

BIOMEDICAL FACTORS IN WEIGHTLESS OR ROTATING SPACE VEHICLES

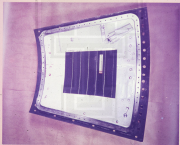
	<u>ROTATING VEHICLE</u>	<u>NON-ROTATING VEHICLE</u>
CARDIOVASCULAR EFFECTS	NONE AT 1 g	"DECONDITIONING" ? NOT SIGNIFICANT UNTIL RETURN TO 1 g WHEN PREVENTABLE BY CUFFS, DRUGS OR ANTI-g SUITS
DISORIENTATION MOTION SICKNESS	SEVERE FROM CANAL SICKNESS & CORIOLIS FORCES WITH SMALL RADIUS PROBABLY MILD WITH LARGE RADIUS	POSSIBLE FROM OTOLITH VISUAL CUES OVERCOME DRUGS COULD PREVENT

MA-9

MERCURY GROUND NETWORK

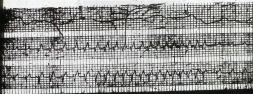
STATION	CHANNEL	VOICE / TM	S M C RANGE RADAR	ACQUISITION AND	COMMAND CAPABILITY	TM RECEPTION
CAPE CANAVERAL (CONTROL CENTER)	CCV	V/TM	S/C	A	YES	TM
BIRMINGHAM	BOM	V/TM	S/C	A	YES	—
CANNARY ISLANDS	CTI	V/TM	S	A	—	TV
LAGOS, NIGERIA	RNO	V/TM	—	A	—	—
ZANTHAR	ZTN	V/TM	—	A	—	—
MURCHEL, AUSTRALIA	MUC	V/TM	S	A	YES	—
CANTON ISLAND	CTN	V/TM	—	A	—	—
CENTRAL TANKY GROUP (SHIP)	CSO	V/TM	—	A	YES	TV
HAIRAN	RAW	V/TM	S/C	A	YES	—
PT ARQUELLO, CALIFORNIA	CAL	V/TM	S/C	A	YES	—
GUAYMAS, MEXICO	GTM	V/TM	S	A	YES	—
WHITE SANDS, NEW MEXICO	WNS	—	C	A	—	—
COMPTON CREEK, TEXAS	TLX	V/TM	S	A	—	—
EGLIN AFB, FLORIDA	ESL	—	S/C	A	—	—
ROSE KNOT VICTOR (SHIP)	RVK	V/TM	—	A	YES	—
TWIN FALLS VICTORY (SHIP)	TVV	V/TM (RECORD)	C	A	—	—
RANGE TRACKER (SHIP)	RTK	V/TM (RECORD)	C	A	—	—

RADIATION DOSIMETER ON HATCH



BIOMEDICAL FACTORS IN WEIGHTLESS OR ROTATING SPACE VEHICLES (CONT)

	ROTATING VEHICLE	NON-ROTATING VEHICLE
SKELETAL CHANGES	NONE AT 1 g	OSTEOPOROSIS PREVENTABLE BY APPROPRIATE EXERCISES
MUSCULAR CHANGES	NONE WITH STANDARD EXERCISES	NONE WITH SPECIAL EXERCISES



JANUARY 27, 1942 8:40 A.M. E.C.G.
WAVE ATTACHED LEAD II
PAPER SPEED 150/1000

MERCURY BIOMEDICAL DATA SUMMARY

1 OBJECTIVE: TO ASSESS THE PHYSIOLOGICAL AND
PSYCHOLOGICAL EFFECTS OF SPACE FLIGHT ON THE
HUMAN ORGANISM

2 EXPERIMENTAL FORMAT: DICTATED LARGELY BY
OPERATIONAL CONSTRAINTS:

A) DESIGN: SIMPLICITY

B) GOAL: GROSS TRENDS INDEX IN
TROUBLE AREAS

CEMINI MEDICAL EXPERIMENT M-8
BONE DEMINERALIZATION



PURPOSE

ESTABLISH DEGREE
OF BONE
DETERIORATION

EQUIPMENT

STANDARD X-RAY

WEIGHT

N/A VOLUME N/A

PROCEDURE

PRE AND POST FLIGHT
HEEL AND FINGER X-RAYS
BY SPECIAL TECHNIQUE

LOCATION

N/A

GEMINI SPACECRAFT ENGINEERING MOCK-UP

AUGUST 1965



54-104-100-100

100-10000



GEMINI EXPERIMENT M-9
HUMAN OTOLITH FUNCTION

PURPOSE - IDENTIFY AND CALIBRATE TIME
COURSE OF CHANGES IN
OTOLITH FUNCTION

EQUIPMENT SPECIAL FLIGHT GOGGLES;
PRE AND POST FLIGHT TILT
FRAME AND OCULAR PHOTOGRAPHY

WEIGHT GOGGLES INCORPORATED INTO
S-B EQUIPMENT

PROCEDURE DETERMINE ISOCENTRIC VISUAL
LOCATION OF HORIZON INFIGHT.
DETERMINE OCULAR COUNTER-ROLLING
PRE AND POST FLIGHT.

LOCATION PRESSURIZED CABIN



IN-FLIGHT
VISION TESTER

SEMINI EXPERIMENT M-1

CARDIOVASCULAR CONDITIONING



PURPOSE

DETERMINE EFFECTIVENESS OF
TECHNIQUE TO PREVENT
CARDIOVASCULAR RECONDITIONING

EQUIPMENT

PNEUMATIC CUFF DEVICE

WEIGHT

5 LBS. VOLUME: 0.04 CU. FT.

PROCEDURE

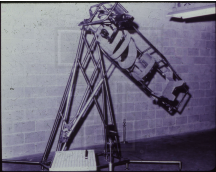
RHYTHMIC CUFF INFLATION-ONE
ASTRONAUT

LOCATION

PRESSURIZED CABIN AND
ASTRONAUT'S BODY

FORM 1-60-000





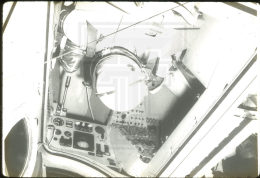
GEMINI EXPERIMENT

M-1

CARDIOVASCULAR
CONDITIONING



U.S. AIR FORCE



IN-FLIGHT MEDICAL EXPERIMENTS

- M-1 (CUFF EXPERIMENT)
- M-3 (CALIBRATED EXERCISE TEST)
- M-4 (PHONOELECTROCARDIOGRAM)
- M-5 (HORMONAL STUDIES - STEROIDS, CATECHOLS, AHA)
- M-6 (BONE DENSITOMETRY)
- M-7 (ELECTROLYTE BALANCE)
- M-8 (EEG)
- M-9 (VESTIBULAR STUDY)
- M-11 (CYTOGENETIC AND IMMUNOLOGIC BLOOD STUDY)
- M-12 (BICYCLE ERGOMETER - A. AS PREVENTIVE; B. AS PROVOCATIVE TEST)
- M-17 (CARDIAC OUTPUT BY ELECTRICAL IMPEDANCE)
- M-18 (VECTERCARDIOGRAPHY - FRANK LEADS)
- M-19 (IN-FLIGHT METABOLIC RATE)
- M-20 (PULMONARY FUNCTION)
- M-21 (SEMICIRCULAR CANAL FUNCTION)
- M-22 (RBC SURVIVAL)

- OPERATIONAL PROCEDURES - M-2 (TILT TABLE AND BODY FLUID COMPARTMENTS)
M-10 (ASTRONAUT BODY MOVEMENT)
M-13 (VENOUS COMPLIANCE AND ARTERIOLAR REACTIVITY)

- UNDER CONSIDERATION - M-14 (EAR GONIOMETER)
M-15 (PERFORMANCE MEASUREMENT)
M-16 (NEPHELOMETER)
M-23 (PHYSICAL FITNESS FOLLOWING WEIGHTLESSNESS)

SEMI IN-FLIGHT EXERCISE (M-3)



PURPOSE

ASSESSMENT OF THE COURSE
OF CARDIOVASCULAR RESPONSE TO
A FIXED WORK/LOAD STIMULUS

EQUIPMENT

SEMI-COORD (IN-FLIGHT)
ELECTROCARDIOGRAPHY: ECG, BP,
PULSE, & RESP.

WEIGHT

8 OZ. POLYMER BINDER

PROCEDURE

IDENTICAL MATCHED EXERCISE
PERIODS THROUGHOUT FLIGHT

LOCATION

PRELIMINARY CABIN

W-1-100-1

GEMINI RENDEZVOUS

RADAR COMPUTER MODE







GIMMI MEDICAL EXPERIMENT M-4 INFLIGHT PHONOCARDIOGRAM

PURPOSE

USED IN CONNECTION WITH
SIMULTANEOUSLY RECORDED
ECG TO INDICATE POSSIBLE
MYOCARDIAL (HEART MUSCLE)
RECONDITIONING

EQUIPMENT

CHEST MICROPHONE BBSINGER
OPERATIONAL ECG

WEIGHT

1 TO 2 OZS. VOLUME MINOR

PROCEDURE

PASSIVE RECORDING DURING
FLIGHT

LOCATION

APPLIED TO ASTRONAUT'S CHEST

200-10000



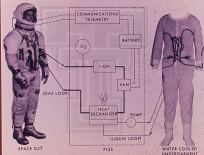
GEMINI MEDICAL EXPERIMENTS

- M-1 CARDIOVASCULAR CONDITIONING
- M-3 INFLIGHT EXERCISER
- M-4 INFLIGHT PHONOCARDIOGRAM
- M-5 BIOASSAYS BODY FLUIDS
- M-6 BONE DEMINERALIZATION
- M-7 CALCIUM BALANCE STUDY
- M-8 INFLIGHT SLEEP ANALYSIS
- M-9 HUMAN OTOLITH FUNCTION

HUMAN PERFORMANCE
AND
BIOINSTRUMENTATION
STATION



APOLLO PORTABLE LIFE SUPPORT SYSTEM



GEMINI MEDICAL EXPERIMENTS

M-1 CARDIOVASCULAR REFLEX CONDITIONING EXPERIMENT: CUFFS

M-2 CARDIOVASCULAR EFFECTS OF SPACE FLIGHT:
TILT TABLE: BLOOD VOLUME, INTERSTITIAL FLUID
VOLUME, TOTAL BODY WATER

M-3 INFLIGHT CARDIOVASCULAR ASSESSMENT: CALIBRATED EXERCISE
TOLERANCE

M-4 INFLIGHT CARDIOVASCULAR ASSESSMENT: PHONO-ELECTROCARDIOGRAM

M-5 BIOCHEMICAL ANALYSIS OF BODY FLUIDS: STEROIDS: CATECHOLS: ADH

M-6 PRE AND POSTFLIGHT BONE DENSITOMETRY

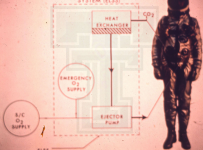
M-7 ELECTROLYTE BALANCE STUDY: CALCIUM: NITROGEN: HYDROXYPROLINE

M-8 INFLIGHT ELECTROENCEPHALOGRAM (EEG)

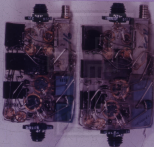
M-9 VESTIBULAR EXPERIMENT

NASA-8-64-1075

GEMINI EXTRAVEHICULAR LIFE SUPPORT SYSTEM (ELSS)



EEG SIGNAL CONDITIONERS



MSFEB APPROVED APOLLO MEDICAL EXPERIMENTS SCHEDULE

FLIGHT	204	205	207	503	504
	M-1A	M-4A	M-23	M-5A	M-5A
	M-4A	M-5A		M-11	M-11
	M-5A	M-7A			
	M-6A	M-8A			
	M-8A	M-11			
	M-11	M-12			
	M-12	M-19			
		M-20			

- MASS MEASUREMENT
DEVICE

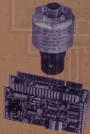
- BARANY CHAIR

- EXAMINATION TABLE

- CREWMAN "CHAIR"



CARBON DIOXIDE SENSOR



00000-01-003
10-6-85

MEMBERS OF MEDICAL ADVISORY COUNCIL

NAME

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WOOD, EARL, M.D., PH.D. PROFESSOR OF PHYSIOLOGY	MAYO CLINIC

ALTERNATIVE FILTER PAPER TECHNIQUE FOR BLOOD CHEMISTRIES (SPAMAG)



TOP VIEW



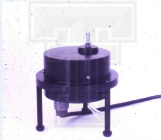
SIDE VIEW

MASS MEASUREMENT DEVICE



RESEARCH-10, 1000
10, 10, 100

RESPIRATION ANALYZER



AP01JL005
10-1-65

PAROTID SECRETION COLLECTOR



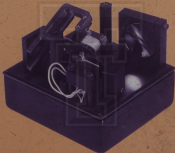
ARMED-PL-101
11-1-53

MICRO ANALYTICAL SYSTEM



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J. H. H. H. H. H.

INFRA-RED CARBON DIOXIDE ANALYZER



APOLLO APPLICATIONS LEM LAB MOCK-UP



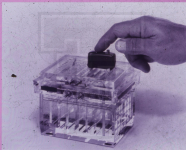
APOLLO 15-007
11-5-68

**PAROTID
SECRETION
COLLECTION
SYSTEM**



WISDOM, 201
01-01-00

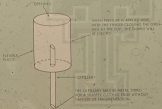
MICROZONE ELECTROPHORESIS



WALL PAPER
10-6-55

INFLIGHT BLOOD SAMPLING TECHNIQUE

(SPINAS)



LIST OF MSFEB APPROVED GEMINI AND APOLLO EXPERIMENTS CURRENTLY PLANNED FOR INCLUSION ON APOLLO APPLICATIONS FLIGHTS

EXPERIMENT NO.

SHORT TITLE

M-4	IN-FLIGHT PHONOCARDIOGRAM
M-5	BIOASSAYS BODY FLUIDS
M-7	CALCIUM BALANCE STUDY
M-8	IN-FLIGHT SLEEP ANALYSIS
M-11	CYTOTOXIC STUDY
M-12	EXERCISE DROGMETER
M-17	THORACIC BLOOD FLOW
M-18	VECTOCARDIOGRAM
M-19	METABOLIC RATE MEASUREMENT
M-20	PULMONARY FUNCTION
M-22	RED BLOOD CELL SURVIVAL
M-23	LOWER BODY NEGATIVE PRESSURE

FILTER PAPER TECHNIQUE

FOR BLOOD CHEMISTRIES (SPAMAG)

FILTER PAPER
WITH CORNER
SPOT



FILT

SIDE VIEW

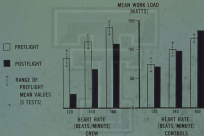


SPOT

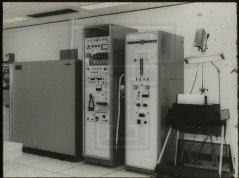
TOP VIEW

TOP
BOTTOM

SUMMARY OF WORK LOAD CHANGE — APOLLO VII.



NASA HQ MEMO-2810
4-10-67









1000
1-0000



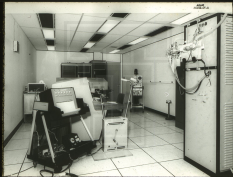
NEURAL EXPERIMENT PROGRAM
FUNCTIONAL ORGANIZATION

I. NEURAL/NEURAL EXPERIMENT

- A. IDENTIFICATION OF APPROPRIATE AND VALIDATING RELATIONSHIPS, SUPPORT, AND PARTICIPATION OF THE SCIENTIFIC COMMUNITY.
- B. REVIEW OF EXISTENT PROGRAMS FOR SCIENTIFIC MERIT.
- C. REVIEW OF EXPERIMENT IN RELEVANCE.
- D. SELECTION, COMPARISON, AND SUPPORT OF EXPERIMENT FOR DEVELOPMENT PHASE.
- E. SUPPORT AND RESOURCES DURING OPERATIONAL DATA GENERATION, AND POST FLIGHT DATA REDUCTION AND REPORTING PHASE.
- F. AFFILIATION OF DATA TO THE NEURAL/NEURAL EXPERIMENT PROGRAM, NEURAL SPACE FLIGHT, AND THE CIVILIAN COMMUNITY AS INDICATED.

II. NASA SUPPORT OF NEURAL/NEURAL EXPERIMENT PROGRAM

- A. INSURE (ENHANCED NEURAL AND NEURAL/NEURAL LABORATORY MANAGEMENT SYSTEMS).
- B. FINANCIAL DEVELOPMENT EFFORTS TO ADDRESS NEEDS OF THE ART IN NEURAL/NEURAL TECHNOLOGY AND EFFORTS TO ENHANCE THE CAPABILITY OF INSURE AND NEURAL EXPERIMENT.
- C. SIMULATIONS AND OTHER DATA SETS, I.E., THE SUPPORT OF GROUNDBASED SIMULATION AND OTHER STUDIES IN ORDER TO OBTAIN A SET OF FLIGHT DATA AS A REFERENCE OR CONTROL DATA TO VERIFY THE EXTRACTION OF VALID CONCLUSIONS FROM FLIGHT DATA.





IMBLMS

INTEGRATED MEDICAL/BEHAVIORAL LABORATORY MEASUREMENT SYSTEM



MADE IN AMERICA

MEDICAL/BEHAVIORAL EXPERIMENTS PROGRAM DRIHS

AIR

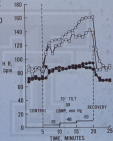
1. PROVIDE INFIGHT MEASUREMENT CAPABILITY TO ACCOMMODATE ALL MEDICAL/BEHAVIORAL EXPERIMENTS
2. PROVIDE MAXIMUM FLEXIBILITY FOR:
 - a. ADAPTABILITY TO LATE CHANGES IN MISSION EXPERIMENT PLANS
 - b. EASE OF INFIGHT MAINTENANCE
 - c. EASE AND ECONOMY OF INCORPORATION OF UPDATED TECHNIQUES AND EQUIPMENT

DRIHS FUNCTIONAL ELEMENTS

1. PHYSIOLOGICAL MEASUREMENT
2. BEHAVIORAL MEASUREMENT
3. BIOCHEMICAL
4. NEUROPHYSIOLOGICAL
5. DATA HANDLING

HEART RATE RESPONSE TO LOWER BODY NEGATIVE PRESSURE AND 70° TILT TABLE TESTS.

- APOLLO VII
PREFLIGHT MEAN
- APOLLO VII
POSTFLIGHT NO. 1
- GEMINI VII
PREFLIGHT MEAN
- GEMINI VII
POSTFLIGHT NO. 1



GRAPH BY GEMINI VII
4-10-68

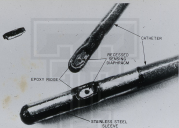
GEMINI 4 & 5 BLOOD VOLUME CHANGES

DETERMINATION	GEMINI 4 (CP)	GEMINI 4 (P)	GEMINI 5 (CP)	GEMINI 5 (P)
BLOOD VOLUME, cc	-576 (2%)	-880 (12%)	-592 (12%)	-547 (12%)
PLASMA VOLUME, cc	-438 (8%)	-492 (12%)	-429 (8%)	-366 (8%)
RBC MASS, cc	-138 (12%)	-438 (12%)	-163 (12%)	-181 (12%)
RBC SURVIVAL AT 8 DAYS (Cr 51)				
% DEPLETED			82 - 87%	82 - 87%
% DEPLETED			76%	69%

TABLE VI. RED CELL MASS

PERCENTAGE CHANGE IN RED
CELL MASS IN EACH CREWMAN

APOLLO VII	-0.5	-9.4	-0.3
APOLLO VIII	+2.3	-2.3	-4.0



1 mm









WASA 649-1618

**IMPEDANCE
CARDIOGRAPH
FLIGHT
INSTRUMENTATION
AND
HARNESS**









LIGHT SOURCE
STRETCHER AND LENS

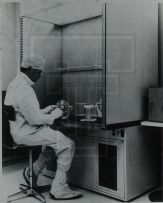
CONTROL

SPEAKER

CABLE TO BATTERY PACK
AND CONTROL UNIT



FL-40-8000 (MAY 1964) 100



MEDICAL/BIOMEDICAL EXPERIMENTS PROGRAM
PARALLEL DEVELOPMENT

REQUIREMENTS (SELECTED)

METABOLIC ANALYSIS, RAPID RESPONSE, ADAPTABLE TO SUITED ACTIVITY

BACTERIAL CULTURE AND IDENTIFICATION TECHNIQUES FOR INFIGHT USE

TECHNIQUES FOR INFIGHT BIOCHEMICAL ANALYSIS

SAMPLE PRESERVATION TECHNIQUES FOR INFIGHT USE

IMPROVED LENS PHOTOGRAPHY TECHNIQUES

NON-INVASIVE CARDIAC OUTPUT DETERMINATION TECHNIQUES

NON-INVASIVE VISCOS PRESSURE TECHNIQUES

BEHAVIORAL MEASUREMENT TECHNIQUE REFINEMENT

BLOOD CELL COUNTING TECHNIQUES FOR INFIGHT USE

TECHNIQUES FOR INFIGHT MEASUREMENT OF PULMONARY DIFFUSION CAPACITY

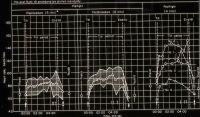
IMPROVED URINE VOLUME MEASUREMENT DEVICE

^a The mean percentage of predicted heart rate response values are plotted separately. The range and range of heart rate values plotted are shown after 15 min duration. Four 15-minute periods were incorporated (average may be).

- 1st 15 min (0800-0815) on May 14, 1964
- 2nd 15 min (0815-0830) on May 14, 1964
- 3rd 15 min (0830-0845) on May 14, 1964
- 4th 15 min (0845-0900) on May 14, 1964

The actual heart rate responses are plotted individually.

- 1st 15 min (0800-0815)
- 2nd 15 min (0815-0830)
- 3rd 15 min (0830-0845)
- 4th 15 min (0845-0900)
- 5th 15 min (0900-0915)
- 6th 15 min (0915-0930)
- 7th 15 min (0930-0945)
- 8th 15 min (0945-1000)
- 9th 15 min (1000-1015)
- 10th 15 min (1015-1030)
- 11th 15 min (1030-1045)
- 12th 15 min (1045-1100)
- 13th 15 min (1100-1115)
- 14th 15 min (1115-1130)
- 15th 15 min (1130-1145)
- 16th 15 min (1145-1200)
- 17th 15 min (1200-1215)
- 18th 15 min (1215-1230)
- 19th 15 min (1230-1245)
- 20th 15 min (1245-1300)
- 21st 15 min (1300-1315)
- 22nd 15 min (1315-1330)
- 23rd 15 min (1330-1345)
- 24th 15 min (1345-1400)
- 25th 15 min (1400-1415)
- 26th 15 min (1415-1430)
- 27th 15 min (1430-1445)
- 28th 15 min (1445-1500)
- 29th 15 min (1500-1515)
- 30th 15 min (1515-1530)
- 31st 15 min (1530-1545)
- 32nd 15 min (1545-1600)
- 33rd 15 min (1600-1615)
- 34th 15 min (1615-1630)
- 35th 15 min (1630-1645)
- 36th 15 min (1645-1700)
- 37th 15 min (1700-1715)
- 38th 15 min (1715-1730)
- 39th 15 min (1730-1745)
- 40th 15 min (1745-1800)
- 41st 15 min (1800-1815)
- 42nd 15 min (1815-1830)
- 43rd 15 min (1830-1845)
- 44th 15 min (1845-1900)
- 45th 15 min (1900-1915)
- 46th 15 min (1915-1930)
- 47th 15 min (1930-1945)
- 48th 15 min (1945-2000)
- 49th 15 min (2000-2015)
- 50th 15 min (2015-2030)
- 51st 15 min (2030-2045)
- 52nd 15 min (2045-2100)
- 53rd 15 min (2100-2115)
- 54th 15 min (2115-2130)
- 55th 15 min (2130-2145)
- 56th 15 min (2145-2200)
- 57th 15 min (2200-2215)
- 58th 15 min (2215-2230)
- 59th 15 min (2230-2245)
- 60th 15 min (2245-2300)
- 61st 15 min (2300-2315)
- 62nd 15 min (2315-2330)
- 63rd 15 min (2330-2345)
- 64th 15 min (2345-2400)
- 65th 15 min (2400-2415)
- 66th 15 min (2415-2430)
- 67th 15 min (2430-2445)
- 68th 15 min (2445-2500)
- 69th 15 min (2500-2515)
- 70th 15 min (2515-2530)
- 71st 15 min (2530-2545)
- 72nd 15 min (2545-2600)
- 73rd 15 min (2600-2615)
- 74th 15 min (2615-2630)
- 75th 15 min (2630-2645)
- 76th 15 min (2645-2700)
- 77th 15 min (2700-2715)
- 78th 15 min (2715-2730)
- 79th 15 min (2730-2745)
- 80th 15 min (2745-2800)
- 81st 15 min (2800-2815)
- 82nd 15 min (2815-2830)
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- 368th 15 min (9945-10000)



TILT STUDIES—HEART RATE RESPONSES—MA—9

SPAMAG END PRODUCTS

1. GROUP OF ORL MEDICAL EXPERIMENTS IN FORMAT
2. GROUP OF ADDITIONAL ORL MEDICAL MEASUREMENTS IN FORMAT
3. GROUP OF LIFE SUPPORT RECOMMENDATIONS IN FORMAT
4. GROUP OF PREREQUISITE GROUND BASED EXPERIMENTS
5. GROUP OF PREREQUISITE SPACEFLIGHT EXPERIMENTS
6. GROUP OF RECOMMENDATIONS FOR RESEARCH AND DEVELOPMENT
7. GENERAL PHILOSOPHY AND RECOMMENDATIONS FOR ORL EXPERIMENTAL APPROACH
8. RECOMMENDATIONS FOR GENERAL ORL DECISIONS
9. TENTATIVE FLIGHT PLAN
10. REVIEWS OF "WORK OF FOUR STUDY CONTRACTS" AND ORL BEING
11. SUMMARY OF POSSIBLE USES OF SPACE ENVIRONMENT FOR STUDY, AND THERAPY OF PATHOLOGICAL STATES
12. RECOMMENDATIONS FOR FUTURE STUDY EFFORT

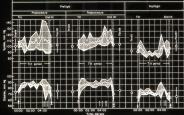
LIST OF EXPERIMENTAL ENVIRONMENTAL FACTORS

- | | |
|--------------------------|--|
| 1. WEIGHTLESSNESS | 9. PARTICULATE MATTER
(IN WEIGHTLESSNESS) |
| 2. RADIATION | 10. MICROORGANISMS |
| 3. CONFINEMENT | 11. CHANGE IN CIRCADIAN
RHYTHMS |
| 4. SOCIAL RESTRICTION | 12. MAGNETIC FIELDS |
| 5. MONOTONY | 13. ULTRA VIOLET EXPOSURE |
| 6. THREAT OF DANGER | 14. INFRA RED EXPOSURE |
| 7. ARTIFICIAL ATMOSPHERE | 15. NOISE |
| 8. TOXIC SUBSTANCES | |

1. Number of observations per site and number of sites per group
 2. Number of observations per site and number of sites per group
 3. Number of observations per site and number of sites per group
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1. Number of observations per site and number of sites per group
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1. Number of observations per site and number of sites per group
 2. Number of observations per site and number of sites per group
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 4. Number of observations per site and number of sites per group



● INFLIGHT DATA

- TM
- ON BOARD RECORDING
- POST FLIGHT DETERMINATIONS

● BASELINE DATA

- SELECTION
- CENTRIFUGE RUNS
- SIMULATIONS
- TRAINERS
- PRESSURE CHAMBER RUNS
- STRESS STUDIES
- ROUTINE PHYSICAL EXAMINATIONS
- GENERAL OBSERVATIONS
- PRE FLIGHT DETERMINATIONS

BODY FUNCTIONS

1. NEUROLOGICAL FUNCTION

CNS

STATES OF CONSCIOUSNESS

SLEEP

ALERTNESS

SPEECH FUNCTIONS

ADAPTABILITY

EMOTIONAL REACTIVITY

SPECIAL SENSES

VISION

AUDITORY

SMELL

TASTE

VESTIBULAR

PERIPHERAL N.S.

SOMATIC

AUTONOMIC

2. PSYCHOLOGICAL PERFORMANCE

SENSATION

PSYCHOMOTOR

PERCEPTION

HIGHER MENTAL PROCESSES

3. CIRCULATION

PUMP

BLOOD VOLUME CONTROL

VASOMOTOR CONTROL

4. RESPIRATION

LUNG

BLOOD

TISSUE

5. DIGESTION

6. METABOLISM

7. ENDOCRINE BALANCE

8. THERMO-REGULATORY AND INTEGUMENTARY

9. NEUROMUSCULAR

10. SKELETAL

11. FLUID & ELECTROLYTE BALANCE, RENAL AND URINARY TRACT FUNCTIONS

12. REPRODUCTION

13. HEMATOLOGICAL RESPONSE

14. IMMUNOLOGICAL RESPONSE

SPAMAG RECOMMENDATIONS

1. LIFE SUPPORT
(CONTROLLED ENVIRONMENTAL FACTORS)
2. MEDICAL EXPERIMENTS
(UNCONTROLLED ENVIRONMENTAL FACTORS)
3. ORL DECISIONS
(SPECIFICATIONS AND OPERATIONS)

LIFE SUPPORT FACTORS

- 
- * 1. ATMOSPHERE
 - 2. SUITS
 - 3. FOOD
 - 4. WATER
 - 5. WASTE
 - 6. LIVING CONDITIONS & STANDARDS
 - 7. GROUP INTEGRITY
 - 8. HAZARD PROTECTION
 - 9. SAFETY MONITORING

VAL-SALVA DEVICE



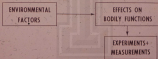
LIST OF ORL DECISIONS- SPAMAG

- | | |
|-------------------------------------|--|
| A. BEST & CHEAPEST OVERALL APPROACH | M. STORAGE REQUIREMENTS (VOLUME & TYPE) |
| B. ORBIT | N. SUPPORTING LOGISTICS |
| C. ON-BOARD CONTINGENCY | O. REORIENTATION REQUIREMENTS |
| D. ROTATION FOR ARTIFICIAL GP | P. COMMUNICATIONS (METHODS & EQUIPMENT) |
| E. ICI REQUIREMENTS | Q. GROUND SUPPORT |
| F. WEIGHT BUDGET | R. NECESSITY FOR TOTAL GROUND SIMULATION PRIOR TO FLIGHT |
| G. POWER BUDGET | S. REQUIREMENTS FOR POST-LANDING MEDICAL EXAMINATIONS |
| H. NUMBER OF PERSONNEL | T. DOUBLE-ENDED TRAMPOLINE IN-FLIGHT? |
| I. TYPES OF PERSONNEL | U. CREW EFFECTIVENESS PARAMETERS |
| J. ANIMALS | |
| K. (TYPING OF PERSONNEL & ANIMALS) | |
| L. GROUND LABORATORY REQUIREMENTS | |

ORL EXPERIMENTS FORMULATION SCHEMA SPAMAG

(UNCONTROLLED ENVIRONMENTAL FACTORS) (VARIABLES)

LIST OF EXPERIMENTS & EXPERIMENTAL REQUIREMENTS TO
BE FORMULATED ACCORDING TO THE FOLLOWING SCHEMA:





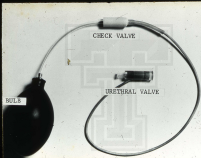


Patient MONITOR

CENTRAL
STATION

PATIENT UNIT



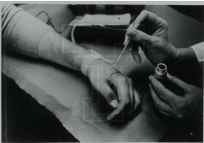


CHECK VALVE

URETHRAL VALVE

BULB





SUMMARY OF FLIGHT DATA

EVENT	PULSE RATE, BEATS/MIN	BLOOD PRESS., mm Hg	RESP. RATE, BREATHS/MIN	BODY TEMP., °F
LIFT-OFF PERIOD (MAXIMUM)	110	-	14	97.6
SPACECRAFT SEP.	114	-	12	97.6
WEIGHTLESSNESS	MEAN 96	MEAN 129/70	8 TO 14	98.6
RETROFIRE	96	-	12	99.2
REENTRY PERIOD (MAXIMUM)	134	-	19	99.3
BIOSENSOR DISCONNECT	104	-	16	99.5

MEASUREMENTS AND TECHNIQUES

ENDOCRINE *

CLINICAL ENDOCRINE EVALUATION (Hx FORM, AND Px)

MEASUREMENT OF PITUITARY ACTIVITY (CIRCULATING ACTH; URINARY ADH,
AND SPECIFIC GRAVITY)

MEASUREMENT OF THYROID ACTIVITY (PB; TBPA)

MEASUREMENT OF PARATHYROID ACTIVITY (CIRCULATING PARATHORMONE)

MEASUREMENT OF ADRENAL CORTICAL ACTIVITY (URINARY 17 OHCS, 17 KETOSTERIODS,
AND ALDOSTERONE)

MEASUREMENT OF GONADAL ACTIVITY (PRE- AND POST-FLIGHT GERM CELL EXAMINATION)

MEASUREMENT OF NEURO-HUMORAL ACTIVITY (URINARY CATECHOLAMINES AND
SEROTONIN)

*The majority of A & A medical measurements and techniques described, particularly under
"Metabolism and Nutrition," are applicable to the evaluation of endocrine function.
They are too numerous to be listed here.

† Assays to be done in earth-based laboratories on specimens collected and stored in flight.

MEASUREMENTS AND TECHNIQUES

CARDIOVASCULAR

1. ASSESSMENT:

CLINICAL CARDIOVASCULAR EVALUATION (Hx FORM, AND P_h)

BLOOD PRESSURE MEASUREMENT

IMPEDENCE PNEUMOGRAPH (SEE "RESPIRATORY")

BODY TEMPERATURE (SEE "METABOLIC AND NUTRITIONAL")

ELECTROCARDIOGRAM

PHONO-ELECTROCARDIOGRAM (M-4)

CARDIAC OUTPUT (NON-INVASIVE)

THORACIC BLOOD FLOW (PLETHYSMOGRAPHY)

CENTRAL AND PERIPHERAL VENOUS PRESSURE

VENOUS COMPLIANCE

REGIONAL BLOOD FLOW | LIMB PLETHYSMOGRAPHY

ARTERIOLE REACTIVITY

BODY FLUID DISTRIBUTION

URINARY CATECHOLAMINES, ADRENAL STEROIDS, ADH (SEE "ENDOCRINE")

FLUID AND ELECTROLYTE BALANCE (SEE "METABOLIC AND NUTRITIONAL")

SUMMARY CARDIOPULMONARY DATA MA-B

<u>EVENT</u>	<u>PULSE</u>	<u>BLOOD PRESSURE</u>	<u>RESPIRATION RATE</u>
PRELAUNCH	72	117/89	20
LAUNCH	112	...	37
ORBITAL	75	126/69	19
REENTRY	104	...	43
POSTFLIGHT	56 (SUPINE)	120/84	"
	104 (RECT)	94/70	"

FLIGHT TIME: 9 HRS 12 MIN

WEIGHT LOSS: 4% ± 5 LBS

POSTFLIGHT TEMPERATURE

100.1°F (RECTAL)

HEMATOCRIT: 44 TO 47

SUBJECTIVE SYMPTOMS: NONE

MEASUREMENTS AND TECHNIQUES

HEMATOLOGICAL

GENERAL:

CLINICAL EVALUATION (H₁ FORM AND P₅₀)

CELLULAR CHANGES:

MEASUREMENT OF HEMIC CELL DYNAMICS (BLOOD CELL COUNTS AND MORPHOLOGY)

RBC SURVIVAL (ISOTOPE TAGGED RBC'S; RBC FRAGILITY; DIRECT BILIRUBIN - M-22)

CYTOGENETIC STUDIES (LYMPHOCYTE KARYOTYPING - M-TE)

BODY DEFENSES:

LEUKOCYTE MOBILITY (PHAGOCYTOSIS)

IMMUNOLOGICAL EVALUATION (GLOBULIN ELECTROPHORESIS; ANTIBODY TITRATION;

MEASUREMENT OF COMPLEMENT)

HEMATOSIS:

EVALUATION OF HEMOSTATIC MECHANISMS (BLEEDING AND COAGULATION TIMES;

ASSAY OF ELEMENTS OF CLOTTING)

CARDIOVASCULAR (CONT'D)

2. PROVOCATIVE TESTING:

TILT TABLE RESPONSE (PRE- AND POST-FLIGHT)

FITNESS EVALUATION (PRE- AND POST-FLIGHT)

RESPONSE TO THERMAL CHANGE (ORTHOSTATIC TOLERANCE AND
OUTAHEOUS BLOOD FLOW)

RESPONSE TO CAROTID BODY STIMULATION (PROVOCATIVE AND REMEDIAL)

RESPONSE TO IN-FLIGHT EXERCISE (PROVOCATIVE AND REMEDIAL)

RESPONSE TO IN-FLIGHT EXERCISE (PROVOCATIVE AND REMEDIAL)

3. COUNTERMEASURES:

RESPONSE TO OCCLUSIVE CUFFS (H-I)

RESPONSE TO ANTI-G SUIT PRE-REENTRY

RESPONSE TO ELASTIC LIGTARD PRE-REENTRY

SUMMARY CARDIOPULMONARY DATA MA-9

<u>EVENT</u>	<u>PULSE</u>	<u>BLOOD PRESSURE</u>	<u>RESPIRATION RATE</u>
PRELAUNCH	72	113/79	19
ORBITAL	89	119/81	15
POSTFLIGHT (1-7 HRS) *	83 (SUPINE) 123 (ERECT)	89/64 90/73	
(18 HRS)	58 (SUPINE) 80 (ERECT)	98/61 94/68	

FLIGHT TIME: 34 1/3 HRS

WEIGHT LOSS: 7 1/2 LBS

POSTFLIGHT TEMPERATURE: 99.4°F (ORAL)

HEMATOCRIT: 43 TO 49

SUBJECTIVE SYMPTOMS: DIZZINESS

* SUBJECT UNDER RESIDUAL EFFECTS OF 5 MG/M
D-AMPHETAMINE SULFATE

MEASUREMENTS AND TECHNIQUES

MICROBIOLOGICAL

CLINICAL EXAMINATION (Hx FORM, AND Px)

ASSESSMENT OF CHANGES IN MICROBIOLOGICAL ECOLOGY AMONG
FLIGHT CREW MEMBERS (CULTURES OF NOSE, THROAT, GI TRACT,
SKIN; COUGH PLATES; CULTURES OF CABIN AND SUIT ECS)

MEASUREMENTS AND TECHNIQUES

RESPIRATORY

CLINICAL RESPIRATORY EVALUATION (Hx FORM, AND Pk)

IMPEDENCE PNEUMOGRAPH

LUNG CAPACITIES (AND BREATH HOLDING TIME)

WORK OF BREATHING

- LUNG COMPLIANCE
- GAS FLOW RATE
- AIRWAY RESISTANCE
- MAXIMUM INSPIRATORY AND EXPIRATORY PRESSURES

CLEARANCE OF INERT GAS (He OR N₂)

MEASUREMENT OF RESPIRATORY GAS EXCHANGE

- O₂ AND CO₂ IN EXPIRED AIR
- ARTERIAL (OR CAPILLARY) O₂ AND CO₂ CONTENT AND P^H

FITNESS EVALUATION PRE- AND POST-FLIGHT (SEE "CARDIOVASCULAR")

WORLD-71-000

11-0-00

IN-FLIGHT EXERCISE EXPERIMENT MA-9

(CALIBRATED WORKLOAD)

	PREFLIGHT (5 DETERMINATIONS)		FLIGHT (12 DETERMINATIONS)	
	MEAN HEART RATE	MEAN BLOOD PRESSURE	MEAN HEART RATE	MEAN BLOOD PRESSURE
PREWORK	74	104/81	89	117/77
WORK	115	-----	131	-----
POSTWORK	85	111/79	106	124/95

MA-9 MEDICAL DATA

- TEMPERATURE, ORAL
- ECG
- RESPIRATION
- BLOOD PRESSURE
- VOICE
- TELEVISION
- MOTION PICTURES OF ASTRONAUT
- SUIT CO_2
- SUIT AND CABIN O_2
- SUIT OUTLET AND CABIN TEMPERATURES

• BLOOD CHEMISTRIES

- CALCIUM
- CHLORIDE
- PHOSPHORUS
- SODIUM
- POTASSIUM
- TOTAL PROTEIN

• URINE

- ROUTINE URINALYSIS
- SODIUM
- POTASSIUM
- CALCIUM
- CHLORIDE
- PO_4
- CREATININE

MEASUREMENTS AND TECHNIQUES

METABOLIC AND NUTRITIONAL

GENERAL:

- CLINICAL METABOLIC AND NUTRITIONAL EVALUATION (H₂ FORM, AND P₂)
- DETERMINATION OF LEAN BODY MASS (BODY MASS AND BODY VOLUME)
- MEASUREMENT OF CORE AND SKIN TEMPERATURES

MUSCULAR STATUS:

- MEASUREMENT OF MUSCLE SIZE AND STRENGTH
- MEASUREMENT OF MUSCULAR EFFICIENCY (BLOOD LACTIC ACID;
URINARY CREATININE AND CREATINE)

ELECTROMYOGRAPHY

FITNESS EVALUATION PRE- AND POST-FLIGHT (SEE "CARDIOVASCULAR")

MINERAL METABOLISM AND SKELETAL STATUS:

- ELECTROLYTE BALANCE (INCLUDING URINALYSIS FOR STONE PRECURSORS)
- IN-FLIGHT BONE DENSITY (INCLUDING SERUM ALKALINE PHOSPHATASE)
- PRE- AND POST-FLIGHT BONE DENSITOMETRY (H-6)

MEASUREMENTS AND TECHNIQUES BEHAVIORAL

1. SENSORY-PERCEPTUAL PROCESSES:

VISUAL FUNCTION (ACUITY, DEPTH PERCEPTION, PHORIAS, PATTERNS, READING)

AUDITORY FUNCTION (PITCH, INTENSITY, LOCALIZATION, PATTERNS, RHYTHM, SPEECH)

KINESTHETIC FUNCTION (POSITIONAL, DYNAMIC)

VESTIBULAR FUNCTION (LINEAR, ANGULAR) (SEE "NEUROLOGICAL")

ORIENTATION ABILITY (TEMPORAL, POSITIONAL, LOCATION)

2. PSYCHOMOTOR FUNCTIONING:

FINE MOTOR MOVEMENT (MANIPULATION, DEXTERITY, POSITIONING, STEADINESS)

GROSS MOTOR MOVEMENT (LOCOMOTION, DEXTERITY)

CONTINUOUS PROCESS (PURSUIT AND COMPENSATORY TRACKING -- MOTOR AND COGNITIVE)

DISCRETE PROCESS (SIMPLE AND COMPLEX REACTION -- MOTOR AND COGNITIVE)

3. COGNITIVE PROCESSES:

MEASUREMENT OF ATTENTION AND VIGILANCE (VISUAL AND AUDITORY)

PROBLEM SOLVING ABILITY (COMPUTATIONAL, SYMBOLIC, DIAGNOSTIC)

LEARNING ABILITY AND MEMORY RETENTION (LONG AND SHORT TERM)

4. INTEGRATED PERFORMANCE:

CONDUCT OF REENTRY SIMULATION

MA-9 MEDICAL DATA

(CONTINUED)

- RETINAL PHOTOGRAPHS PRE- AND POST FLIGHT
- RADIOLOGICAL MEASUREMENT
 - FILM BADGES AND THERMO-LUMINESCENT DETECTORS ON ASTRONAUT
 - IONIZATION CHAMBER INSIDE HATCH
 - EMULSION PACKS ABOUT CABIN
 - GEIGER-MUELLER CHAMBERS (2) IN RETROPACK
- SPECIAL TESTS
 - INFLIGHT EXERCISE - BUNGEE CORD
 - PRE- AND POSTFLIGHT TILT TABLE STUDIES WITH FLACK TEST

MEASUREMENTS AND TECHNIQUES

METABOLIC AND NUTRITIONAL (CONT'D)

GENERAL METABOLISM AND NUTRITION:

METABOLISM AT VARIOUS LEVELS OF ACTIVITY (O_2 CONSUMPTION, CO_2 PRODUCTION, AND CALORIC INTAKE)

GLUCOSE TOLERANCE

LIPID TOLERANCE

MEASUREMENT OF ACID-BASE METABOLISM (SEE ALSO "RESPIRATORY GAS EXCHANGE")

PROTEIN METABOLISM (SERUM PROTEINS WITH ELECTROPHORESIS; NPN; BUN; BLOOD UREA NITROGEN)

FLUID BALANCE

BODY FLUID DISTRIBUTION (SEE "CARDIOVASCULAR")

STANDARD CLINICAL URINALYSIS

GASTROINTESTINAL ACTIVITY:

MEASUREMENT OF GASTRIC MOTILITY AND pH (CHOLEBRANDAGE)

* THERMAL REGULATION:

COMFORT INDEX FOR VARYING THERMAL LOADS

CARDIOVASCULAR RESPONSE TO THERMAL CHANGE (ORTHOSTATIC TOLERANCE AND CIRCULATORY BLOOD FLOW) (SEE "CARDIOVASCULAR")

* Effects of thermal change on metabolism, fluid and electrolyte balance, and other measurements also to be assessed.

MEASUREMENTS AND TECHNIQUES
NEUROLOGICAL

CLINICAL NEUROLOGICAL EVALUATION (Rx FORM, AND Px)

CEREBRAL ELECTRICAL ACTIVITY (EEG-M-8)

OCULAR COUNTER-ROLLING (IN-FLIGHT)

EGGENTRIC VISUAL LOCATION OF HORIZON (M-8)

OCULOGRAVIC ILLUSION

OCULODYNIC ILLUSION

THRESHOLD OF LINEAR ACCELERATIONS TO HEAD

VISUAL TASK PERFORMANCE WITH HEAD ROTATION

NYSTAGMOGRAPH (EDG)

EYE MOVEMENT CINEMATOGRAPHY (FIBER OPTICS BUNDLE)

pH PROBE



PH-100-01-001
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PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : ENDOCRINE EXPERIMENT UNIT

EXPERIMENTAL OBJECTIVES :

1. DETERMINE AND QUANTITATE THE OCCURRENCE OF ANY CHANGES IN ENDOCRINE AND HYPOTENOCRINE FUNCTION
2. DETERMINE MECHANISMS WHICH MEDIATE ANY OBSERVED CHANGES

CANDIDATE EQUIPMENT:

- + M-5 (A)
- + STANDARD CLINICAL AND LABORATORY TECHNIQUES
- + STANDARD STORAGE TECHNIQUES

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : NEUROLOGICAL EXPERIMENTS 0101 AND 0102

EXPERIMENTAL OBJECTIVES : 1. EVALUATE CHANGES IN SENSITIVITY OF
OTOLITH MECHANISM
2. INVESTIGATE THE OCULOGRAVIC ILLUSION

CANDIDATE EQUIPMENT:

- M-BAL: H-21
- VESTIBULAR RESEARCH TECHNIQUES

HUMAN PERFORMANCE MEASUREMENTS

MEASUREMENT

METHOD

SENSORY-PERCEPTUAL

ATTENTION-AUDITORY

VISION-PATTERNS

VISION-READING

KINESTHESIS-POSITION

KINESTHESIS-TRACKING

KINESTHESIS-DYNAMIC

VESTIBULAR-LINEAR

VESTIBULAR-ANGULAR

ORIENTATION-TEMPORAL

ORIENTATION-POSITION

ORIENTATION-LOCATION

WARNING SIGNALS

MATCHING ON CRT DISPLAY

COMPREHENSION-CRT

JOYSTICK AIMING-CRT

JOYSTICK-VISUAL CRT TARGET

LEAD POSITION-TIME & CAMERA RECORDING

DETECTION OF THRESHOLD

DETECTION OF THRESHOLD

FILLED/UNFILLED TIME ESTIMATES

SITUATIONAL-CAMERA RECORDING

SITUATIONAL-CAMERA RECORDING

OXYGEN SENSOR



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PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : HEMATOLOGICAL-EXPERIMENTS 0110, 0115, AND 0120

EXPERIMENTAL OBJECTIVES :

1. DETERMINE HEMATOLOGICAL CELLULAR CHANGES
2. ASSESS CHANGES IN IMMUNOLOGICAL SYSTEM AND LEUKOCYTE FUNCTION
3. DETERMINE BLOOD COAGULATION AND HEMOSTASIS CHANGES

CANDIDATE EQUIPMENT:

- M-30
- STANDARD CLINICAL AND LABORATORY TECHNIQUES

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : CARDIOVASCULAR-EXPERIMENTS 0103, 0104, 0105, 0106,
0107, 0108

EXPERIMENTAL : 1. ASSESSMENT:
OBJECTIVES

- A. GENERAL CARDIOVASCULAR STATUS
- B. STATUS OF MYOCARDIUM
- C. STATUS OF VENOUS AND ARTERIAL INTEGRITY
- D. STATUS OF BODY FLUID DISTRIBUTION

HUMAN PERFORMANCE MEASUREMENTS (CONT'D)

MEASUREMENT

METHOD

SENSORY-PERCEPTUAL

VISUAL ACUITY

OCULOMETER

DEPTH PERCEPTION

OCULOMETER

VISION-PHORIA

OCULOMETER

AUDITION-INTENSITY

THRESHOLDS-TAPE RECORDINGS

AUDITION-PITCH

THRESHOLDS-TAPES

AUDITION-LOCALIZATION

DICHOTIC TAPE PRESENTATION

AUDITION-PATTERNS

TAPE PATTERNS

AUDITION-MOTION

DICHOTIC TAPES

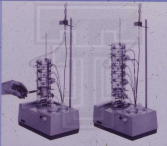
AUDITION-SPEECH

PERCEPTION "CLIPPED" TAPES

VIGILANCE-AUDITORY

MONITORING FOR PRESENCE OR
ABSENCE OF SIGNAL

BLOOD GAS ANALYZER



AP001-11-04

11-1-85

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : MICROBIOLOGICAL-EXPERIMENT (022)

EXPERIMENTAL OBJECTIVES : 1. DETERMINE CHANGES IN BACTERIAL ECOLOGY
UNDER ACTUAL SPACE FLIGHT CONDITIONS

CANDIDATE EQUIPMENT:

- STANDARD BACTERIOLOGIC TECHNIQUES

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM (CONT'D)

2. PROVOCATIVE TESTING:

- A. TILT TABLE STUDIES
(PRE & POST FLIGHT)
- B. FITNESS EVALUATION
(PRE & POST FLIGHT)
- C. EXERCISE
- D. LBNP
- E. CAROTID SINUS STIMULATION

3. COUNTERMEASURES:

- A. EXERCISE
- B. LBNP
- C. PNEUMATIC CUFFS-LOWER
EXTREMITIES
- D. MEDICATIONS
- E. SUPPORTING MEASURES

CANDIDATE EQUIPMENT:

- M-1(A); M-2; M-4(A); M-5(A); M-11; M-12; M-15; M-16; M-22; M-23
- OPERATIONAL SAFETY MONITORING; TILT; BODY FLUID DISTRIBUTION STUDIES
- CARDIOVASCULAR CLINICAL AND LABORATORY EQUIPMENT
- STANDARD STORAGE TECHNIQUES
- PROPOSED TECHNIQUES (SPARKS)

HUMAN PERFORMANCE MEASUREMENTS

MEASUREMENT

METHOD

PSYCHOMOTOR

FINE MOTOR-MANIPULATION

DIAL ADJUSTMENT

FINE MOTOR-DEXTERITY

FINGER DEXTERITY IN SWITCHING

FINE MOTOR-POSITIONING

BALLISTIC AIMING

FINE MOTOR-STEADINESS

DRIFT AND HAND STEADINESS

GROSS MOTOR-LOCOMOTION

SCANNING-CAMERA RECORDING

GROSS MOTOR-DEXTERITY

PRESSURE SUI-DOH AND OFF-TIME
AND CAMERA RECORDING

CONTINUOUS PROCESS-PURSUIT
TRACKING

CRT DISPLAY/CONTROL

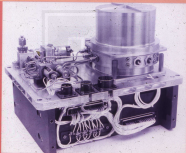
CONTINUOUS PROCESS-COMPENSATORY
TRACKING

CRT DISPLAY/CONTROL

DISCRETE PROCESS-SIMPLE REACTION

VISUAL REACTION

GAS CHROMATOGRAPH



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T. L. 100

ELECTROCARDIOGRAM AND IMPEDANCE PNEUMOGRAPH SIGNAL CONDITIONERS



MODEL 10-100
10-10-100

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA: RESPIRATORY-EXPERIMENTS D108 AND D110

EXPERIMENTAL OBJECTIVES : 1. MEASURE PULMONARY CAPACITIES AND LUNG VOLUMES
2. DETERMINE STATUS OF PULMONARY GAS EXCHANGE

CANDIDATE EQUIPMENT:

- + M-12; M-18; M-20
- + PULMONARY CLINICAL AND RESEARCH EQUIPMENT
- + STANDARD PHYSICAL CHEMISTRY TECHNIQUES
- + STANDARD STORAGE TECHNIQUES
- + PROPOSED TECHNIQUES (SPAMAG, INDUSTRY)

HUMAN PERFORMANCE MEASUREMENTS (CONT'D)

MEASUREMENT

METHOD

COGNITIVE

DISCRETE PROCESS-COMPLEX REACTION

VISUAL CRT SIGNALS

DISCRETE PROCESS-COMPLEX SEQUENCE

SYNTHETIC OPERATIONAL TASK

VIGILANCE-VISUAL

DRIFT MONITORING

ATTENTION-VISUAL

WARNING LIGHTS

PROBLEM-SOLVING-COMPUTATION

CRT PRESENTATION

PROBLEM-SOLVING-SYMBOLIC

INDUCTIVE CATEGORIZATION

PROBLEM-SOLVING-DIAGNOSTIC

SYNTHETIC TROUBLESHOOTING

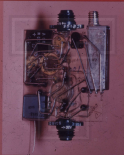
LEARNING AND MEMORY-SHORT TERM

ALPHANUMERIC PRESENTATION

MEMORY-LONG TERM

OPERATIONAL PROCEDURES

PHONOCARDIOGRAM SIGNAL CONDITIONER



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PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA: METABOLIC AND NUTRITIONAL-EXPERIMENTS 0111,
0112, 0113, 0114, AND 0115

EXPERIMENTAL OBJECTIVES :

1. EVALUATE EFFECTS ON MUSCLE MASS AND STRENGTH
2. EVALUATE EFFECTS ON MINERAL METABOLISM
3. ASSESS NUTRITION STATUS
4. EVALUATE EFFECTS ON GASTROINTESTINAL MOTILITY
5. EVALUATE EFFECTS ON THERMAL REGULATION

CANDIDATE EQUIPMENT:

- M-5 (A); M-6 (A); M-7 (A); M-12; M-18
- STANDARD CLINICAL AND LABORATORY TECHNIQUES
- STANDARD STORAGE TECHNIQUES
- PROPOSED TECHNIQUES (SPAMAG, INDUSTRY)

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : BEHAVIORAL-EXPERIMENTS 0201, 0202 AND 0203

EXPERIMENTAL OBJECTIVES :

1. EVALUATE SENSORY-PERCEPTUAL PROCESSES
2. EVALUATE PSYCHOMOTOR FUNCTIONING
3. EVALUATE HIGHER MENTAL PROCESSES

CANDIDATE EQUIPMENT:

- M-B
- STANDARD CLINICAL AND LABORATORY TECHNIQUES
- PROPOSED BEHAVIORAL CONSOLE (INDUSTRY)

GEMINI MEDICAL EXPERIMENTS SCHEDULE (JANUARY 1965)

CODE	EXPERIMENT TITLE	WEIGHT GROSS	VOLUME GROSS	ST-3 1 subject	ST-6 4 subjects	ST-7 7 (5-6)	ST-8-9 7 (5-6)	ST-7	ST-8	ST-9	ST-10	ST-11	ST-12
EM-1	COFFIN	2 ML	24			1	+	1	+				
EM-2	SOFT TISSUE	NA	NA	+ INCORPORATED INTO MED. SPL. PROCEDURE				1	+	1	1	+	
EM-3	EXERCISE TOLERANCE	1 ML	10		1	1	+	1				+	
EM-4	PRIMAL ELECTROCARDIOGRAM	1 ML 1-10	10		1	1	1	1	+	+	1	+	
EM-5	WATER FLUIDS	25-50 ML 10-20	25-50 10-20				1	1	1	1	1	1	1
EM-6	WIRE DENSITOMETRY	NA	NA		1	1	+	1	+	+	+		
EM-7	ELECTROLYTE BALANCE	NA SPL. ANAL.	NA SPL. ANAL.					1		+			
EM-8	WATER ANALYSIS	10 ML	NA			+		1		1			
EM-9	PERMEABILITY	1 ML	1-10 EXPERIMENT			1 st		1					
EM-10	REPERIMENT	NA	NA	INCORPORATED AS OPERATIONAL PROCEDURE									
EM-11	ANALOGUE RESPONSE	NA	NA	INCORPORATED AS MED. SPL. PROCEDURE									

1 - APPROVED AND RECOMMENDED

+ - APPROVED, LATER-GRANTED BY MED. SEC.

1st - APPROVED TO SCHEDULE BY BOARD AT LATER DATE

WORLDWIDE MED. SEC.
REV. 10-27-65



GEMINI OPERATIONAL MEDICAL FINDINGS THROUGH GEMINI 5

(MAXIMUM DURATION 8 DAYS)

- DEHYDRATION
- DECREASED BLOOD VOLUME
- DIMINISHED TILT TABLE TOLERANCE
(UP TO 36 HOURS POST-FLIGHT)
- ALTERED SLEEP PATTERNS IN-FLIGHT
(WITH LATER RETURN TO NORMAL - GEMINI 5)
- NO DEGRADATION OF OPERATIONAL PERFORMANCE
- PHYSIOLOGICAL STATUS RETURNED TO NORMAL WITHIN
ONE WEEK



POTENTIAL MEDICAL PROBLEM AREAS AS VIEWED PRE-GEMINI

FUNCTIONS QUESTIONED

ORIGIN OF EVIDENCE

GEMINI APPROACHES

PRIMARY QUESTIONS

CARDIOVASCULAR	1, 2, & 3	M.O. - EXP. M1, M3, M4 & M5
WATER BALANCE (DEHYDRATION)	1, 2, & 3	M.O. - EXP. M5
SKELETAL	2	EXP. M5, M6, & M7
MUSCULAR	1 & 2	M.O. - EXP. M7

OTHER IMPORTANT QUESTIONS

BEHAVIORAL	2	M.O.
VESTIBULAR	2 & 3	EXP. M3
METABOLIC & DIGESTIVE	2	[APOLLO]
RESPIRATORY	2	M.O.
CELLULAR	3	[APOLLO]
SLEEP AND DIURNAL RHYTHMS	2	M-8 [M-5]
VISUAL	1	[EXP. 5-8]

1 - MERCURY FLIGHTS

3 - RUSSIAN FLIGHT DATA

2 - GROUND BASED DATA

M.O. - MEDICAL OPERATIONS INFO.

FORM NO. 5-15-104

7-10-63

EXPECTED TIME COURSE IF SYMPTOMS DEVELOP IN WEIGHTLESSNESS

4½ HRS. 9 HRS. 24HRS. 48 HRS. 14 DAYS 3 MONTHS

NAUSEA
LABYRINTHINE
DISTURBANCE

GLBN
CARPENTER TITOV

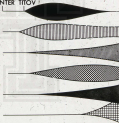
DIGESTIVE UPSET

SENSORY DEPRIVATION

SLEEP & DIURNAL
RHYTHM CHANGES

CIRCULATORY
IMPAIRMENT

MUSCLE & BONE
ATROPHY





BONE DEMINERALIZATION EXPERIMENT (M-6) PRELIMINARY FINDINGS GEMINI 4 AND 5

RAW DATA: GEMINI 4 (4 DAYS) - BS CALCIUS AND FIFTH FINGER X-RAYS OF BOTH ASTRONAUTS SHOW DIMINISHED POST-FLIGHT X-RAY DENSITY.

GEMINI 5 (8 DAYS) - QUANTITATIVE CHANGES SAME AS GEMINI 4 IN ONE ASTRONAUT; GREATER IN OTHER.

PROBLEMS: DATA VERY PRELIMINARY. REPETITION REQUIRED, PREFERABLY WITH SIMULTANEOUS CALCIUM BALANCE STUDY FOR ESTABLISHMENT OF STATISTICAL VALIDITY.

TENTATIVE CONCLUSIONS: SKELETAL DECONDITIONING OCCURS IN SPACE FLIGHT APPROXIMATELY AS ANTICIPATED. NO PRACTICAL PROBLEM IN 8 DAYS.

FUTURE PLANS: WILL BE REPEATED ON GEMINI 7 IN CONJUNCTION WITH CALCIUM BALANCE STUDY.



MEDICAL OPERATIONS FLIGHT DATA

PRE AND POST-FLIGHT

SOURCE

- PHYSICAL EXAMINATION
- BRIEFING & DEBRIEFING
- ROUTINE BLOOD & URINE ANALYSIS
- TILT TABLE
- BODY FLUID DISTRIBUTION
 - TOTAL BODY WATER
 - BLOOD VOLUME
 - PLASMA VOLUME
 - RBC MASS
- VENOUS COMPLIANCE
- ARTERIOLAR REACTIVITY

FINDINGS

DEHYDRATION

PERFORMANCE NORMAL

HUNGER IN FLIGHT, FOOD

INCREASED ENERGY [SEMI 4]

DEHYDRATION ONLY

DIMINISHED TOLERANCE

DECREASED

DECREASED

DECREASED

DIMINISHED

NOT MEASURED



SPACEFLIGHT MEDICAL INFORMATION REQUIRED

- EFFECTS ON HUMAN FUNCTIONS AND TIME COURSE
- MECHANISMS INVOLVED
- PREDICTIVE MEANS
- CORRECTIVE MEANS



№ п/п	наименование	2019 г.	2020 г.	2021 г.	2022 г.	2023 г.	2024 г.	2025 г.	2026 г.	2027 г.	2028 г.	2029 г.	2030 г.
01	исследования, разработки и опытные работы	100 000											
01-01	исследования	0	100	исследования по теме: «Исследования»									
01-02	исследования	0 000			0	0		0					
01-03	исследования	0 000			0	0		0					
01-04	исследования	0 000	0 000				0	0	0	0	0	0	0
01-05	исследования	0 000	0 000		0	0		0					
01-06	исследования	0	0		0	0		0					
01-07	исследования	0 000	0 000	исследования по теме: «Исследования»					0				
01-08	исследования	0 000	0					0		0			
01-09	исследования	0 000	0 000				0						
01-10	исследования	0 000	0 000				0						
01-11	исследования	0	0				исследования по теме: «Исследования»						
01-12	исследования	0	0				исследования по теме: «Исследования»						



IN-FLIGHT EXERCISE EXPERIMENT (M-3) PRELIMINARY FINDINGS GEMINI 4 AND 5

COMPARATIVE CARDIOVASCULAR RESPONSES TO EXERCISE:

FLIGHT / PRE-FLIGHT

FLIGHT / FLIGHT
(TIME COURSE)

GEMINI 4 (4 DAYS):
(BOTH ASTRONAUTS)

NO SIGNIFICANT
CHANGE

NO SIGNIFICANT
CHANGE

GEMINI 5 (8 DAYS):
(BOTH ASTRONAUTS)

NO SIGNIFICANT
CHANGE

NO SIGNIFICANT
CHANGE

PROBLEMS: EXERCISER USED NO LIB BECAUSE OF ASTRONAUT DESIRE
FOR EXERCISE.

TENTATIVE CONCLUSIONS: NO CHANGE IN CARDIOVASCULAR RESPONSE TO
EXERCISE DISCERNIBLE IN MISSIONS UP TO 8 DAYS.

FUTURE PLANS: TO BE REPEATED ON GEMINI 7.



GEMINI OPERATIONAL MEDICAL FINDINGS THROUGH GEMINI 5 (MAXIMUM DURATION 8 DAYS)

- DEHYDRATION
- DECREASED BLOOD VOLUME
- DIMINISHED TILT TABLE TOLERANCE
(UP TO 36 HOURS POST-FLIGHT)
- ALTERED SLEEP PATTERNS IN-FLIGHT
(WITH LATER RETURN TO NORMAL - GEMINI 5)
- NO DEGRADATION OF OPERATIONAL PERFORMANCE
- PHYSIOLOGICAL STATUS RETURNED TO NORMAL WITHIN
ONE WEEK



MEDICAL OPERATIONS FLIGHT DATA

IN-FLIGHT

SOURCE

FINDINGS

- ECG _____ ARRHYTHMIAS
- RESPIRATION _____ NO SIGNIFICANT CHANGE
- BLOOD PRESSURE _____ SLIGHT DECREASE
- TEMPERATURE _____ SLIGHT ELEVATION
- VOICE CONTACT _____ NO ABNORMALITIES IN ALERTNESS OR
COGNITION. EASE OF FATIGUE ON GEMINI
4 ATTRIBUTED TO UNSATISFACTORY
W-R-S CYCLES. CORRECTED ON GEMINI 5.



CARDIOVASCULAR CONDITIONING EXPERIMENT (M-1) PRELIMINARY FINDINGS

GEMINI 5

- EQUIPMENT FAILURE AT 92 HOURS, 28 MINUTES (SET)
- COMPARATIVE RESPONSES OF EXPERIMENTAL WITH CONTROL PILOT:
 - INFLIGHT
 - BLOOD PRESSURE _____ NO SIGNIFICANT DIFFERENCE
 - EKG _____ NO SIGNIFICANT DIFFERENCE
 - EXERCISE RESPONSES _____ NO SIGNIFICANT DIFFERENCE
 - PHONO-EKG _____ DATA REDUCTION IN PROCESS
 - POST FLIGHT
 - TILT RESPONSE _____ LESS CHANGE
 - BLOOD VOLUME _____ LESS CHANGE
 - PLASMA VOLUME _____ LESS CHANGE
 - RBC MASS _____ SAME
 - VENOUS COMPLIANCE _____ LESS CHANGE
- CONCLUSIONS: REQUIREMENTS FOR MODERATE TECHNICAL CHANGES ASCERTAINED
- FUTURE PLANS: TO BE REPEATED ON GEMINI 7



GEMINI MEDICAL EXPERIMENTS

- M-1 CARDIOVASCULAR CONDITIONING
- M-3 INFLIGHT EXERCISER
- M-4 INFLIGHT PHONOCARDIOGRAM
- M-5 BIOASSAYS BODY FLUIDS
- M-6 BONE DEMINERALIZATION
- M-7 CALCIUM BALANCE STUDY
- M-8 INFLIGHT SLEEP ANALYSIS
- M-9 HUMAN OTOLITH FUNCTION



SIGNIFICANCE OF MEDICAL DATA THROUGH GEMINI-5

- SIGNIFICANT TO 14 DAY AND LUNAR LANDING MISSIONS.
- SIGNIFICANT TO 14 DAY AND LUNAR LANDING MISSIONS.
- SIGNIFICANT TO PROLONGED EARTH ORBITAL MISSIONS.
- SIGNIFICANT TO ORL PLANNING.
- SIGNIFICANT TO LONG TERM MISSION PLANNING AND VEHICULAR DESIGN.
- SIGNIFICANT TO FUTURE LONG DURATION MISSIONS.
- SIGNIFICANT TO APPLICATION TO RESEARCH IN CLINICAL AND ENVIRONMENTAL MEDICINE.



HUMAN OTOLITH FUNCTION EXPERIMENT (M-9) PRELIMINARY FINDINGS GEMINI 5

COMPARATIVE FINDINGS:

OCULAR COUNTER-ROLLING:

C. PILOT
PILOT

DATA REDUCTION
IN PROCESS

EVLH:

C. PILOT
PILOT

CONSISTENT ERROR INFLIGHT
CONSISTENTLY NOMINAL

ADDITIONAL OBSERVATIONS:

NO VESTIBULAR SYMPTOMS OR SIGNS DURING OR FOLLOWING FLIGHT.

PROBLEMS:

HEAD POSITION NOT FIXED BY BRACE DURING INFLIGHT EVLH TESTS.

TENTATIVE CONCLUSIONS:

PROBABLY NO CHANGE IN OTOLITH FUNCTION IN 8 DAYS OF SPACEFLIGHT.

FUTURE PLANS:

WILL BE REPEATED ON GEMINI 7.

Wallo, WSA-10-100
4-22-68



PHONOCARDIOGRAM EXPERIMENT (M-4) PRELIMINARY FINDINGS GEMINI 4 AND 5

COMPARATIVE RESPONSES:

GEMINI 4 (4 DAYS):
(BOTH ASTRONAUTS)

GEMINI 5 (8 DAYS):

FLIGHT PRE-FLIGHT

FLIGHT FLIGHT
(TIME COURSE)

NO SIGNIFICANT CHANGE
(PRELIMINARY)

NO SIGNIFICANT CHANGE
(PRELIMINARY)

DATA REDUCTION CURRENTLY IN PROGRESS

PROBLEMS:

NONE

TENTATIVE CONCLUSIONS:

NO EVIDENCE OF MYOCARDIAL DECONDITIONING BY THIS METHOD IN
4 DAYS OF SPACE FLIGHT

FUTURE PLANS:

TO BE REPEATED ON GEMINI 7



CONTRIBUTION OF GEMINI MEDICAL INFORMATION [THRU GEMINI 5] TO PRE-GEMINI MEDICAL PROBLEM AREAS

CARDIOVASCULAR	DECONDITIONING TREND DEMONSTRATED; NO DISABILITY - 8 DAYS
WATER BALANCE	DEHYDRATION TREND DEMONSTRATED NO DISABILITY - 8 DAYS
SKELETAL	EARLY ATROPHY SUGGESTED-NO DISABILITY - 8 DAYS
MUSCULAR	EARLY ATROPHY NOTED; NO DISABILITY - 8 DAYS
BEHAVIORAL	NO DEGRADATION
VESTIBULAR	PROBABLY NO CHANGE
METABOLIC AND DIGESTIVE	NO DYSFUNCTION NOTED
RESPIRATORY	NO DYSFUNCTION NOTED
CELLULAR	[APOLLO]
SLEEP AND DIURNAL RHYTHMS	SLEEP PATTERNS ALTERED - THEN NORMALIZED IMPORTANCE OF W-R-S CYCLE STRESSED
VISUAL	ACUITY UNCHANGED - VISIBILITY EXCELLENT FROM EARTH ORBIT



SIGNIFICANCE OF MEDICAL DATA THROUGH GEMINI-5

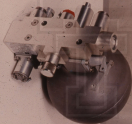
- VALIDATION OF MAN FOR SPACE FLIGHT OF 8 DAYS
- VALIDATION OF LIFE SUPPORT TECHNOLOGY FOR 8 DAYS OF SPACE FLIGHT
- RADIATION HAZARD SMALL IN NEAR EARTH ORBIT
- CARDIOVASCULAR AND BONE RECONDITIONING TENDENCIES AND VESTIBULAR EFFECTS BETTER DEFINED
- EVA CAPABILITY DEMONSTRATED - CREW SUPPORT VALIDATED
- MEDICAL GROUND SUPPORT TECHNIQUES AND EQUIPMENT VALIDATED TO 8 DAYS
- GEMINI BIOSENSORS VALIDATED TO 8 DAYS OF CONTINUOUS FUNCTION

PROJECT MERCURY BIOINSTRUMENTATION

- TEMPERATURE
- ECG
- RESPIRATION
- BLOOD PRESSURE

IMCC - MISSION OPERATIONS CONTROL ROOM





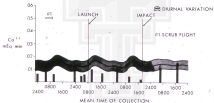


PLANNED SPACE FLIGHT CURRENT MISSION SCHEDULE, ASSIGNMENTS AND PLANNED MEDICAL EXPERIMENTS

MISSION / Duration	COLUMBIA												COLUMBIA												COLUMBIA																																
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12																					
STS-1 1 day 17 hrs	✱	FIRST SPACEWALK (SOLAR)																																																							
STS-2 2 days 18 hrs			✱	SECOND SPACEWALK (SOLAR)																																																					
STS-3 7 days 18 hrs				✱	THIRD SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5																																								
STS-4 7 days 18 hrs					✱	FOURTH SPACEWALK (SOLAR)												SOL 1 SOL 2																																							
STS-5 20 days 18 hrs						✱	FIFTH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9																																						
STS-6 27 days 18 hrs							✱	SIXTH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9 SOL 10 SOL 11 SOL 12																																					
STS-7 27 days 18 hrs								✱	SEVENTH SPACEWALK (SOLAR)												SOL 1 SOL 2																																				
STS-8 27 days 18 hrs									✱	EIGHTH SPACEWALK (SOLAR)												SOL 1 SOL 2																																			
STS-9 27 days 18 hrs										✱	NINTH SPACEWALK (SOLAR)												SOL 1 SOL 2																																		
STS-10 27 days 18 hrs											✱	TENTH SPACEWALK (SOLAR)												SOL 1 SOL 2																																	
STS-11 27 days 18 hrs												✱	ELEVENTH SPACEWALK (SOLAR)												SOL 1 SOL 2																																
STS-12 27 days 18 hrs													✱	TWELFTH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9 SOL 10 SOL 11 SOL 12																															
STS-13 27 days 18 hrs														✱	THIRTEENTH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9 SOL 10 SOL 11 SOL 12																														
STS-14 27 days 18 hrs															✱	FOURTEENTH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9 SOL 10 SOL 11 SOL 12																													
STS-15 27 days 18 hrs																✱	FIFTEENTH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9 SOL 10 SOL 11 SOL 12																												
STS-16 27 days 18 hrs																	✱	SIXTEENTH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9 SOL 10 SOL 11 SOL 12																											
STS-17 27 days 18 hrs																		✱	SEVENTEENTH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9 SOL 10 SOL 11 SOL 12																										
STS-18 27 days 18 hrs																			✱	EIGHTEENTH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9 SOL 10 SOL 11 SOL 12																									
STS-19 27 days 18 hrs																				✱	NINETEENTH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9 SOL 10 SOL 11 SOL 12																								
STS-20 27 days 18 hrs																					✱	TWENTIETH SPACEWALK (SOLAR)												SOL 1 SOL 2 SOL 3 SOL 4 SOL 5 SOL 6 SOL 7 SOL 8 SOL 9 SOL 10 SOL 11 SOL 12																							

MERCURY BIOCHEMICAL DATA

MAY 9 1516 MAY 1963





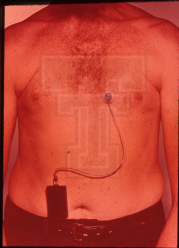


PROPOSED SCHEDULE OF APOLLO MEDICAL IN-FLIGHT EXPERIMENTS

DAY 1 (APR 11-12, 1968)				DAY 2 (APR 13-14, 1968)				DAY 3 (APR 15-16, 1968)			
TIME	TARGET TIME	EXPERIMENT	STATUS	TIME	TARGET TIME	EXPERIMENT	STATUS	TIME	TARGET TIME	EXPERIMENT	STATUS
0600	0600	01-01	01-01								
0600	0600	01-02	01-02								
0600	0600	01-03	01-03								
0600	0600	01-04	01-04								
0600	0600	01-05	01-05								
0600	0600	01-06	01-06								
0600	0600	01-07	01-07								
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0600	0600	01-97	01-97								
0600	0600	01-98	01-98								
0600	0600	01-99	01-99								
0600	0600	01-100	01-100								







- INFLIGHT DATA

- TM
- ON BOARD RECORDING
- POST FLIGHT DETERMINATIONS

- BASELINE DATA

- SELECTION
- CENTRIFUGE RUNS
- SIMULATIONS
- TRAINERS
- PRESSURE CHAMBER RUNS
- STRESS STUDIES
- ROUTINE PHYSICAL EXAMINATIONS
- GENERAL OBSERVATIONS
- PRE FLIGHT DETERMINATIONS

MA - 9 EXPERIMENTS LOCATION

BIOMEDICAL STUDIES
EXPERIMENT

WASHERMAN CAMERA 35 M.M. 1

ORCA LIGHT PHENOMENA

PHOTOGRAPHY WASH

CAMERA 35 M.M. 1

BIOMEDICAL STUDIES

FLUID MANNED

BIOMEDICAL STUDIES

SCAPHODIGITAL ADAPTATION
TO WEIGHTLESSNESS

BIOMEDICAL STUDIES

FLUID MANNED

BIOMEDICAL STUDIES

WASH-ORCA WASH

EXPERIMENT

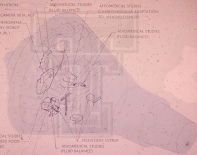
TELEVISION SYSTEM

BIOMEDICAL STUDIES

FLUID MANNED

CARDI ENVIRONMENTAL

FLUID MANNED



MISFEB APPROVED MEDICAL EXPERIMENTS FOR APOLLO

EXPERIMENT NO.

EXPERIMENT TITLE

M-1A	CARDIOVASCULAR REFLEX CONDITIONING
M-4A	IN-FLIGHT PHONOCARDIOGRAM
M-5A	BIOASSAYS BODY FLUIDS
M-6A	BONE DEMINERALIZATION
M-7A	CALCIUM BALANCE STUDY
M-8A	IN-FLIGHT SLEEP ANALYSIS
M-9A	HUMAN STOLITH FUNCTION
M-11	CYTOTOXIC STUDY
M-12	EXERCISE DROOMETER
M-17	THORACIC BLOOD FLOW
M-18	VECTOCARDIOGRAM
M-19	METABOLIC RATE MEASUREMENT
M-20	PULMONARY FUNCTION
M-22	RED BLOOD CELL SURVIVAL
M-23	LOWER BODY NEGATIVE PRESSURE

MEASUREMENTS AND TECHNIQUES

METABOLIC AND NUTRITIONAL (CONT'D)

GENERAL METABOLISM AND NUTRITION:

- METABOLISM AT VARIOUS LEVELS OF ACTIVITY (O_2 CONSUMPTION, CO_2 PRODUCTION, AND CALORIC INTAKE)
- GLUCOSE TOLERANCE
- FAT TOLERANCE
- MEASUREMENT OF ACID-BASE METABOLISM (SEE ALSO "RESPIRATORY GAS EXCHANGE")
- PROTEIN METABOLISM (SERUM PROTEINS WITH ELECTROPHORESIS; NPN; BUN; BLOOD URIC ACID)
- FLUID BALANCE
- BODY FLUID DISTRIBUTION (SEE "CARDIOVASCULAR")
- STANDARD CLINICAL URINALYSIS

GASTROINTESTINAL ACTIVITY:

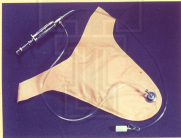
- MEASUREMENT OF GASTRIC ACIDITY AND pH (ENDONASAL)

THERMAL REGULATION:

- COMFORT INDEX FOR VARYING THERMAL LOADS
- CARDIOVASCULAR RESPONSE TO THERMAL CHANGE (ORTHOSTATIC TOLERANCE AND CUTANEOUS BLOOD FLOW) (SEE "CARDIOVASCULAR")

* Effects of thermal change on metabolism, fluid and electrolyte balance, and other measurements also to be assessed.

URINE COLLECTION BAG ASSEMBLY



PROJECT MERCURY MEDICAL EXPERIMENTS

1. XYLOSE ABSORPTION TEST
2. CALIBRATED EXERCISE (BUNGEE CORD)
3. TILT-TABLE STUDIES WITH FLACK TEST
4. EVALUATION OF HORMONAL OUTPUT
 - A) STEROIDS
 - B) ADRENALIN
 - C) NOREPINEPHRINE

MEASUREMENTS AND TECHNIQUES

ENDOCRINE *

- CLINICAL ENDOCRINE EVALUATION (Hx, FORM, AND Px)
- MEASUREMENT OF PITUITARY ACTIVITY (CIRCULATING ACTH; URINARY ADH, AND SPECIFIC GRAVITY)
- MEASUREMENT OF THYROID ACTIVITY (PB; TUBA)
- MEASUREMENT OF PARATHYROID ACTIVITY (CIRCULATING PARATHORMONE)
- MEASUREMENT OF ADRENAL CORTICAL ACTIVITY (URINARY 17 OHCS, 17 KETOSTEROIDS, AND ALDOSTERONE)
- MEASUREMENT OF GONADAL ACTIVITY PRE- AND POST-FLIGHT (SEMI CELL EXAMINATION)
- MEASUREMENT OF NEURO-HUMORAL ACTIVITY (URINARY CATECHOLAMINES AND SEROTONIN)

*The majority of R & A medical measurements and techniques described, particularly under "Metabolism and Nutrition," are applicable to the evaluation of endocrine function. They are too numerous to be listed here.

† Assays to be done in earth-based laboratories on specimens collected and stored in flight.

MEASUREMENTS AND TECHNIQUES

ENDOCRINE *

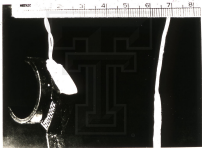
- CLINICAL ENDOCRINE EVALUATION (Rx FORM, AND P₁)
- MEASUREMENT OF PITUITARY ACTIVITY (CIRCULATING ACTH; URINARY ADH, AND SPECIFIC GRAVITY)
- MEASUREMENT OF THYROID ACTIVITY (PBL TBPA)
- MEASUREMENT OF PARATHYROID ACTIVITY (CIRCULATING PARATHORMONE)
- MEASUREMENT OF ADRENAL CORTICAL ACTIVITY (URINARY 17 OHCS, 17 KETOSTEROIDS, AND ALDOSTERONE)
- MEASUREMENT OF GONADAL ACTIVITY (PRE- AND POST-FLIGHT GERM CELL EXAMINATION)
- MEASUREMENT OF NEURO-HUMORAL ACTIVITY (URINARY CATECHOLAMINES AND SEROTONIN)

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URINE TRANSFER SYSTEM





RESPIRATION SENSOR (LEFT) AND DEEP BODY TEMPERATURE PROBE (RIGHT).

MEASUREMENTS AND TECHNIQUES

MICROBIOLOGICAL

- CLINICAL EXAMINATION (Hx FORM, AND Px)
- ASSESSMENT OF CHANGES IN MICROBIOLOGICAL ECOLOGY AMONG FLIGHT CREW MEMBERS (CULTURES OF NOSE, THROAT, GI TRACT, SKIN; COUGH PLATES; CULTURES OF CABIN AND SUIT ECS)

HEMATOLOGICAL

GENERAL:

CLINICAL EVALUATION (R_h FORM AND P_k)

CELLULAR CHANGES:

- MEASUREMENT OF HEMIC CELL DYNAMICS (BLOOD CELL COUNTS AND MORPHOLOGY)
- RBC SURVIVAL (ISOTOPE TAGGED RBC'S; RBC FRAGILITY; DIRECT BILIRUBIN - M-22)
- CYTOGENETIC STUDIES (LYMPHOCYTE KARYOTYPING - M-11)

BODY DEFENSES:

- LEUKOCYTE MOBILITY (PHAGOCYTOSIS)
- IMMUNOLOGICAL EVALUATION (GLOBULIN ELECTROPHORESIS; ANTIBODY TITRATION; MEASUREMENT OF COMPLEMENT)

HEMOSTASIS:

- EVALUATION OF HEMOSTATIC MECHANISMS (BLEEDING AND COAGULATION TIMES; ASSAY OF ELEMENTS OF CLOTTING)

SPAMAG RECOMMENDATIONS

1. LIFE SUPPORT
[CONTROLLED ENVIRONMENTAL FACTORS]
2. MEDICAL EXPERIMENTS
[UNCONTROLLED ENVIRONMENTAL FACTORS]
3. ORL DECISIONS
[SPECIFICATIONS AND OPERATIONS]

ORAL
TEMPERATURE
PROBE
INSTALLATION



METABOLIC AND NUTRITIONAL (CONT'D)

GENERAL METABOLISM AND NUTRITION:

- METABOLISM AT VARIOUS LEVELS OF ACTIVITY & CONSUMPTION, O_2 PRODUCTION, AND CALORIC INTAKE
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- FAT TOLERANCE
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- FLUID BALANCE
- BODY FLUID DISTRIBUTION (SEE "CARDIOVASCULAR")
- STANDARD CLINICAL URINALYSIS

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- MEASUREMENT OF GASTRIC ACIDITY AND pH (ENDONASAL/INTRA)

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MEASUREMENTS AND TECHNIQUES

MICROBIOLOGICAL

- CLINICAL EXAMINATION (Hx FORM, AND Px)
- ASSESSMENT OF CHANGES IN MICROBIOLOGICAL ECOLOGY AMONG FLIGHT CREW MEMBERS (CULTURES OF NOSE, THROAT, GI TRACT, SKIN; COUGH PLATES; CULTURES OF CABIN AND SUIT ECS)

SOURCES OF MEDICAL AND BEHAVIORAL IN-FLIGHT EXPERIMENTS

BIO MEDICAL EXPERIMENT WORKING GROUP

[IN-HOUSE - ARC - LRC - MSC - HQRS, REPRESENTATIVES]

TECHNICAL ADVISORY COMMITTEE ON MEDICAL BEHAVIORAL IN-FLIGHT EXPERIMENTS

[IN-HOUSE - ARC - LRC - MSC - HQRS, REPRESENTATIVES]

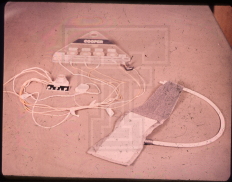
INDUSTRY STUDIES

[NORTH AMERICAN - REPUBLIC - LOCKHEED]

SPACE MEDICINE ADVISORY GROUP

[SCIENTIFIC COMMUNITY]

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MEASUREMENTS AND TECHNIQUES

HEMATOLOGICAL

GENERAL:

CLINICAL EVALUATION (Rx FORM AND Px)

CELLULAR CHANGES:

- MEASUREMENT OF HEMIC CELL DYNAMICS (BLOOD CELL COUNTS AND MORPHOLOGY)
- RBC SURVIVAL (ISOTOPE TAGGED RBC'S; RBC FRAGILITY; DIRECT BILIRUBIN - M-22)
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HEMOSTASIS:

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G. DONALD WHEDON, M.D.

EARL A. WOOD, M.D., PH.D.

LOCATION OF FILM BADGES

