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## SPACE LIFE SCIENCES PERSPECTIVES FOR SPACE STATION FREEDOM

Presented by Laurence R. Young, Sc.D.  
Massachusetts Institute of Technology and  
NASA Johnson Space Center

### ABSTRACT

It is now generally acknowledged that the life science discipline will be the primary beneficiary of Space Station Freedom. The unique facility will permit advances in understanding the consequences of long duration exposure to weightlessness and evaluation of the effectiveness of countermeasures. It will also provide an unprecedented opportunity for basic gravitational biology, on plants and animals as well as human subjects. The major advantages of SSF are the long duration exposure and the availability of sufficient crew to serve as subjects and operators.

In order to fully benefit from the SSF, life sciences will need both sufficient crew time and communication abilities. Unlike many physical science experiments, the life science investigations are largely exploratory, and frequently bring unexpected results and opportunities for study of newly discovered phenomena. They are typically crew-time intensive, and require a high degree of specialized training to be able to react in real time to various unexpected problems or potentially exciting findings. Because of the long duration tours and the large number of experiments, it will be more difficult than with Spacelab to maintain astronaut proficiency on all experiments. This places more of a burden on adequate communication and data links to the ground, and suggests the use of AI expert system technology to assist in astronaut management of the experiment. Typical life science experiments, including those flown on Spacelab Life Sciences I, will be described from the point of view of the demands on the astronaut. A new expert system, "PI in a Box," will be introduced for SLS-2, and its applicability to other SSF experiments discussed.



# **SPACE LIFE SCIENCES: EXPERIENCE AND PLANS**

**PROF. LAURENCE R. YOUNG**

**MIT, DEPT OF AERONAUTICS & ASTRONAUTICS**

**PAYLOAD SPECIALIST CANDIDATE, SLS-2**

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# **WHY IS SSF VITAL TO SPACE LIFE SCIENCES?**

**LONG DURATION EXPOSURES**

**COMPARABLE TO MARS EXPLORATION**

**ANIMALS AND PLANTS AS WELL AS HUMANS**

**MULTIPLE GENERATIONS OF PLANTS AND ANIMALS**

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## **WHAT DOES SSF OFFER FOR LIFE SCIENCES?**

### **CREW TIME:**

**SUFFICIENT NUMBER OF SUBJECTS**

**SPECIALIZED EXPERIMENTERS**

**FLEXIBILITY TO REPLAN STUDIES**

## **FACILITY REQUIREMENTS FROM LIFE SCIENCES**

**TWO WAY COMMUNICATION AND DATA LINKS  
EVENTUAL USE OF UPLINK VIDEO**

**SAMPLE RETURN CAPABILITY**

**ON BOARD ANALYSIS**

**BIOISOLATION**

**NORMAL ATMOSPHERIC CONDITIONS**

## MAJOR ON-BOARD EQUIPMENT

### BIOISOLATION:

GLOVE BOX TO PROTECT CREW AND SAMPLES

ANIMAL AND PLANT HOLDING FACILITIES

### CENTRIFUGE:

PROVIDE 1-G CONTROLS

MAINTAIN 1-G SAMPLES UNTIL NEEDED

PERMIT STUDIES IN THE 0-1 G RANGE

HEALTH MAINTENANCE FACILITY



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## SPECIALIZED ON-BOARD EQUIPMENT

LINEAR AND ANGULAR ACCELERATORS

IMAGING DEVICE

LOWER BODY NEGATIVE PRESSURE DEVICE



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## **HUMAN-ORIENTED RESEARCH**

### **ISSUES RELATED TO ADAPTATION TO 0-G**

**CARDIOVASCULAR DECONDITIONING  
PULMONARY FUNCTION ALTERATION  
MUSCLE LOSS AND CHANGE OF FIBER TYPES  
BONE LOSS AND CHANGE IN CALCIUM BALANCE  
PLASMA AND RED BLOOD CELL LOSS  
RENAL/ENDOCRINE SYSTEM  
IMMUNE SYSTEM  
SPACE MOTION SICKNESS AND NEUROVESTIBULAR  
ADAPTATION**



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## **PLANT AND ANIMAL EXPERIMENTS**

**COVER ALL BRANCHES OF PHYSIOLOGY  
CURRENT ANIMAL SPECIES: RATS, MONKEYS, FISH  
REQUIRE SOME SPECIALIZED CREW SKILLS**



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## RECENT LIFE SCIENCES EXPERIENCE

SPACELAB LIFE SCIENCES 1 (JUNE '92)

FIRST ALL LIFE SCIENCES MISSION

TWENTY INVESTIGATIONS/ SIX BODY SYSTEMS

HUMANS, RATS AND JELLYFISH STUDIED

SUCCESS DEPENDED ON CREW SKILLS

SPACELAB LIFE SCIENCES 2 SCHEDULED FOR 1993

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## SPECIAL PROBLEM RAISED BY SSF FOR LIFE SCIENCE STUDIES

LONG DURATION TOURS

MULTIPLE DISCIPLINES AND EXPERIMENTS

FLEXIBILITY TO ADJUST PROTOCOLS AND TIMES

*BUT*

*THE CREW NEEDS TIMELY REMOTE COACHING, AND  
GUIDANCE DURING CONDUCT OF THE EXPERIMENTS*

HIGH B/W COMMUNICATION TO PI'S IS AN APPROACH  
ON-BOARD EXPERTS SYSTEMS ARE ALTERNATIVES

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