I have seen further it is only by standing on the shoulders of giants.”
– Isaac Newton



Galileo, 1632
Dynamics

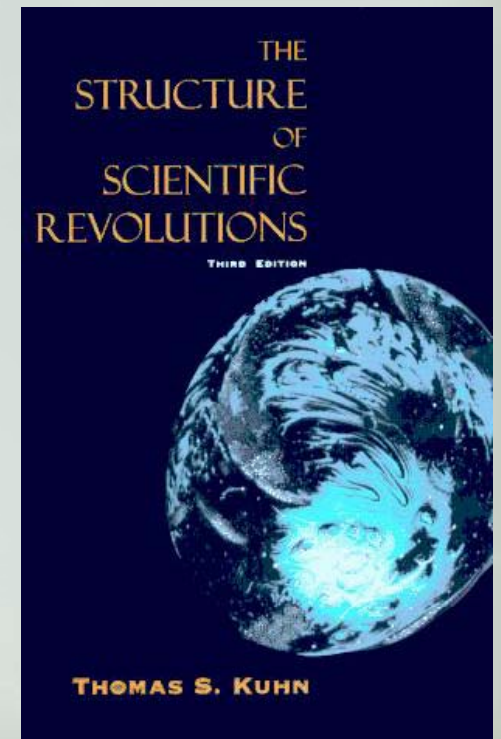
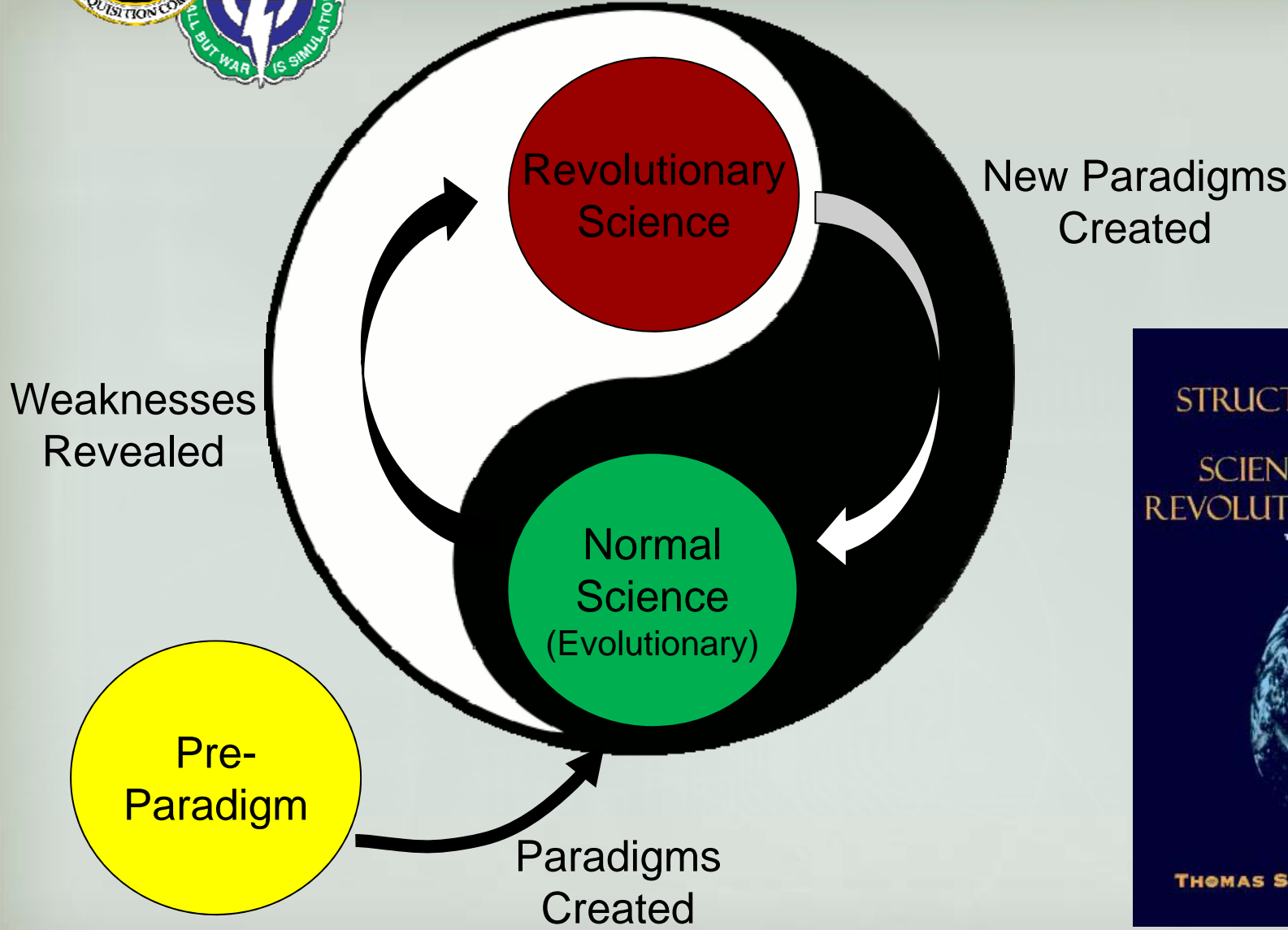


Kepler, 1630
Planetary Motion



Newton, 1687
Newtonian Mechanics

Kuhn's Scientific Revolution





Scientific Revolution

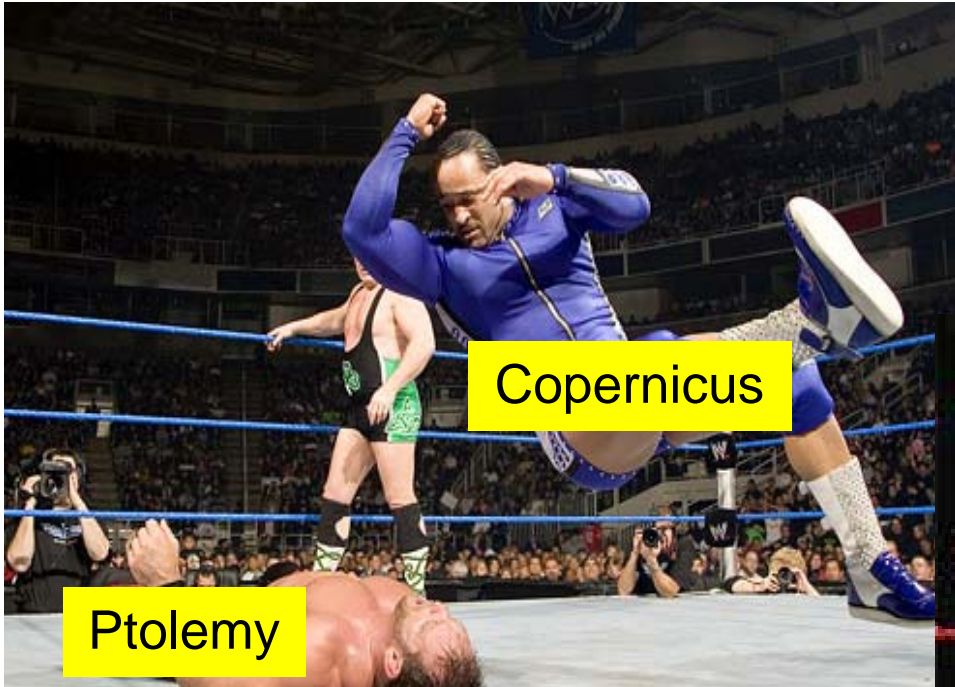


Newton's fixed space



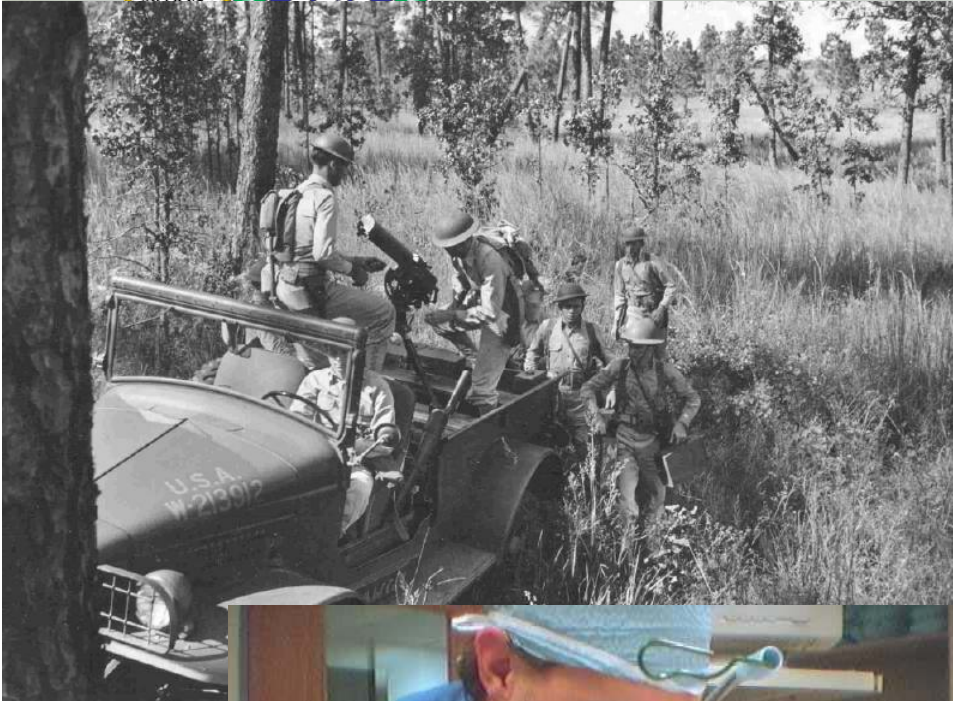
Einstein's flexible space-time

Scientific Smackdown



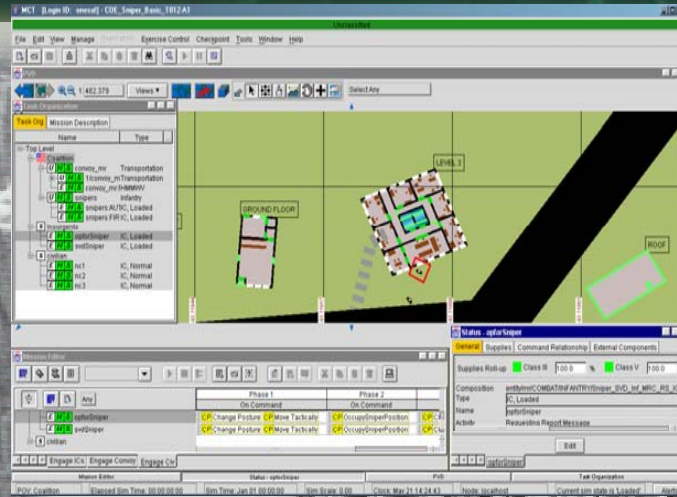


Evolutionary Change



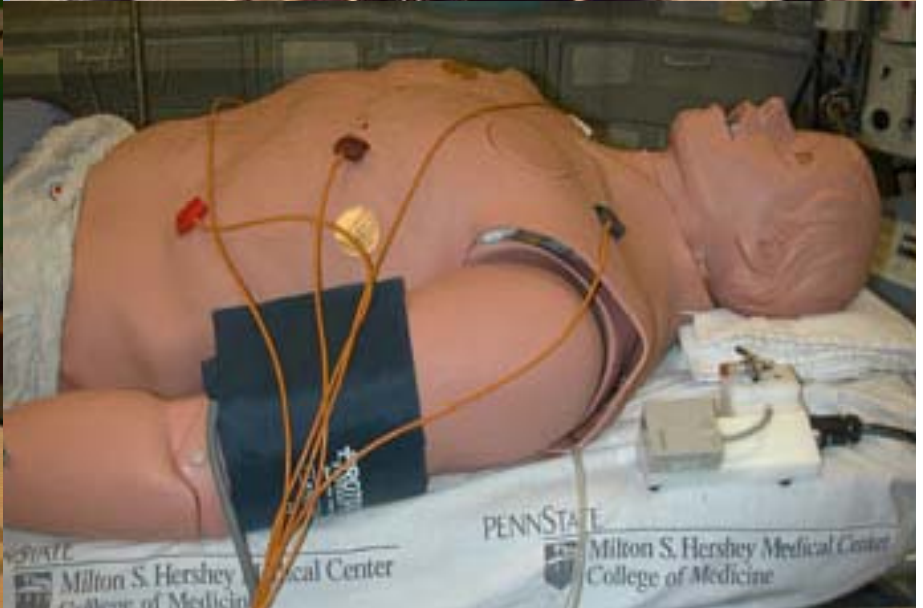
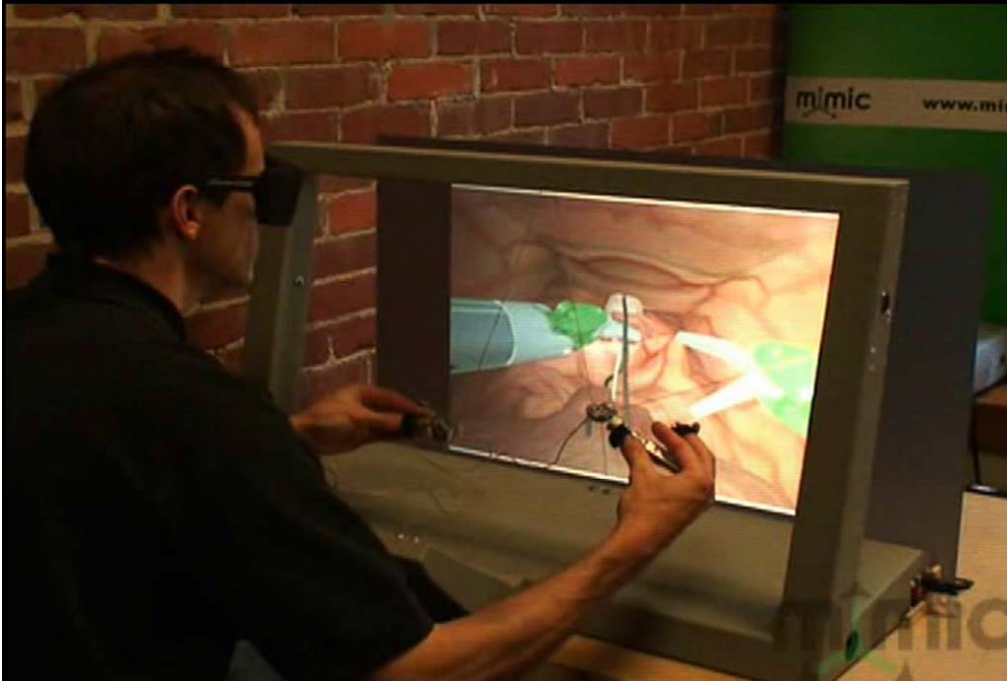
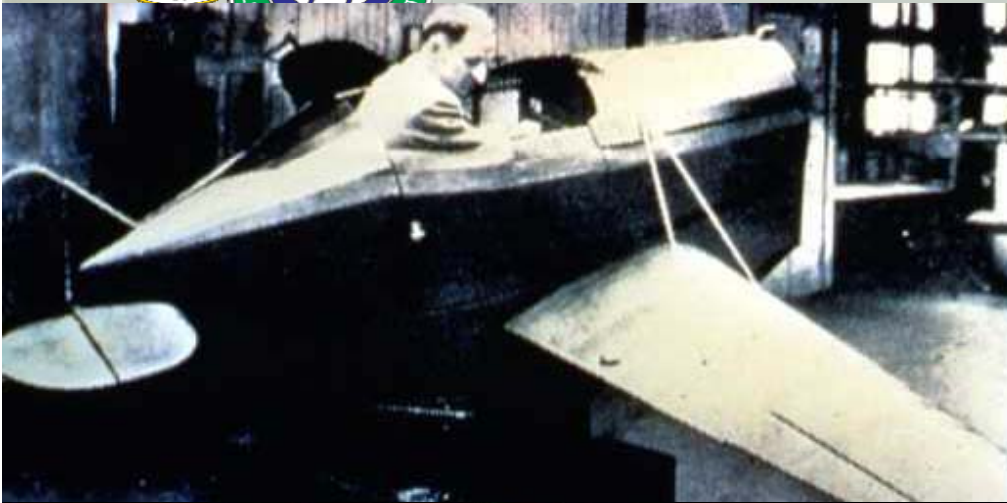


Evolutionary Change





Revolutionary Change





Revolutionary Change

Harpoon 3 Advanced Naval Warfare : H3CA Version 3.7.2.3 Beta Build 3

PC File Settings Mission Window

Tactical

363 NM →
428 NM

US05
0000
0000

Lat: 34D 15M 21S N
Lon: 125D 44M 44S U

Game Status

Game Time: 14:38:03 Zulu
Game Date: 14 February 1985
Time Compression: 30 Min.

Unit Status

DATABASE REPORT

Name: Hamilton
Tag: U045
Type: UHEC
Side: USA
Course: 0
Speed: 0 (Stop)
Damage: 0%
Fuel: 4000:00:00
EMCON: PASSIVE





U.S. Army Military Occupational Specialties

Enlisted MOS

Infantry Branch

11B Infantryman
11C Indirect Fire Infantryman
11X Infantryman (ambiguous; turns into 11B, 11C, or 11M)
11Z Infantry Senior Sergeant
11H Infantry Anti-Armor Specialist
11M Mechanized Infantryman

Field Artillery Branch

13B Cannon Crewmember
13C TAC Fire Operations Specialist
13D Field Artillery Tactical Data Systems Specialist
13E Cannon Fire Direction Specialist
13F Fire Support Specialist
13M Multiple Launch Rocket System Crewmember
13P MLRS/LANCE Operations Fire Directions Specialist
13R Field Artillery Firefinder Radar Operator
13S Field Artillery Surveyor
13W Field Artillery Meteorological Crewmember
13X Field Artillery Enlistment Option
13Z Field Artillery Senior Sergeant

Air Defense Artillery Branch

14E Patriot Fire Control Enhanced Operator/Maintainer
14J Early Warning System Operator
14M Man Portable Air Defense System Crewmember
14R Bradley Linebacker Crewmember
14S Avenger Crewmember
14T PATRIOT Launching Station Enhanced Operator/Maintainer
14Z Air Defense Artillery (ADA) Senior Sergeant

Aviation Branch

15B Aircraft Powerplant Repairer
15D Aircraft Powertrain Repairer
15F Aircraft Electrician
15G Aircraft Structural Repairer
15H Aircraft Pneumatics Repairer
15J OH-58D Armament/Electrical/Avionics Systems Repairer
15K Aircraft Components Repair Supervisor
15M UH-1 Helicopter Repairer
15N Avionics Mechanic
15P Aviation Operations Specialist
15Q Air Traffic Control Operator
15R AH-64 Attack Helicopter Repairer
15S OH-58D Helicopter Repairer
15T UH-60 Helicopter Repairer
15U Medium Helicopter Repairer
15V Observation/Scout Helicopter Repairer
15X AH-64 Armament/Electrical Systems Repairer
15Y AH-64D Armament/ Electrical Systems Repairer
15Z Aircraft Maintenance Senior Sergeant

Special Forces Branch

18B Special Forces Weapons Sergeant
18C Special Forces Engineer Sergeant
18D Special Forces Medical Sergeant
18E Special Forces Communications Sergeant
18F Special Forces Assistant Operations & Intelligence Sergeant
18X Special Forces Operations Sergeant

Armor Branch

9D Cavalry Scout
9K Armor Crewmember
9Z Armor Senior Sergeant

Corps of Engineers Branch

21B Combat Engineer (Formally 12B)
21C Bridge Crewmember
21D Diver
21E Heavy Construction Equipment Operator
21G Quarrying Specialist
21H Construction Engineer
21J General Construction Equipment Operator
21K Plumber
21L Lithographer
21M Firefighter
21N Construction Equipment Supervisor
21P Prime Power Production Specialist
21Q Transmission and Distribution Specialist
21R Interior Electrician
21S Topographic Surveyor
21T Technical Engineering Specialist
21U Topographic Analyst
21V Concrete and Asphalt Equipment Operator
21W Carpentry and Masonry Specialist
21X General Engineering Supervisor
21Y Topographic Engineering Supervisor
21Z Combat Engineering Senior Sergeant

Signal Corps Branch

25B Information Systems Operator Analyst (*to be renamed Information Technology Specialist in Oct'07*)
25C Radio Operator Maintainer
25D Telecommunications Operator/Maintainer (*to be deleted in Oct'07*)
25F Network Switching Systems Operator/Maintainer
25L Wire Systems Installer
25M Multimedia Illustrator
25N Nodal Network Systems Operator/Maintainer
25P Microwave Systems Operator/Maintainer
25Q Multichannel Transmission Systems Operator
25R Visual Information/Audio Equipment Repairer Operator/Maintainer
25T Satellite/Microwave Systems Chief
25U Signal Support Systems Specialist
25V Combat Documentation & Production Specialist
25W Telecommunications Operations Chief
25X Senior Signal Sergeant
25Y Information Systems Chief (*to be deleted in Oct'07*)
25Z Visual Information Operations Chief

Judge Advocate General Branch

27D Paralegal Specialist

Military Police Corps Branch

31B Military Police
31D CID Special Agent
31E Internment/Resettlement Specialist

Military Intelligence Branch

33W (35T) MI Systems Maintainer/Integrator
96B (35F) Intelligence Analyst
96D (35G) Imagery Analyst
96H (35H) Imagery Ground Station Operator
96R (35H) Ground Surveillance Systems Operator
96U (35K) Unmanned Aerial Vehicle Operator
96Z (35X) Intelligence Senior Sergeant
97B (35L) Counterintelligence Agent
97E (35M) Human Intelligence Collector
97L (35Q) Translator/Interpreter
97Z (35Y) Counterintelligence/Human Intelligence Senior Sergeant
98C (35N) Signal Intelligence Analyst (Linguist)
98G (35P) Cryptologic Linguist
98P (35U) Multi-Sensor Operator
98Y (35S) Signals Collector/Analyst
98Z (35Z) Signals Processor Sergeant
09L (35V) Cryptologic Linguist
05H EW Specialist
Psychological Operations Branch
38B Civil Affairs Specialist

Adjutant General Branch

42A Human Resource Specialist
42F Human Resource Systems Information Specialist
42L Administration Specialist (*to be deleted*)
42R9B Trumpet Player
42R9C Baritone or Euphonium Player
42R9D French Horn Player
42R9E Trombone Player
42R9F Tuba Player
42R9G Flute or Piccolo Player
42R9H Oboe Player
42R9J Clarinet Player
42R9K Bassoon Player
42R9L Saxophone Player
42R9M Percussion Player
42R9N Piano Player
42R9T Guitar Player
42R9U Electric Bass Guitar Player
42S Special Band member

Finance Branch

44C Finance Specialist/Accounting Specialist
Public Affairs Branch
46Q Public Affairs Specialist
46R Broadcast Journalist
46Z Public Affairs Chief
Chaplain Branch
56M Chaplain Assistant

CMF 63 - Mechanical Maintenance

44B Metal Worker
44E Machinist
45B Small Arms/Artillery Repairer
45G Fire Control Repairer
45K Armament Repairer
52C Utilities Equipment Repairer
52D Power Generation Equipment Repairer
62B Construction Equipment Repairer
63A M1 Abrams Tank Turret Mechanic/M1 Abrams Tank System Mechanic
63B Light-Wheel Vehicle Mechanic/Heavy Wheel Vehicle Mechanic/Wheel Vehicle Repairer
63D Artillery Mechanic
63X Fuel and Electrical Repairer/Track Vehicle Mechanic
63J Quartermaster and Chemical Equipment Repairer
63M M2-3 Bradley Fighting Vehicle System Mechanic/Bradley Fighting Vehicle Systems Turret Mechanic
63K Track Vehicle Repairer
63W All Wheel Vehicle Repairer
63Z Mechanical Maintenance Supervisor

Medical Department Branches

68A Medical Equipment Repairer
68D Operating Room Specialist
68E Dental Specialist
68G Patient Administration Specialist
68H Optical Laboratory Specialist
68J Medical Logistic Specialist
68K Medical Laboratory Specialist
68M Hospital Food Specialist
68P Radiology Specialist
68Q Pharmacy Specialist
68R Veterinary Food Inspection Specialist
68S Preventive Medicine Specialist
68T Animal Care Specialist
68V Respiratory Specialist
68W Health Care Specialist (aka Combat Medic)
68X Mental Health Specialist
68Z Chief Medical NCO

Chemical Branch

74D Chemical Operations Specialist (formerly 54B)

CMF 79 - Recruiting and Retention

79R Recruiter Noncommissioned Officer
79S Career Counselor
79T Recruiting and Retention NCO
79V Retention and Transition Noncommissioned Officer
Transportation Branch
88H Cargo Specialist
88K Watercraft Operator
88L Watercraft Engineer
88M Motor Transport Operator
88N Traffic Management Coordinator
88P Railway Equipment Repairer
88T Railway Section Repairer
88U Railway Operations Crewmember
88Z Transportation Senior Sergeant

Ordnance Branch

89B Ammunition Specialist
89D Explosive Ordnance Disposal Specialist
Quartermaster Corps Branch
92A Automated Logistical Specialist
92F Petroleum Supply Specialist
92G Food Service Specialist
92L Petroleum Laboratory Specialist
92M Mortuary Affairs Specialist
92R Parachute Rigger
92S Shower/Laundry and Clothing Repair Specialist
92W Water Treatment Specialist
92Y Unit Supply Specialist
92Z Senior Noncommissioned Logistician

CMF 94 - Electronic Maintenance

94A Land Combat Electronic Missile System Repairer
94D Air Traffic Control Equipment Repairer
94E Radio and Communications Security Repairer
94F Special Electronics Devices Repairer
94H Test, Measurement & Diagnostic Equipment Support Specialist
94K Automatic Test Equipment Operator/Maintainer
94L Avionics Communications Equipment Repairer
94M Radar Repairer
94P Multiple Launch Rocket System Repairer
94R Avionics System Repairer
94S Patriot System Repairer
94T Avenger System Repairer
94W Electronic Maintenance Chief
94Y Integrated Family of Test Equipment
94Z Senior Electronic Maintenance Chief
Branch Immaterial (not oriented to a branch)
00Z Command Sergeant Major
Commissioned Officer & Warrant Officer MOS
Officer MOS's are usually two numerical digits plus a letter (most of the time "alpha"). Letterless MOS's are ambiguous and have several specific MOS's within the E.g. 62 contains 62A (Emergency Physician) and 62B (Field Surgeon).

Warrant Officer MOS's (known as WOMOS) are three numerical digits plus a letter, except 09W who is not yet WO.

Officer Candidates

09R Cadet
09S Officer Candidate
09W Warrant Officer Candidate

Infantry Branch

11A Infantry Officer
Field Artillery Branch
13A Field Artillery Officer
131A Field Artillery Targeting Technician
Air Defense Artillery Branch
14 Air Defense Artillery Officer
140A Command and Control Systems Technician
140E Air and Missile Defense (AMD) Tactician/Technician (Patriot Systems Technician)
140X Air Defense Artillery (ADA) Immaterial



U.S. Army Military Occupational Specialties

Aviation Branch

15 Aviation Officer
 150A Air Traffic and Air Space Management Technician
 150U Tactical Unmanned Aerial Vehicle Pilot
 Operations Technician (still classified at 350K until official transfer to Aviation Branch)
 151A Aviation Maintenance Technician
 152C OH-6 Pilot
 152B OH-58A/C Pilot
 152D OH-58D Pilot
 152F AH-64A Pilot
 152H AH-64D Pilot
 153A Rotary Wing Aviator (Aircraft Nonspecific)
 153B UH-1 Pilot
 153D UH-60 Pilot
 153DD UH-60 MEDEVAC Pilot
 153E MH-60 Pilot
 154C CH-47D Pilot
 154E MH-47 Pilot
 155A Fixed Wing Aviator (Aircraft Nonspecific)
 155E C-12 Pilot
 155F Jet Aircraft Pilot
 155G O-5A/EO-5B/RC-7 Pilot

Special Forces Branch

18A Special Forces Officer
 180A Special Forces Warrant Officer

Armor Branch

19A Armor, General
 19B Armor
 19C Cavalry

Corps of Engineers Branch

21A Engineer Officer
 210A Utilities Operation and Maintenance Technician
 215D Geospatial Information Technician (Old - Terrain Analysis Technician)

Signal Corps Branch

25A Signal Officer
 250N Network Management Technician
 251A Information Systems Technician
 254A Signal Systems Support Technician
 255Z Senior Signal Systems Technician

Judge Advocate General Branch

27A JAG Corps Attorney
 27B Military Judge
 270A Legal Administrator

Military Police Corps Branch

31A Military Police Officer
 311A CID Special Agent

Military Intelligence Branch

35D Military Intelligence Officer
 350F All Source Intelligence Technician
 350G Imagery Intelligence Technician
 350Z Attaché Technician
 350K (150U) Tactical Unmanned Aerial Vehicle Operations (*transferring to Aviation Branch in Summer 07*)
 351L Counterintelligence Technician
 351M Human Intelligence Collection Technician
 351Y Area Intelligence Technician
 352N Traffic Analysis Technician
 352P Voice Intercept Technician
 352Q Morse Intercept Technician
 352R Emanations Analysis Technician
 352S Non Morse Intercept Technician
 353T Intelligence and Electronic Warfare Technician

Psychological Operations Corps Branch

37A Psychological Operations Officer
 37X Psychological Operations Officer, Designated

Civil Affairs Branch

38A Civil Affairs Officer
 38X Civil Affairs Officer, Designated

Adjutant General Branch

42B Personnel Systems Management Officer
 42C Band Officer
 420A Military Personnel Technician
 420C Bandmaster

Finance Branch

44A Finance Officer

Chaplain Branch

56 Chaplain
 56A Command and Unit Chaplain
 56D Clinical Pastoral Educator

Medical Department Branches

60A OPERATIONAL MEDICINE
 60B NUCLEAR MEDICINE OFFICER
 60C PREVENTIVE MEDICINE OFFICER
 60D OCCUPATIONAL MEDICINE OFFICER
 60F PULMONARY DISEASE/CRITICAL CARE OFFICER
 60G GASTROENTEROLOGIST
 60H CARDIOLOGIST
 60J OBSTETRICIAN AND GYNECOLOGIST
 60K UROLOGIST
 60L DERMATOLOGIST
 60M ALLERGIST, CLINICAL IMMUNOLOGIST
 60N ANESTHESIOLOGIST
 60P PEDIATRICIAN
 60Q PEDIATRIC SUB-SPECIALIST
 60R CHILD NEUROLOGIST
 60S OPHTHALMOLOGIST
 60T OTOLARYNGOLOGIST
 60U CHILD PSYCHIATRIST
 60V NEUROLOGIST
 60W PSYCHIATRIST

61A NEPHROLOGIST

61B MEDICAL ONCOLOGIST/HEMATOLOGIST
 61C ENDOCRINOLOGIST
 61D RHEUMATOLOGIST
 61E CLINICAL PHARMACOLOGIST
 61F INTERNIST
 61G INFECTIOUS DISEASE OFFICER
 61H FAMILY MEDICINE
 61J GENERAL SURGEON
 61K THORACIC SURGEON
 61L PLASTIC SURGEON
 61M ORTHOPEDIC SURGEON
 61N FLIGHT SURGEON
 61P PHYSIATRIST
 61Q RADIATION ONCOLOGIST
 61R DIAGNOSTIC RADIOLOGIST
 61U PATHOLOGIST
 61W PERIPHERAL VASCULAR SURGEON
 61Z NEUROSURGEON
 62 Medical Corps Officer

62A Emergency Physician
 62B Field Surgeon

63 Dental Corps Officer

63A General Dentist
 63B Comprehensive Dentist
 63D Periodontist
 63E Endodontist
 63F Prosthodontist
 63H Public Health Dentist
 63K Pediatric Dentist
 63M Orthodontist
 63N Oral and Maxillofacial Surgeon
 63P Oral Pathologist
 63R Executive Dentist

64A Veterinary Corps Officer

640A Veterinary Services Food Safety Technician

65 Medical Specialist Corps Officer

65A Occupational Therapy
 65B Physical Therapy
 65C Dietitian
 65D Physician Assistant
 65X Specialist Allied Operations

66 Nurse Corps Officer

66B Community Health Nurse
 66C Psychiatric/Mental Health Nurse
 66E Perioperative Nurse
 66F Nurse Anesthetist
 66G Obstetrics and Gyneco
 66H Medical-Surgical Nurse
 66N Generalist Nurse
 66P Family Nurse Practitioner

67 Medical Service Corps Officer

67A Health Services
 67B Laboratory Sciences
 67C Preventive Medicine Sciences
 67D Behavioral Sciences
 67E Pharmacy
 67F Optometry
 67G Podiatry
 67J Aeromedical Evacuation

670A Health Services Maintenance Technician

70A Healthcare Administrator

70B Health Services Officer

70C Comptroller

70D Information Systems Manager

70E Patient Administrator

70F Human Resources Manager

70H Plans, Operations, Intelligence Training, and Security

70K Medical Logistics

70K9I Health Facilities Management

Chemical Branch

74A Chemical, General

74B Chemical Operations and Training

74C Chemical Munitions and Materiel Management

Transportation Branch

88A Transportation Officer

88D Transportation Officer - Motor/Rail

880A Marine Deck Officer

881A Marine Engineering Officer

882A Mobility Officer

Ordnance Branch

91A Ordnance Officer

890A Ammunition Technician

913A Armament Systems Maintenance Technician

914A Allied Trades Technician

915A Automotive Maintenance Technician

915E Senior Automotive Maintenance/Senior Ordnance Logistics Officer

919A Engineer Equipment Maintenance Technician

Quartermaster Corps Branch

92A Quartermaster Officer

920A Property Accounting Technician

920B Supply Systems Technician

921A Airdrop Systems Technician

922A Food Service Technician

923A Petroleum Systems Technician

CMF 94 - Electronic Maintenance

948B Electronic Systems Maintenance Technician

948D Electronic Missile Systems Maintenance Technician

948E Senior Electronics Maintenance Technician



Surgical Procedures

Abdominal surgery
 Abdominoplasty
 Acromioplasty
 Adenoidectomy
 Amputation
 Angioplasty
 Appendicectomy
 Arthrodesis
 Arthroplasty
 Arthroscopy
 Bilateral cingulotomy
 Biopsy
 Brain surgery (Neurosurgery)
 Breast biopsy
 Brostrom prodedure
 Cauterization
 Cesarean section
 Cholecystectomy
 Circumcision
 Clitoridectomy
 Colon resection
 Colostomy
 Colporrhaphy
 Commissurotomy
 Cordotomy
 Corneal transplantation
 Cricothoracotomy
 Discectomy
 Diverticulectomy
 Episiotomy
 Endarterectomy
 Endoscopic thoracic sympathectomy
 Foreskin restoration

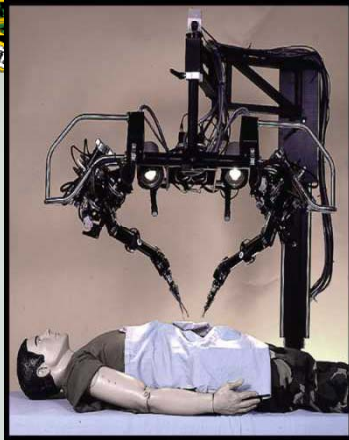
101

Fistulotomy
 Frenectomy
 Frontalis lift
 Fundectomy
 Gastrectomy
 Grafting
 Heart transplantation
 Hemicorporectomy
 Hemilaminectomy
 Hemorrhoidectomy
 Hepatectomy
 Hernia repair
 Hypnosurgery
 Hysterectomy
 Kidney transplantation
 Khyphoplasty
 Laminectomy
 Laparoscopy
 Laparotomy
 Laryngectomy
 Lithotripsy
 Lobotomy
 Lumpectomy
 Lung transplantation
 Mammectomy
 Mammoplasty
 Mastectomy
 Mastoidectomy
 Mentoplasty
 Myotomy
 Mryingotomy
 Nephrectomy
 Nissen fundoplication
 Nuss procedure
 Oophorectomy

Orchidectomy
 Pancreaticoduodenectomy
 Parathyroidectomy
 Penectomy (also known as peotomy)
 Phalloplasty
 Pleurodesis
 Pneumotomy
 Pneumonectomy
 Prostatectomy
 Psychosurgery
 Radiosurgery
 Ritidoplasty
 Rotationplasty
 Sigmoidostomy
 Sphincterotomy
 Splenectomy
 Stapedectomy
 Thoracotomy
 Thrombectomy
 Thymectomy
 Thyroidectomy
 Tonsillectomy
 Tracheotomy
 Tracheostomy
 Tubal ligation
 Tubal reversal (Tubal Anastomosis)
 Ulnar Collateral Ligament Reconstruction
 Ureterosigmoidostomy
 Vaginectomy
 Vasectomy
 Vivisection
 Vulvectomy



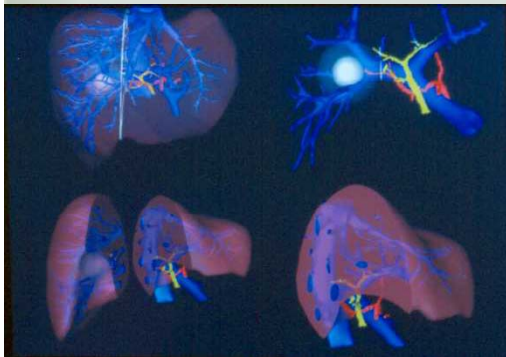
Total Integration of Surgical Care



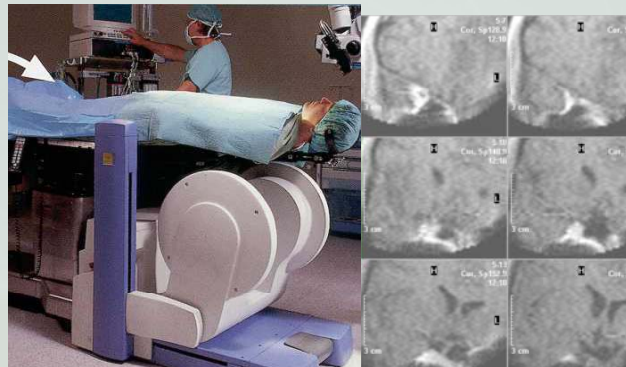
Remote Surgery



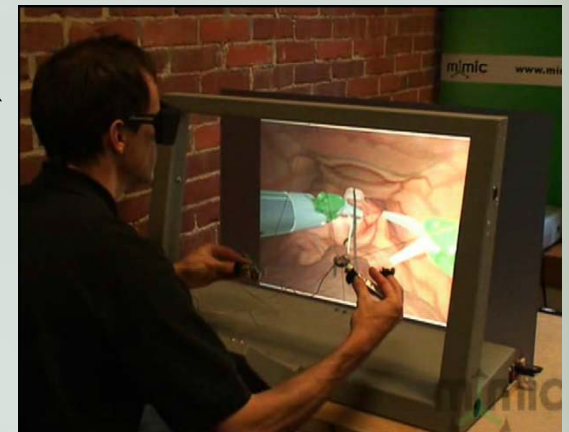
Minimally Invasive & Open Surgery



Pre-operative planning
Surgical Rehearsal



Intra-operative navigation



Simulation & Training
Pre-operative Warmup



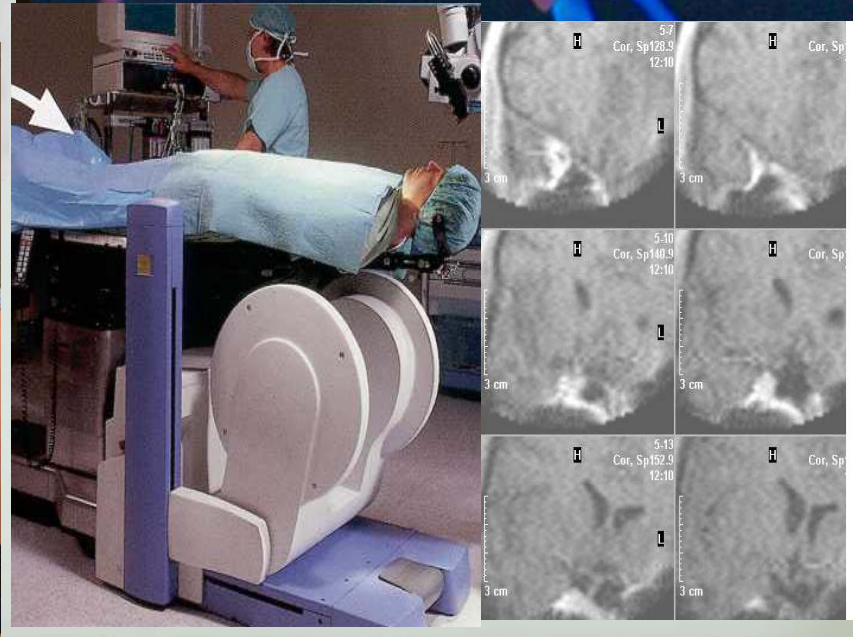
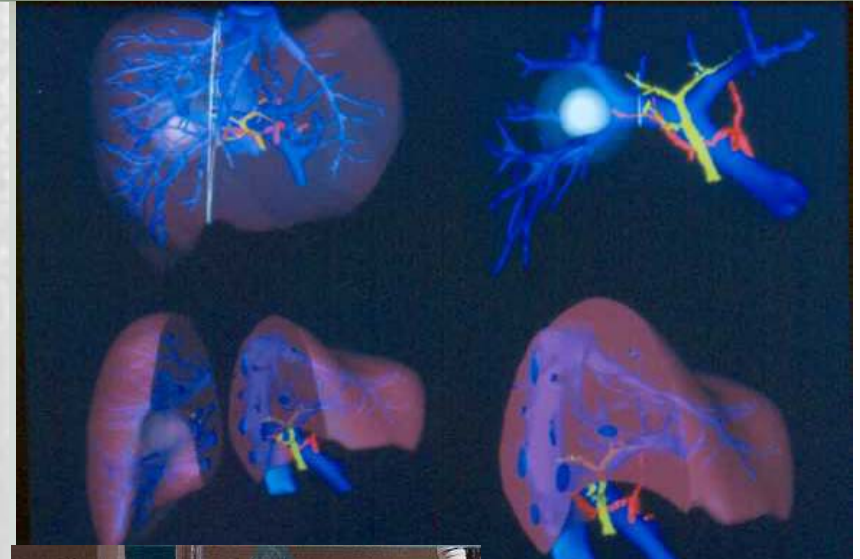
The New Paradigm Struggle



Rick Satava: What is the **REVOLUTION** in surgical education?



Simulation Augmented Learning & Treatment



Denson JS, Abrahamson S. A computer-controlled patient simulator. *Journal of the American Medical Association* 1969; 208:504-8.



What Really Matters

- ↓ Lower Cost
- ↑ Better Access to Symptoms/Cases
- ↓ Reduced Time to Competence
- ↓ Reduced Errors



If simulation can deliver one or more of these, then it may be valuable enough to trigger a scientific smackdown.



Scientific Smackdown



Do Many in Sim

See One, Do One,
Teach One