ANCILLARY SUPPORT ACTIVITIES

- LUNAR AND PLANETARY SCIENCE STATION
- SOLAR SYSTEM OBSERVATORY
- BASIC PHYSICS RESEARCH CENTER
- FAR-SIDE RADIO AND OPTICAL OBSERVATORY
- TERRESTRIAL METEOROLOGY CENTER
- DEEP SPACE MISSION OPERATIONS CENTER
- ONE-SIXTH GRAVITY SPACE PHYSIOLOGY RESEARCH CENTER
- ONE/SIXTH GRAVITY MATERIALS RESEARCH CENTER
- TOURIST FACILITY
- ARCHIVAL FACILITY
“CULTURAL” DESIGN CONSIDERATIONS

• HABITAT AND INDOOR WORKING FACILITIES PERSONNEL FRIENDLY
  – ELECTONIC, REALTIME WINDOWS
  – PIPED IN NATURAL LIGHT
  – PRIVACY AREAS
  – PERSONAL GARDEN PLOTS
  – INDIVIDUAL AND PRIVATE VOICE AND ELECTONIC COMMUNICATIONS BACK TO EARTH

• PLAN ON EXTERIOR RECREATION
  – ADDITIONAL DEMAND ON SPACE SUIT LONGEVITY AND RELIABILITY

• DETERMINE LONG TERM SUITABILITY OF 1/6 GRAVITY FOR INDIVIDUALS AND FAMILIES
  – BIOMEDICAL RESEARCH IN LONG TERM EFFECTS
  – BIOMEDICAL RESEARCH IN CHILD PHYSICAL DEVELOPMENT
  – BIOMEDICAL RESEARCH IN TO BASIS FOR OCCUPATIONAL MEDICAL PRACTICE
  – RE-ADAPTATION PROTOCOL FOR RETURN TO EARTH

• FINANCIAL / POLITICAL INCENTIVES FOR ENTERPRISE OWNERSHIP
  – STOCK AND STOCK OPTIONS
  – GOVERNANCE REPRESENTATION
  – LONG TERM PLAN FOR SELF-GOVERNANCE OF SETTLEMENT
VARIOUS CLASS MISSIONS

• SPLIT/SPRINT-OPPOSITION CLASS (1988 NASA OFFICE OF EXPLORATION)
  – ROBOTIC PRECURSORS
  – ONE CARGO VEHICLE/ONE CREW VEHICLE
  – 14 MONTHS
  – 30 DAYS IN ORBIT
  – 20 DAYS ON SURFACE
  – 4 CREW ON SURFACE / 4 IN ORBIT
  – 60 TOTAL HOURS OF EVAS BY 2 CREW MEMBERS
  – 3 MISSIONS

• SPLIT/SPRINT-OPPOSITION CLASS (1988 NASA JSC)
  – ROBOTIC PRECURSORS
  – ONE CARGO VEHICLE/ONE CREW VEHICLE
  – 14 MONTHS
  – 30 DAYS IN ORBIT
  – <20 DAYS ON SURFACE
  – 2 CREW ON SURFACE / 1 IN ORBIT
  – 60 TOTAL HOURS OF EVAS BY 2 CREW MEMBERS
  – 1 MISSION

• VENUS SWING-BY (COLLINS, 1988)
  – ROBOTIC PRECURSORS?
  – ONE VEHICLE
  – 22 MONTHS
  – 30 DAYS IN ORBIT?
  – 40 DAYS ON SURFACE
  – 4 CREW ON SURFACE / 4 IN ORBIT?
  – 120 TOTAL HOURS OF EVAS BY 2 CREW MEMBERS?
  – 3 MISSIONS?

• "MARS DIRECT" CONJUNCTION CLASS (ZUBRIN, 1996, NASA INTEREST, 1999)
  – ONE AUTOMATED CREW RETURN VEHICLE/ONE DELAYED CREW VEHICLE
  – 30 MONTHS
  – MANUFACTURE RETURN FUEL AND OXIDIZER PRIOR
  – TO CREW LAUNCH
  – 0 DAYS IN ORBIT
  – 18 MONTHS ON SURFACE
  – 4 CREW ON SURFACE / 0 IN ORBIT
  – REPEATED MISSIONS
MINIMUM ENERGY

- MINIMUM ENERGY-CONJUNCTION CLASS (NEAL, ET AL., 1989)
  - RECONNAISSANCE FROM ORBIT / NO ROBOTIC PRECURSORS REQUIRED
  - ONE VEHICLE / TWO LANDERS
  - 32 MONTHS
  - 18 MONTHS IN ORBIT
  - 90 TOTAL DAYS ON SURFACE
  - 4 CREW ON SURFACE / 4 IN ORBIT ALTERNATING TO SURFACE
  - 1200 TOTAL HOURS EVAS BY 8 CREW MEMBERS AT TWO SITES
  - 4 MISSIONS/8 SITES WITH FIFTH MISSION THE CREATION OF A PERMANENT MARS BASE WITH 8 INITIAL INHABITANTS

- MAJOR POSSIBLE ENHANCEMENT OPTIONS
  - LAUNCH FROM THE MOON WITH LUNAR DERIVED CONSUMABLES (GREATER PAYLOAD) (SEE STANCATI, ET AL., 1991)
  - 3HE FUSION / NUCLEAR FISSION / SOLAR ELECTRIC PROPULSION (SHORTENED TRANSIT TIME)
  - TRAJECTORY SHAPING (FLEXIBLE STAY TIMES AT MARS)
  - AEROBRAKING (MARS ORBIT INSERTION AND RETURN TO EARTH)
MINIMUM ENERGY

FLEXIBILITY IN TRANSIT AND ORBIT

• LANDING DELAY DUE TO EQUIPMENT OR WEATHER PROBLEMS
• SURFACE EXPLORATION DELAY DUE TO EQUIPMENT, WEATHER, ADAPTATION, OR BIOLOGICAL HAZARD PROBLEMS
• ASCENT DELAY DUE TO EQUIPMENT PROBLEMS
• EARLY ASCENT DUE TO DEGRADING SYSTEMS OR A CREW HEALTH PROBLEM
• DESIRE EXPLORE PHOBOS AND / OR DEIMOS(?)
• "MISSION CONTROL" AND COMMUNICATIONS RELAY IN MARS ORBIT
• LANDING SITE VERIFICATIONS FROM MARS ORBIT SENSORS AND ANALYSIS

• OTHER ISSUES
  – IN-ROUTE, IN-ORBIT, ON-SURFACE SIMULATION AND TRAINING REQUIRED
  – MISSION RELEVANT AND VALUABLE SCIENTIFIC ACTIVITIES IN-ROUTE
  – MISSION MONITORING AND NON-TIME CRITICAL DATA PROCESSING ON EARTH
  – HIGH RATE DATA TRANSMISSION MARS-EARTH-MARS

• PROBLEMS
  – MASS COST TO SUPPORT CREW OF 8 (COULD REDUCE TO 4 AND ONE LANDING WITH INCREASE OVERALL RISK)
SPACE BIOMEDICAL ISSUES IN MICROGRAVITY

• MAJOR KNOWN PROBLEMS
  – MUSCLE ATROPHY
    • HEART
    • SUPPORT
  – BONE AND OTOLITH DEMINERALIZATION
  – RATE OF RE-ADAPTATION TO GRAVITY ENVIRONMENT
  – IMMUNE SYSTEM COMPROMISE (?)
  – RADIATION PROTECTION

• COUNTER-MEASURE OPTIONS
  – HEAVY, ANAROBIC EXERCISE
  – CENTRIFUGAL FORCE
  – DRUG THERAPY
  – EXERCISE
  – CENTRIFUGAL FORCE
  – DRUG THERAPY
  – EXERCISE IN GRAVITY

NOTE: NO SCIENTIFICALLY CREDITABLE UNDERSTANDING OF THESE PROBLEMS AND OPTIONS HAS BEEN DEVELOPED TO DATE DUE TO THE LACK OF A SYSTEMATIC RESEARCH PROTOCOL AND USE OF INAPPROPRIATE TEST SUBJECTS. NASA HAS ONLY HAD 40 YEARS, FOR CRYING OUT LOUD!

ALL OF THE ABOVE

IN-TRANSIT AND IN ORBIT
“WATER” SURROUNDED STORM CELLER
ON-SURFACE
“REGOLITH” COVER FOR ZENITH
ORBITAL “MISSION CONTROL”  
(FIRST FEW MISSIONS)

• OVERALL SUCCESS NOT DEPENDENT ON SUCCESS OF PRECURSORS

• COMMUNICATIONS DELAY OF 8-40 MINUTES PUTS EARTH “OUT OF THE LOOP”

• TAKE ADVANTAGE OF CONJUCTION CLASS MARS-STAY REQUIREMENT
  – 16 MONTHS IN ORBIT

• PROVIDES CURRENT ENVIRONMENTAL DATA AND HUMAN COGNITIVE ANALYSIS ON THE SPOT
  – LANDING SITE SELECTION AND VERIFICATION AND DETAILED SURFACE MISSION PLANNING
  – SPECTRAL DATA
  – RADAR DATA
  – SURFACE PROBES
  – LANDING BEACON DEPLOYMENT
  – LANDING TRAJECTORY PRECURSORS THROUGH ATMOSPHERE
  – DATA FUSION SOFTWARE
  – SAMPLE RETURN TO ORBIT VS. TESTS AFTER LANDING (?)
  – REFINE LANDER PAYLOAD
ORBITAL “MISSION CONTROL” -2
(FIRST FEW MISSIONS)

- BUILD ON MARINER, VIKING, PATHFINDER, AND MARS SURVEYOR DATA BASE
- USE EARTH DATA PROCESSING AND CONSULTATION
- MARS ENVIRONMENT AND SURFACE BETTER CHARACTERIZED THAN BEFORE APOLLO 11
  - EXCEPT FOR POTENTIAL PATHOGENS IN ISOLATED ECOSYSTEMS
- LANDING SYSTEMS MONITORING
- LANDER-EARTH DATA RELAY AS REQUIRED
- EVA PLANNING ASSISTANCE
- PHOBOS-DEIMOS EXPLORATION (SEE NEAL, ET AL, 1989)
IMAGINE, YOU ARRIVE IN MARS ORBIT AND THIS IS WHAT HAS HAPPENED SINCE LEAVING EARTH!

Mars • Global Dust Storm

June 26, 2001
Hubble Space Telescope • WFPC2

September 4, 2001
PICK YOUR LANDING REGION

OLYMPUS MONS?

VALLES MARINERIS?
VALLES MARINERIS AND OUTFLOW CHANNEL ELEVATIONS
NASA/MOLA

PICK YOUR LANDING AREA
...VALLES MARINERIS MAY PRESENT AN EXCITING APPROACH, LANDING, AND EXPLORATION TARGET!

NASA/JPL/MALIN SPACE SCIENCE SYSTEMS.
WITH A LANDING AMONG THE LAYERS AND FOSSILS (?) OF CANDOR CHASMA

100 METERS OR A LITTLE LESS THAN A SATURN V OR A LITTLE MORE THAN A FOOTBALL FIELD
A POSSIBLE REPRESENTATIVE VIEW FROM THE “MARTIAN MODULE”
BEFORE THE FIRST EVA, HOWEVER....
VALLES MARINERIS WILL BE A TAD MORE SPECTACULAR
EVA SCHEMATIC
45 DAY SURFACE STAY

“13” = DAY SINCE LANDING
HUMAN MISSION FOR MARS BASE SITE EVALUATION

• WEEK ONE (DAYS 1-6)
  – READAPTATION
  – ENVIRONMENTAL TESTS
  – ACTIVATION OF EXTERIOR SENSORS
  – PHYSICAL MONITORING
  – PLANNING

• WEEK TWO (DAYS 8-13)
  – SHORT/SIMPLE PROXIMITY EVAS
  – DEPLOY COMM ANTENNA / SCIENCE STATION / AGRICULTURAL TEST STATION
  – START DEEP DRILL SYSTEM
  – SELECTED SAMPLE ANALYSIS
  – PHYSICAL MONITORING
  – PLANNING SESSIONS

• WEEK THREE (DAYS 15-20)
  – SECTOR 1 EXPLORATION
  – MID LENGTH EVAS USING ROVER
  – EXTENDED RANGE EVA WITH TWO ROVERS
  – SHALLOW DRILLING/DEPLOY GEO. NET
  – SELECTED SAMPLE ANALYSIS
  – PHYSICAL MONITORING
  – PLANNING SESSIONS

• WEEK FOUR (DAYS 22-27)
  – SECTOR 2 EXPLORATION
  – DITTO WEEK THREE

• WEEK FIVE (DAYS 29-34)
  – SECTOR 3 EXPLORATION
  – DITTO WEEK THREE

• WEEK SIX (DAYS 36-41)
  – SECTOR 4 EXPLORATION
  – ASCENT SIMULATIONS
  – DITTO WEEK THREE

• WEEK SEVEN (DAYS 43-45)
  – MOTHBALL FACILITY
  – PREPARE ROVER FOR REMOTE OPERATION
  – FINAL ASCENT SIMULATIONS
  – SAMPLE SELECTION AND STORAGE

• NOTE: ONE REST DAY PER WEEK
  – FOUR PERSON CREW
  – TWO PERSON EVAS, ALTERNATE BETWEEN PAIRS
EARLY LANDINGS STRATEGY
GOAL: PERMANENT BASE

- FIRST AND SECOND MISSIONS (POSSIBLE FOUR LANDINGS)
  - GENERAL EXPLORATION AND RECONNAISSANCE
    - AUTOMATED ROVER AFTER CREW DEPARTURE
  - DEVELOPMENT OF CRITERIA FOR BASE SELECTION
  - POTENTIAL TO ACCELERATE DECISION ON BASE SITE SELECTION
    - CORRELATION OF ORBITAL RECONNAISSANCE WITH DATA FROM SURFACE

- THIRD AND FOURTH MISSIONS (POSSIBLE FOUR LANDINGS)
  - EXAMINATION OF CANDIDATE BASE SITES
    - AUTOMATED ROVER AFTER CREW DEPARTURE
  - USE FOURTH LANDING TO SET UP CONSUMABLES PLANT AT SELECTED BASE SITE
  - GENERAL EXPLORATION AND RECONNAISSANCE
CURRENT SCHEDULE FOR MARS - 1
(REVISED AND TO BE REVISED)

• APRIL 2001
  – MARS ODYSSEY ORBITER
    • MINERAL ANALYSIS / RADIATION

• MAY 2003
  – ROVERS
    • SURFACE GEOLOGY / WATER

• JUNE 2003
  – MARS EXPRESS ORBITER
  – BEAGLE 2 LANDER
    • ATMOSPHERE / SURFACE REMOTE SENSING
    • SURFACE SCIENCE / ASTROBIOLOGY

• DECEMBER 2003
  – ARRIVAL OF NOZOMI (ALREADY ON THE WAY)
    • UPPER ATMOSPHERE

• JULY 2005
  – RECONNAISSANCE ORBITER
    • IMAGING / MAPPING
CURRENT SCHEDULE FOR MARS - 2
(REVISED AND TO BE REVISED)

• LATE 2007
  – SMART LANDER/ROVER
    • SURFACE SCIENCE/SAMPLE RETURN TECHNOLOGY DEMO

• LATE 2007
  – ORBITER
    • REMOTE SENSING/NETLANDERS RELAY/ SAMPLE RETURN TECHNOLOGY DEMO

• LATE 2007
  – NETLANDERS
    • ATMOSPHERE/SEISMIC SOUNding

• LATE 2007
  – TELEMARS ORBITER
    • COMMUNICATIONS

• LATE 2009
  – ORBITER
    • POSSIBLE RADAR MAPPER

• 2011-2016
  – SAMPLE RETURN

NASA
CNES (FRANCE)
CNES (FRANCE)
ASI (ITALY)
NASA/ASI
ALL OF THE ABOVE
IF A LUNAR HELIUM-3 INITIATIVE BEGAN BY 2005 WITH ASSURED FUNDING, THE FIRST HUMAN MISSION TO MARS COULD BE LAUNCHED BY 2015, LARGELY USING TECHNOLOGY PAID FOR BY THE HELIUM-3 INITIATIVE.

HARRISON H. SCHMITT - 2001

(NOTWITHSTANDING DR. GRIFFIN’S COMMENT ABOUT “30 YEARS.”)
ENJOY THE VIEW WHEN YOU GET THERE!!!!!

“TRUE COLOR OF MARS”
PATHFINDER LANDER VIEW
NASA/JPL