



National Aeronautics and
Space Administration

SPACE STATION FREEDOM EVOLUTION SYMPOSIUM

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OFFICE OF COMMERCIAL PROGRAMS

AUGUST 6, 1991

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RESPONSIBILITIES

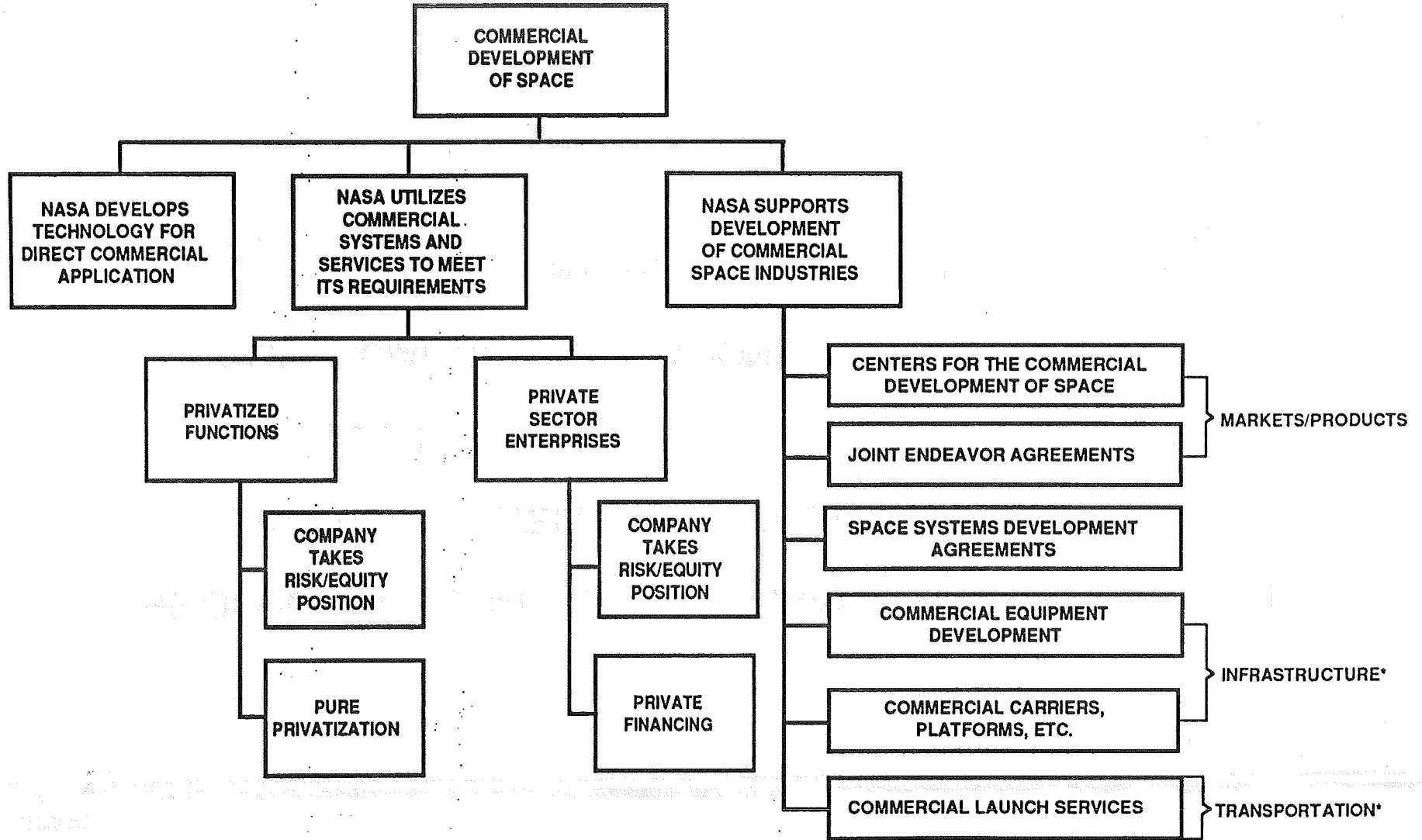
THE OFFICE OF COMMERCIAL PROGRAMS IS RESPONSIBLE FOR:

- COMMERCIAL DEVELOPMENT OF SPACE
- TECHNOLOGY UTILIZATION
- COMMERCIAL COMMUNICATIONS SYSTEMS
- SMALL BUSINESS INNOVATION RESEARCH PROGRAM

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NASA'S ACTIVITIES IN COMMERCIAL DEVELOPMENT OF SPACE



*NOTE: DIRECTLY SUPPORT DEVELOPMENT OF MARKETS AND PRODUCTS

**INDUSTRY DEVELOPMENT NEEDS AND
OFFICE OF COMMERCIAL PROGRAMS STRATEGY**

• **GIVEN**

- PRIVATE MARKETS/PRODUCTS MUST BE DEVELOPED IF TRUE COMMERCIAL DEVELOPMENT IS TO HAPPEN
- SATELLITE COMMUNICATIONS AND MICROGRAVITY TECHNOLOGIES WILL STIMULATE THE GROWTH OF PRIVATE MARKETS
- PRIVATE MARKET ENTERPRISES ARE THE FUTURE CUSTOMERS FOR TRANSPORTATION AND INFRASTRUCTURE ENTERPRISES

• **STRATEGY**

- THE GOVERNMENT MUST CONCENTRATE ITS ASSISTANCE AND RESOURCES ON STIMULATING NEW SPACE MARKET DEVELOPMENTS
- THE GOVERNMENT SHOULD SUPPORT TRANSPORTATION AND INFRASTRUCTURE VENTURES THAT CAN DIRECTLY CONTRIBUTE TO DEVELOPMENT OF NEW MARKETS OR BE TRANSITIONED IN THE FUTURE FROM GOVERNMENT TO PRIVATE USE
- GET INDUSTRY DIRECTLY INVOLVED IN PLANNING AND OVERSIGHT OF NATION'S COMMERCIAL SPACE ACTIVITIES



CENTERS FOR THE COMMERCIAL DEVELOPMENT OF SPACE (CCDS)

DESCRIPTION:

CCDS'S ARE JOINT UNDERTAKINGS INVOLVING TEAMS OF U.S. INDUSTRY, UNIVERSITY, AND OTHER NON-NASA GOVERNMENT

OBJECTIVE:

PROVIDE A PATHWAY FOR U.S. INDUSTRY TO DEVELOP COMMERCIAL MARKETS USING THE ATTRIBUTES OF SPACE

- NEW PRODUCTS**
- NEW SERVICES**
- NEW PROCESSES**

CRITERIA:

CONSORTIA OF INDUSTRY/ACADEMIA/GOVERNMENT

INDUSTRIALLY DRIVEN RESEARCH AND DEVELOPMENT

COMMITMENT OF NON-NASA RESOURCES

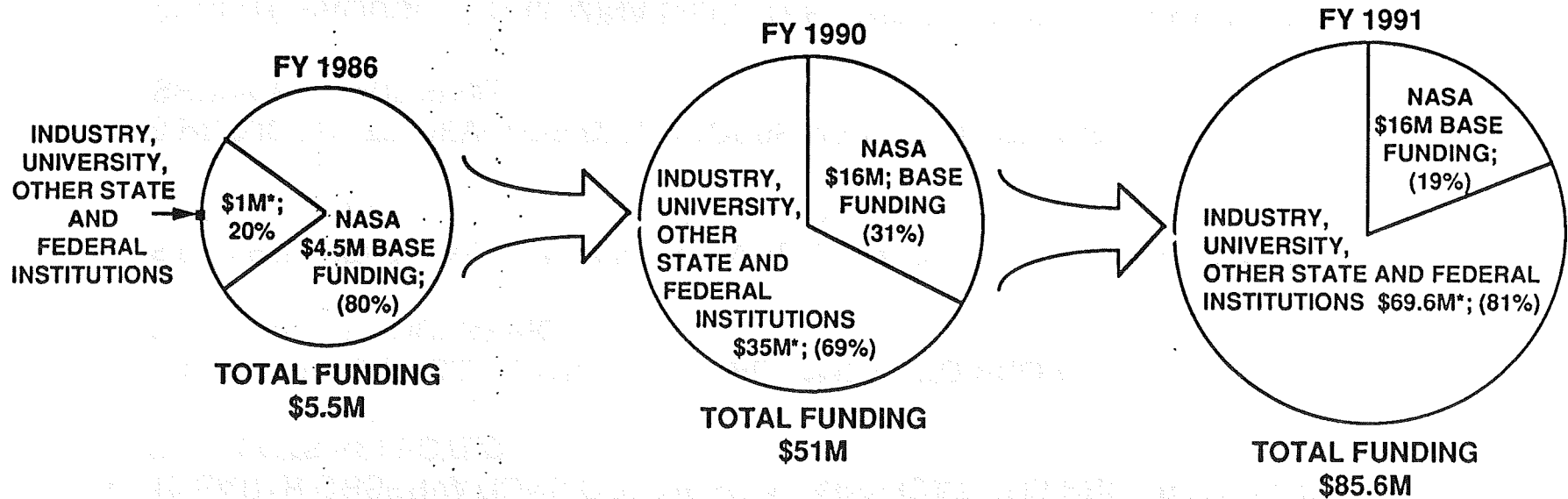
NASA FUNDS AT APPROX. \$1 MILLION/YEAR/CCDS PLUS SPECIFIC AUGMENTATIONS

COMMERCIAL USE OF SPACE PROGRAM SUMMARY – 1991

CENTER	COMMERCIAL FOCUS	AFFILIATES		
		INDUSTRY	UNIVERSITY	GOVT
<i>MATERIALS PROCESSING IN SPACE</i>				
BATTELLE	ELECTRONICS, POLYMER AND CATALYSTS APPLICATIONS—AEROPROPULSION, AIRFRAMES AND SPACE STRUCTURES	12	9	1
UAH	SUPERCONDUCTORS AND ELECTRO-OPTICAL MATERIALS—OPTICAL SCANNERS, SATELLITE COMPONENTS	10	0	1
VANDERBILT	METALS, ALLOYS, CERAMICS AND GLASSES—SOLAR DYNAMICS, NUCLEAR SYSTEMS, TURBINES, NOZZLE COMPONENTS	2	2	3
CLARKSON	ELECTRONICS, COMMUNICATIONS—COMPUTERS, SEMICONDUCTORS	10	6	4
HOUSTON	THIN FILM GROWTH AND MATERIALS PURIFICATION—ELECTRONICS, MAGNETIC DEVICES, COMPUTER CIRCUITS	6	4	5
<i>SPACE STRUCTURES</i>				
CASE WESTERN	FILMS, EXPANDABLE STRUCTURES—SPACE STRUCTURES	22	7	5
<i>REMOTE SENSING</i>				
ITD SRSC	PROCESSED REMOTE SENSING INFORMATION—FORESTRY, FISHERIES, AGRICULTURE	9	6	8
OHIO STATE	REMOTE SENSING SENSOR AND DISPLAY APPLICATIONS—COASTAL PLANNING, CROP STRESS, MINING	16	0	5
NASA STENNIS (EOCAP)	COMMERCIAL APPLICATION OF REMOTE SENSING DATA	49	10	11
<i>LIFE SCIENCES</i>				
PENN STATE	UNDERSTANDING OF CELL FUNCTIONS FOR DISEASE TREATMENT—OSTEOPOROSIS, GROWTH SYSTEM	30	0	3
COLORADO BIOSERVE	PHARMACEUTICAL, HEALTH CARE OR AGRICULTURAL PRODUCTION	33	4	3
UAB	CRYSTAL GROWTH FOR USE IN NEW PHARMACEUTICALS OR BIOTECHNOLOGY	11	17	3
<i>ROBOTICS</i>				
WISCONSIN	AUTOMATION AND ROBOTICS—DEXTEROUS ROBOT HANDS, INTELLIGENT, FLEXIBLE AUTOMATED SYSTEMS	10	3	2
ERIM	SENSOR AND AUTOMATED MANIPULATION TECHNOLOGY FOR HAZARDOUS ENVIRONMENTS—NUCLEAR WASTE CLEAN UP, MINING	12	1	3
AUBURN	ALTERNATIVE COMMERCIAL SPACE POWER—TRANSMISSION SYSTEMS, ADVANCED CONTROLLERS	4	3	6
<i>SPACE POWER</i>				
TEXAS A&M	COMMERCIAL SPACE POWER SYSTEMS—MICROWAVE TRANSMISSION, SPACE STATION FREEDOM AUGMENTATION	26	3	7
TENNESSEE	ALTERNATIVE SPACE PROPULSION TECHNOLOGIES	9	4	4
	TOTAL	271*	79*	74*
<i>SPACE PROPULSION</i>				

*SOME COMPANIES PARTICIPATE IN MORE THAN ONE CCDS

NASA IS SUCCESSFUL IN PHASE 1



NASA FUNDS, LEVERAGED BY INDUSTRY, UNIVERSITY, AND OTHER STATE AND FEDERAL INSTITUTIONS, HAVE YIELDED MANY ACCOMPLISHMENTS: 61 INDUSTRY-DRIVEN TECHNOLOGIES ARE BEING DEVELOPED TO DETERMINE COMMERCIAL POTENTIAL

- 238 INDUSTRY RELATIONSHIPS
- 72 UNIVERSITY RELATIONSHIPS
- 59 PATENTS IN PROCESS
- 865 PUBLICATIONS TO DATE
- 200 PUBLICATIONS IN WORK
- 14 SPINOFF COMPANIES/PRODUCTS
- 44 TECHNOLOGIES BEING USED BY INDUSTRY
- 1,089 DROP TUBE/DROP TOWER EXPERIMENTS COMPLETED
- 81 LEAR/KC-135 FLIGHTS COMPLETED
- 10 SHUTTLE FLIGHT TESTS COMPLETED SINCE RESUMPTION
- 19 SOUNDING ROCKET FLIGHT TESTS COMPLETED
- 64 HARDWARE SYSTEMS UNDER DEVELOPMENT FOR FLIGHT TEST

*NOTE: INCLUDES IN-KIND SERVICES

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CENTERS FOR THE COMMERCIAL DEVELOPMENT OF SPACE COMPANY AND TECHNOLOGY SPINOFFS

- **7 SPINOFF COMPANIES WITH 2 MORE IN NEGOTIATION**
- **8 DEVELOPMENT PROGRAMS IN REMOTE SENSING**
- **12 EARTH OBSERVATIONS COMMERCIAL APPLICATIONS PROGRAM (EOCAP II) PROJECTS SELECTED**
- **WAKE SHIELD FACILITY UNDER DEVELOPMENT TO PROVIDE ON-ORBIT MATERIALS PROCESSING**
- **5 PHARMACEUTICAL COMPANIES INVOLVED IN DEVELOPING PRODUCTS THROUGH PROTEIN CRYSTALLOGRAPHY RESEARCH**
- **8 PROJECTS TO DEVELOP BIOPROCESSING PRODUCTS OR SERVICES UNDERWAY**
- **ZEOLITE PRODUCTS (ALUMINA SILICATES) SHOW INCREASING PROMISE FOR BUSINESS AND MEDICAL APPLICATIONS**

KEY PROVISIONS JOINT ENDEAVOR AGREEMENT

- **OBJECTIVE:** TO INDUCE THE PRIVATE CAPITAL INVESTMENT DECISION ON A SPACE-BASED VENTURE BY SIGNIFICANTLY REDUCING UPFRONT FINANCIAL AND TECHNICAL RISKS

- **MAJOR RESPONSIBILITIES OF PRIVATE ENTITY**
 - CONDUCT EXPERIMENTS IN LOW G AND/OR DEVELOP HARDWARE AT COMPANY EXPENSE

 - COMMERCIALIZE ANY PROMISING RESULTS DEVELOPED UNDER JEA

- **MAJOR NASA RESPONSIBILITIES**
 - PROVIDE SHUTTLE FLIGHTS AND OTHER LAUNCH RELATED STANDARD SERVICES AT NO CHARGE TO PRIVATE ENTITY

 - PROVIDE TECHNICAL SUPPORT AND USE OF OTHER NASA EQUIPMENT, FACILITIES ON A NONINTERFERENCE BASIS AT NO CHARGE TO PRIVATE ENTITY

SPACE SYSTEMS DEVELOPMENT AGREEMENT (SSDA)

- **LAUNCH SERVICE AGREEMENT WITH SPECIAL PROVISIONS (E.G. DEFERRED PAYMENT SCHEDULE, EXCLUSIVITY)**
- **EARLY ENTRANTS IN NEW INDUSTRY**
- **INITIAL FLIGHTS OF A NEW SYSTEM CONTEMPLATED TO BEGIN GENERATING REVENUES DURING TERM OF AGREEMENT**
- **GENERALLY ASSOCIATED WITH DEVELOPMENT OF SPACE HARDWARE INFRASTRUCTURE**
- **POTENTIAL FOR SIGNIFICANT NATIONAL ECONOMIC OR OTHER BENEFITS**

CURRENT COMMERCIAL FLIGHT EXPERIMENT REQUIREMENTS

BATTELLE

POLYMER COMPOSITES
PLASMA PARTICLE/FILM GENERATION
INVESTIGATIONS INTO POLYMER MEMBRANES
PROCESSING
SOLUTION CRYSTAL GROWTH
FLOAT ZONE CRYSTAL GROWTH
ZEOLITE CRYSTAL GROWTH

CASE WESTERN

MATERIALS EXPOSURE - BASIC
MATERIALS EXPOSURE - APPLIED
MATERIALS EXPOSURE - ADVANCED

CLARKSON

LOW TEMPERATURE SOLIDIFICATION
DIRECTIONAL SOLIDIFICATION-CDTE
CHEMICAL VAPOR TRANSPORT OF CDTE
LIQUID ENCAPSULATED MELT ZONE
COMMERCIAL SOLUTION GROWTH FACILITY

COLORADO

GENERIC BIOPROCESSING APPARATUS
AUTONOMOUS BIOMEDICAL TEST APPARATUS
MICRO-ORGANISMIC REACTOR
CENTRIFUGAL FLUIDS MANAGEMENT
PLANT GROWTH APPARATUS
BIOSERVE MATERIALS DISPERSION APPARATUS

ERIM

GLOBAL TROPOSPHERIC CARBON MONOXIDE
MEASUREMENTS
AUTOMATED MICROGRAVITY MATERIALS PROCESSING
AUTONOMOUS RENDEZVOUS AND DOCKING

HOUSTON

MOLECULAR BEAM EPITAXY-SEMICONDUCTORS AND
GaAs
MOLECULAR BEAM EPITAXY-SEMICONDUCTORS, GaAlAs
AND GaInAs
MOLECULAR BEAM EPITAXY-SUPERCONDUCTORS AND
GaAs
MOLECULAR BEAM EPITAXY-HIGH TEMP
SUPERCONDUCTOR AND GaAlAs

OHIO/ITD

MAPSAT

PENN STATE

LIGHT STIMULUS
BONE DENSITOMETRY
EGG INCUBATOR
PHYSIOLOGICAL SYSTEMS EXPERIMENT
BIOMODULE
COMMERCIAL ELECTROPHORESIS PROGRAM IN SPACE

CURRENT COMMERCIAL FLIGHT EXPERIMENT REQUIREMENTS (CONT.)

TENNESSEE

PROPULSION
MICROGRAVITY FLUID MANAGEMENT
SPACE APPLICATIONS OF INDUSTRIAL LASER SYSTEMS

TEXAS A&M

MICRO HEAT PIPE EVALUATION
MICROWAVE POWER TRANSMISSION-PHASE I
MICROWAVE POWER TRANSMISSION-PHASE II
FROZEN STARTUP OF A HEAT PIPE IN MICROGRAVITY

UAB

PROTEIN CRYSTALLIZATION FACILITY
PROTEIN CRYSTAL GROWTH
PROTOTYPE PROTEIN CRYSTAL GROWTH
THERMAL ENCLOSURE SYSTEM

UAH

NON-LINEAR OPTICAL MATERIALS
3-D MICROGRAVITY ACCELEROMETER
IMMISCIBLE POLYMERS
ORGANIC SEPARATION
ELECTRODEPOSITION
NUCLEAR TRACK DETECTORS
POLYMER FOAM
SPACE EXPERIMENT FACILITY
HIGH TEMPERATURE SUPERCONDUCTORS
SINTERED AND ALLOYED MATERIALS
MATERIALS DISPERSION APPARTUS
ATOMIC OXYGEN

VANDERBILT

CRYSTAL GROWTH OF ELECTRONIC
MATERIALS
COMPUTATIONAL MODELING OF CASTING
PROCESSES
SOLAR FURNACE SATELLITE

WISCONSIN

ASTROCULTURE

GODDARD SPACE FLIGHT CENTER

ROBOTIC MATERIALS PROCESSING
SYSTEM

LANGLEY RESEARCH CENTER

GAS PERMEABLE POLYMER MATERIALS
MATERIALS IN DEVICES AS
SUPERCONDUCTORS

3M (JEA)

POLYMER MORPHOLOGY
PHYSICAL VAPOR TRANSPORT OF
ORGANIC SOLUTIONS
GELATION OF SOLS
POLYMERIZATION WITH LIGHT UNDER
MICROGRAVITY

CURRENT COMMERCIAL FLIGHT EXPERIMENT REQUIREMENTS (CONT.)

BIOCRYST (SSDA*)
PROTEIN CRYSTAL GROWTH

ITA (SSDA*)
MATERIALS DISPERSION APPARATUS

BOEING (JEA)
CHEMICAL VAPOR TRANSPORT EXPERIMENT

ROCKWELL (JEA)
FLUIDS EXPERIMENT APPARATUS

ITA (JEA)
ITA STANDARDIZED EXPERIMENT MODULE

* IN NEGOTIATION

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**CURRENT TRANSPORTATION PLANNING
COMMERCIAL USE OF SPACE**

	FISCAL YEAR								TOTAL
	1991	1992	1993	1994	1995	1996	1997	1998	
SHUTTLE EXPERIMENTS									
CARGO BAY/CAP	1	7	4	12	8	2	5	—	39
MIDDECK / SPACELAB	9	11	10	17	17	10	4	—	78
SPACEHAB EXPERIMENTS									
FLIGHTS (MODULE UTILIZATION)	—	—	0.8	1.6	1.6	—	—	—	4
PAYLOAD TESTS	—	—	16	32	29	—	—	—	77
EXPENDABLE LAUNCH VEHICLES (COMET)									
FLIGHTS	—	1	—	1	1	—	—	—	4
PAYLOAD TESTS	—	9	—	7	6	—	—	—	27
SOUNDING ROCKETS									
FLIGHTS	1	2	2	2	2	—	—	—	9
PAYLOAD TESTS	0	19	17	13	10	—	—	—	59
SPACE STATION									
FLIGHTS (UTILIZATION)	—	—	—	—	—	2	2	2	6
PAYLOAD TESTS	—	—	—	—	—	7	13	21	41
									321
							TOTAL		

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OFFICE OF
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CCDS EXPENDABLE LAUNCH VEHICLE PROGRAM

MISSION	1989	1990	1991	1992
CONSORT 1	▲ 3/29			
CONSORT 2*		▲ 11/15		
CONSORT 3		▲ 5/16		
JOUST 1*			▲ 6/18	
CONSORT 4				▲ 11/13
JOUST 2				▲ 5/6
COMET 1				10/92 ▲
* UNSUCCESSFUL				

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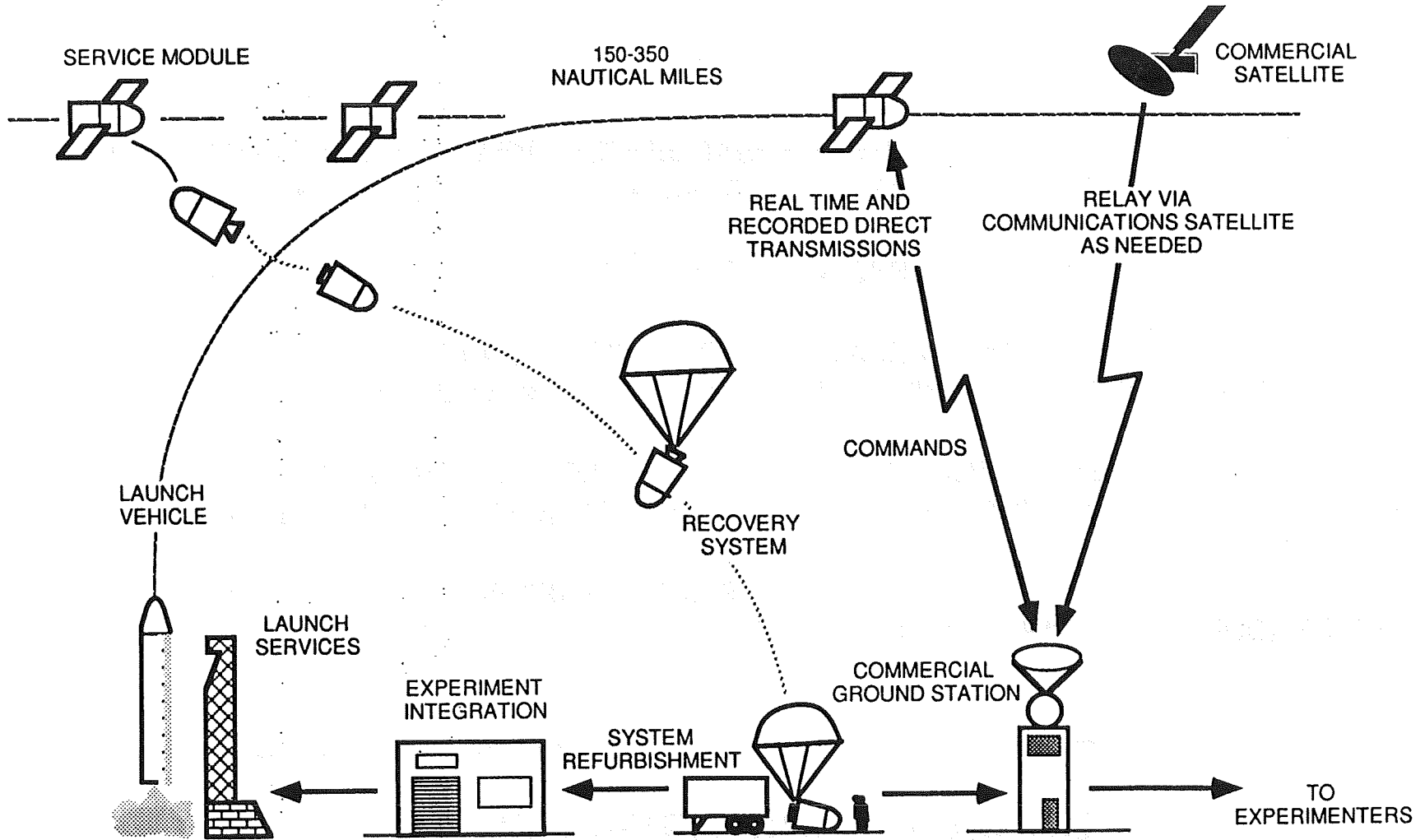
COMMERCIAL MIDDECK AUGMENTATION MODULE (CMAM)

- OFFICE OF COMMERCIAL PROGRAMS WILL LEASE SPACEHAB SERVICES TO ACCOMMODATE ITS PAYLOAD FLIGHT REQUIREMENTS
- ON NOVEMBER 30, 1990, A CMAM CONTRACT WAS SIGNED FOR 200 MIDDECK LOCKER EQUIVALENTS OVER 6 FLIGHTS WITH SPACEHAB, INC.
- SPACEHAB IS A PRESSURIZED, ORBITER-BASED CARRIER DESIGNED TO AUGMENT THE ORBITER MIDDECK
- FIRST FLIGHT FOR SPACEHAB IS SCHEDULED FOR APRIL 1993

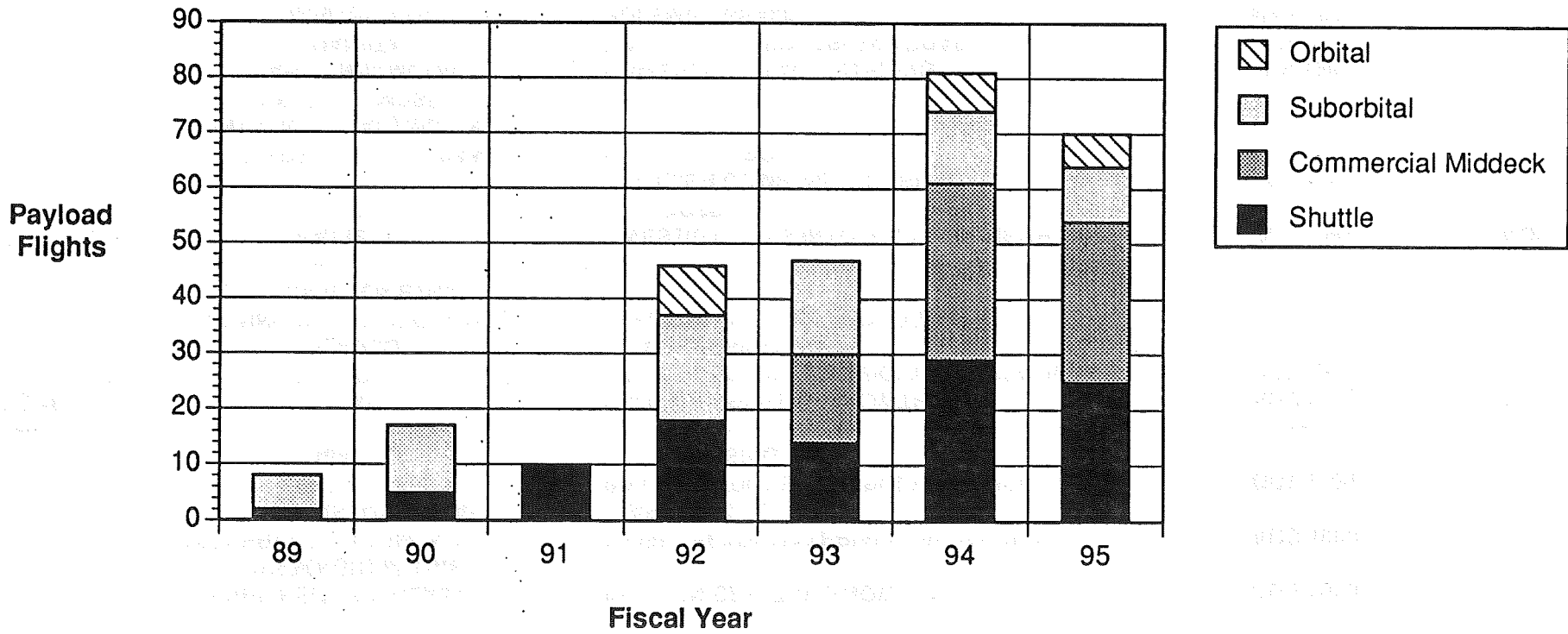
COMMERCIAL EXPERIMENT TRANSPORTER (COMET) PROGRAM

- COMET IS A COMMERCIALLY DEVELOPED SYSTEM FOR LAUNCHING AND RECOVERING COMMERCIAL SPACE-BORNE EXPERIMENTS
- LED BY THE CENTER FOR ADVANCED SPACE PROPULSION, UNIVERSITY OF TENNESSEE WITH SIX OTHERS CCDS'S PROVIDING OVERSIGHT FOR COMET SYSTEMS
- COMET WILL BE CARRIED ALOFT BY AN EXPENDABLE LAUNCH VEHICLE AND CONTAIN BOTH AN ORBITING SERVICE MODULE AND A RECOVERY CAPABILITY
- EER TO PROVIDE THE LAUNCH VEHICLE AND SERVICES
- SPACE INDUSTRIES, INC. TO PERFORM PAYLOAD INTEGRATION AND ORBITAL OPERATIONS; AND TO PROVIDE THE RECOVERY SYSTEM
- WESTINGHOUSE TO PROVIDE SYSTEMS ENGINEERING AND THE SERVICE MODULE
- LAUNCH OF COMET-1 SCHEDULED FOR SEPTEMBER 1992, TWO FOLLOW-ON FLIGHTS IN 1994 AND 1995

COMMERCIAL EXPERIMENT TRANSPORTER CONCEPT



OCP FLIGHT PROGRAM



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OFFICE OF
COMMERCIAL
PROGRAMS

COMMERCIAL FLIGHT PROJECTION THROUGH FISCAL YEAR 1992

<u>FLIGHT</u>	<u>SPONSOR</u>	<u>PAYLOAD</u>	<u>HARDWARE AVAILABILITY</u>	<u>LAUNCH DATE</u>
STS-43	UNIVERSITY OF ALABAMA -BIRMINGHAM (UAB)	PROTEIN CRYSTAL GROWTH*	AUG 1988	AUG 1991
	BIOSERVE/INSTRUMENTATION TECH. ASSOCS. (ITA)	BIOSERVE/ITA MATERIALS DISPERSION APPARATUS*	AUG 1990	
	BATTELLE/ AMOCO	INVESTIGATIONS INTO POLYMER MEMBRANE PROCESSING*	OCT 1989	
STS-48	UAB	PROTEIN CRYSTAL GROWTH*	AUG 1988	SEP 1991
	BATTELLE/ AMOCO	INVESTIGATIONS INTO POLYMER MEMBRANE PROCESSING*	OCT 1989	
	JOHNSON SPACE CENTER (JSC)/AUTOMETRIC	ELECTRONIC STILL PHOTOGRAPHY - DTO*		
CONSORT-04	BATTELLE/ AMOCO	INVESTIGATIONS INTO POLYMER MEMBRANE PROCESSING*	OCT 1989	NOV 1991
		POLYMER COMPOSITE CURING*	APR 1990	
		ELECTRODEPOSITION*	FEB 1989	
		POWERED METAL SINTERING*	FEB 1989	
		MATERIALS DISPERSION APPARATUS*	FEB 1989	
		POLYMER BEAM*	MAY 1991	
		GENERIC BIOPROCESSING APPARATUS*	APR 1990	
	BIOMODULE*	OCT 1989		
	UNIVERSITY OF ALABAMA -HUNTSVILLE (UAH)/MCDONNELL DOUGLAS (MDSSC)			
	UAH/KENAMETAL			
	UAH/ITA			
	UAH/THIOKOL			
	BIOSERVE			
	PENN STATE UNIV./GENENTECH			

* ASSIGNED

** FLIGHT COMPLETED

NOTE: SHUTTLE FLIGHT DATES ARE BASED ON MANIFEST PLANNING ON 6/28/91

COMMERCIAL FLIGHT PROJECTION THROUGH FISCAL YEAR 1992 (CONTINUED)

<u>FLIGHT</u>	<u>SPONSOR</u>	<u>PAYLOAD</u>	<u>HARDWARE AVAILABILITY</u>	<u>LAUNCH DATE</u>
STS-42	BATTELLE/ AMOCO UAB 3M JSC/AUTOMETRIC	INVESTIGATIONS INTO POLYMER MEMBRANE PROCESSING*	OCT 1989	JAN 1992
		PROTEIN CRYSTAL GROWTH *	AUG 1988	
		GELATION OF SOLS* ELECTRONIC STILL PHOTOGRAPHY - DTO*	JAN 1991	
STS-45	BATTELLE/AMOCO	INVESTIGATIONS INTO POLYMER MEMBRANE PROCESSING*	OCT 1989	MAR 1992
STS-49	BOEING UAB	CRYSTALS BY VAPOR TRANSPORT EXPERIMENT *	OCT 1991	APR 1992
		PROTEIN CRYSTAL GROWTH*	SEPT 1991	
143 JOUST-02	BATTELLE/AMOCO UAH/MDSSC UAH/KENAMETAL UAH/THIOKOL BIOSERVE PENN. STATE UNIV/GENENTECH UAH/(ITA)	INVESTIGATIONS INTO POLYMER MEMBRANE PROCESSING*	OCT 1989	MAY 1992
		POLYMER COMPOSITE CURING*	APR 1990	
		ELECTRODEPOSITION*	FEB 1989	
		POWERED METAL SINTERING*	FEB 1989	
		POLYMER FOAM*	FEB 1989	
		THIOKOL THIN FILMS*	FEB 1989	
		GENERIC BIOPROCESSING APPARATUS*	APR 1990	
		BIOMODULE*	OCT 1989	
MATERIALS DISPERSION APPARATUS*	FEB 1989			
STS-50	BATTELLE/AMOCO UAB WISCONSIN BIOSERVE UAH/TELEDYNE BROWN	ZEOLITE CRYSTAL GROWTH*	DEC 1991	JUNE 1992
		INVESTIGATIONS INTO POLYMER MEMBRANE PROCESSING	OCT 1989	
		PROTEIN CRYSTAL GROWTH*	AUG 1988	
		ASTROCULTURE*	DEC 1991	
		GENERIC BIOPROCESSING APPARATUS*	SEPT 1991	
		CONCAP-4	DEC 1991	

* ASSIGNED

** FLIGHT COMPLETED

NOTE: SHUTTLE FLIGHT DATES ARE BASED ON MANIFEST PLANNING ON 6/28/91

COMMERCIAL FLIGHT PROJECTION THROUGH FISCAL YEAR 1992 (CONTINUED)

<u>FLIGHT</u>	<u>SPONSOR</u>	<u>PAYLOAD</u>	<u>HARDWARE AVAILABILITY</u>	<u>LAUNCH DATE</u>
STS-46	CASE WESTERN	LIMITED DURATION CANDIDATE	DEC 1991	JUN 1992
	UAH/LOS ALAMOS NATL LABS	MATERIALS EXPOSURE (3)*	DEC 1991	
	UAH/TELEDYNE BROWN	CONCAP-2* CONCAP-3*	DEC 1991	
STS-47	UAB	PROTEIN CRYSTAL GROWTH*	AUG 1988	AUG 1992
STS-52	UAB	PROTEIN CRYSTAL GROWTH	AUG 1988	SEP 1992
	PENN STATE UNIV/GENENTECH	PHYSIOLOGICAL SYSTEMS EXPERIMENT	APR 1990	
	UAH/ITA	MATERIALS DISPERSION APPARATUS	AUG 1990	
	BIOSERVE	GENERIC BIOPROCESSING APPARATUS	SEPT 1991	
	BATELLE/AMOCO	INVESTIGATIONS INTO POLYMER MEMBRANE PROCESSING	OCT 1989	
	UAH/LOS ALAMOS NATL LABS	CONCAP-2	DEC 1991	
	CASE WESTERN	LIMITED DURATION CANDIDATE MATERIALS EXPOSURE	DEC 1991	
COMET-01	BIOSERVE	AUTONOMOUS BIOMEDICAL TEST APPARATUS	JUNE 1991	SEPT 1992
	UAH/ITA	PLANT GROWTH APPARATUS		
	UAH	MATERIALS DISPERSION APPARATUS		
		NON-LINEAR OPTICAL MATERIALS		
		ATOMIC OXYGEN		
	PENN STATE	BIOMODULE		
	CASE WESTERN	MATERIALS LABORATORY-2		
	UAB	PROTEIN CRYSTAL GROWTH		
	ERIM	AUTONOMOUS RENDEZVOUS DOCKING		

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* ASSIGNED

** FLIGHT COMPLETED

NOTE: SHUTTLE FLIGHT DATES ARE BASED ON MANIFEST PLANNING ON 6/28/91

SPACE STATION FREEDOM PAYLOAD SPONSORS

- JAPAN – NASDA
- EUROPEAN SPACE AGENCY – ESA
- CANADA – CSA
- UNITED STATES – NASA
 - OFFICE OF COMMERCIAL PROGRAMS - OCP (CODE C)
 - OFFICE OF SPACE SCIENCE AND APPLICATIONS - OSSA (CODE S)
 - OFFICE OF AERONAUTICS, EXPLORATION AND TECHNOLOGY - OAET (CODE R)
 - OFFICE OF SPACE FLIGHT - OSF (CODE M)

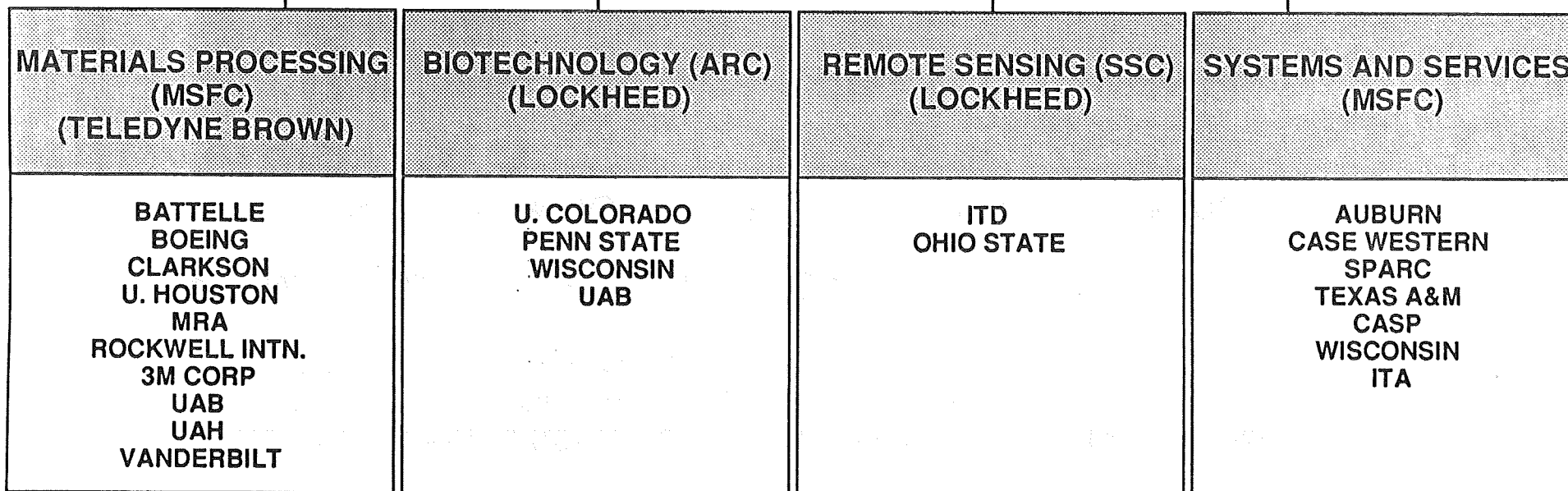
COMMERCIAL SPACE STATION FREEDOM PLANNING TEAM

PURPOSE

- PLAN FOR COMMERCIAL UTILIZATION OF SPACE STATION FREEDOM
- IDENTIFY COMMERCIAL SPACE STATION FREEDOM PAYLOAD TRAFFIC MODEL
- DEVELOP OFFICE OF COMMERCIAL PROGRAMS SPACE STATION FREEDOM DATA BASE
- SUPPORT THE OFFICE OF SPACE STATION USER ACTIVITIES

COMMERCIAL SPACE STATION FREEDOM PLANNING TEAM

COMMERCIAL SPACE STATION PLANNING (NASA HEADQUARTERS)



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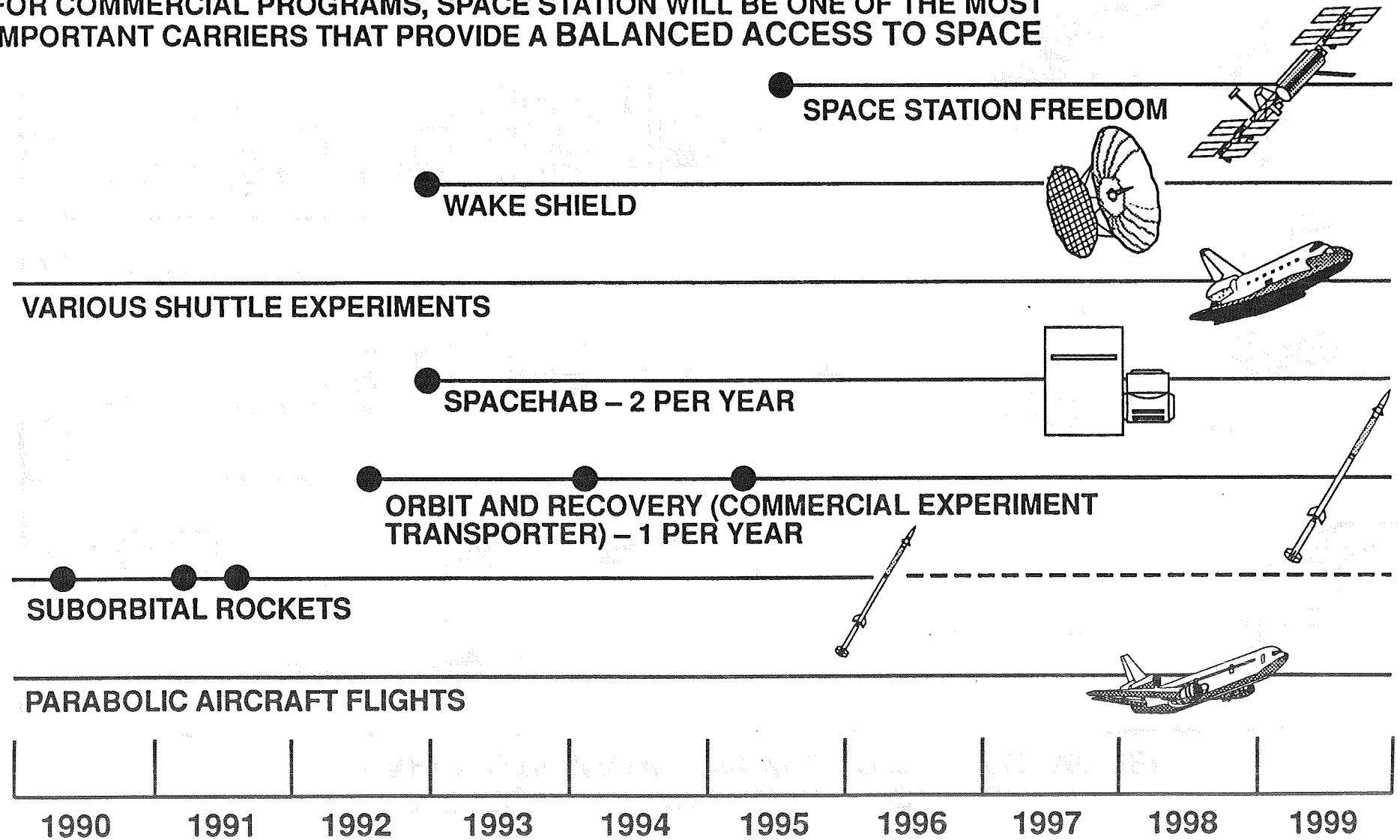
CENTERS FOR THE COMMERCIAL DEVELOPMENT OF SPACE (CCDS) EXPERIENCE

- **FLIGHT EXPERIENCE ON MANNED AND UNMANNED VEHICLES**
 - **KC-135, SOUNDING ROCKETS, SHUTTLE (MIDDECK, COMMERCIAL MIDDECK AUGMENTATION MODULE (CMAM), PAYLOAD BAY), WAKE SHIELD, COMMERCIAL EXPERIMENT TRANSPORTER (COMET)**
- **HARDWARE DEVELOPMENT EXPERIENCE**
- **RIGOROUS PRE-STATION FLIGHT PLAN WITH COMMERCIAL PAYLOADS**
- **SAFETY AND INTEGRATION EXPERIENCE WITH NASA FIELD CENTERS**
- **DEMONSTRATED ABILITY TO BUILD LOW-COST, HIGH-QUALITY HARDWARE**

CONCLUSION: CCDS'S SHOULD BE ABLE TO DOVETAIL NICELY WITH SPACE STATION FREEDOM CAPABILITIES

COMMERCIAL ROLES OF SPACE STATION FREEDOM

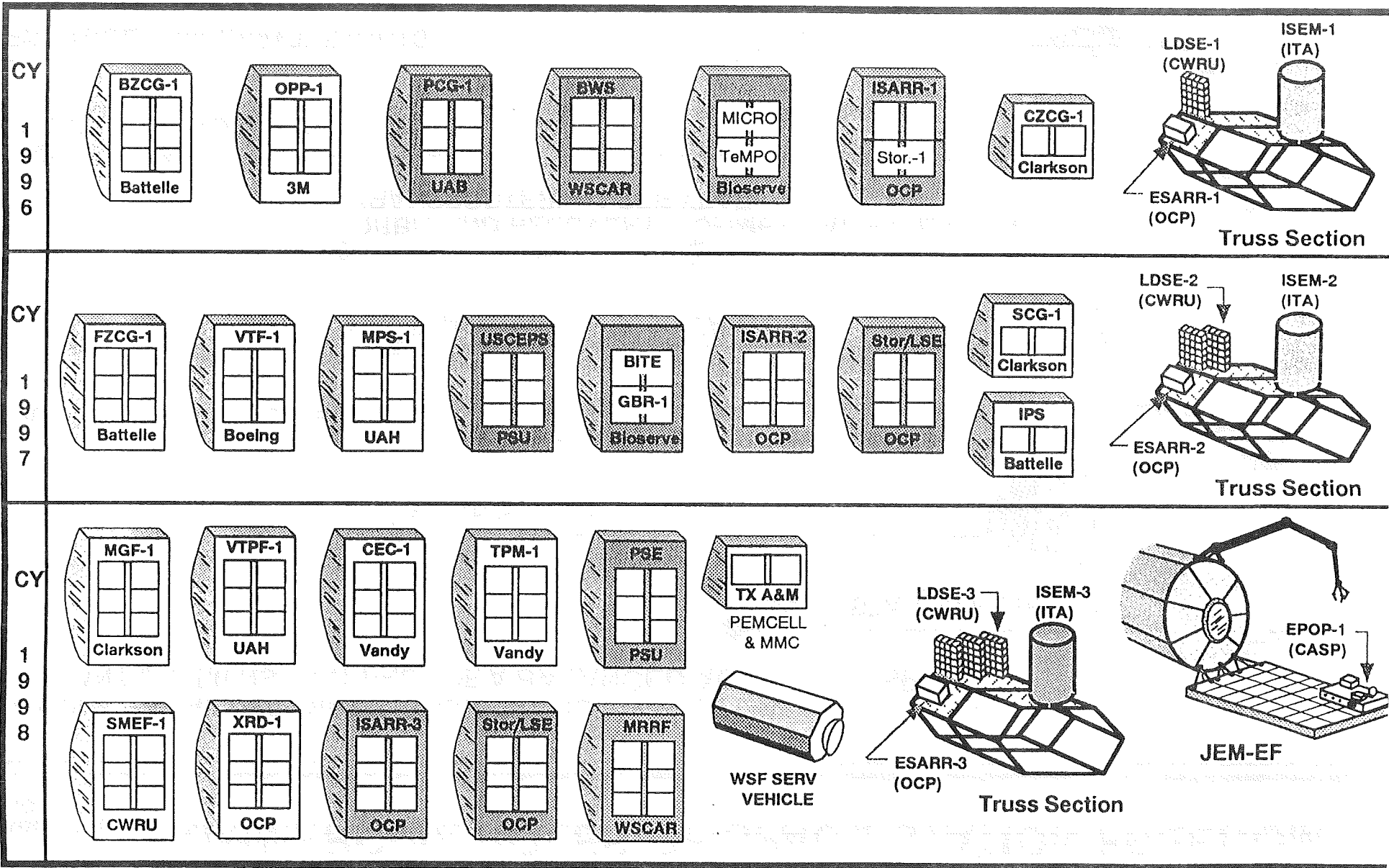
FOR COMMERCIAL PROGRAMS, SPACE STATION WILL BE ONE OF THE MOST IMPORTANT CARRIERS THAT PROVIDE A BALANCED ACCESS TO SPACE



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DRAFT

OFFICE OF COMMERCIAL PROGRAMS SSF EARLY UTILIZATION PAYLOAD TRAFFIC MODEL



150

Note: ISEM, ESARR, and ISARR return after one increment. All other payload racks are cumulative. Total: 25 racks

Materials Discipline
 Life Sciences/Biotechnology Discipline
 Robotics Discipline
 Storage/LSE
 TBD

July 31, 1991

OFFICE OF COMMERCIAL PROGRAMS SPACE STATION FREEDOM PAYLOADS

PAYLOAD

ACRONYM

PAYLOAD

INTERNAL PAYLOADS

3M CORPORATION
BATTELLE
BATTELLE
BATTELLE
BIOSERVE
BIOSERVE
BIOSERVE
BIOSERVE
BOEING
CLARKSON
CLARKSON
CLARKSON
CASE WESTERN
OCP
PENN STATE
PENN STATE
TEXAS A&M
TEXAS A&M
UA/BIRMINGHAM
UA/HUNTSVILLE
UA/HUNTSVILLE
VANDERBILT
VANDERBILT
WISCONSIN

OPP
FZCG
BZCG
IPS
MICRO
TEMPO
BITE
GBR
VTF
CZCG
SCG
MGF
SMEF
XRD
USCEPS
PSE
PEMCELL
MMC
PCG
MPS
VTPF
CEC
TPM
BWS

ORGANIC AND POLYMER PROCESSING
FLOAT ZONE CRYSTAL GROWTH
BATTELLE ZEOLITE CRYSTAL GROWTH
INVESTIGATIONS OF POLYMER STRUCTURES
MODULE FOR INTEGRATED CELL RESEARCH IN ORBIT
TEST MODULE FOR PLANTS/ORGANICS
BIOMEDICAL ISOMORPHISMS TEST EQUIPMENT
GENERIC BIOPROCESSING RACK
VAPOR TRANSPORT FURNACE
CLARKSON ZEOLITE CRYSTAL GROWTH
SOLUTION CRYSTAL GROWTH
MELT GROWTH FURNACE
SPACE MATERIALS EVALUATION FACILITY
X-RAY DIFFRACTION
U.S. COMMERCIAL ELECTROPHORESIS
PHYSIOLOGICAL SYSTEMS EXPERIMENTS
PROTON EXCHANGE MEMBRANE FUEL CELL
METAL MATRIX COMPOSITES
PROTEIN CRYSTAL GROWTH
MATERIALS PROCESSING SYSTEM
VAPOR TRANSPORT PROCESSING FURNACE
CONVECTIVE EFFECTS IN CASTING
THERMOPHYSICAL PROPERTIES MEASUREMENTS
BIOREGENERATIVE WATER SYSTEM

INTERNAL PAYLOADS

LDSE
ISEM
EPOP
WSFSV

CASE WESTERN
ITA
U/TENNESSEE/CASP
U/HOUSTON

LONG DURATION SPACE EXPERIMENTS
ITA STANDARDIZED EXPERIMENT MODULE
ELECTRIC PROPULSION ORBITAL PLATFORM
WAKESHIELD FACILITY SERVICE VEHICLE

SPACE STATION FREEDOM PAYLOAD HERITAGE

PRECURSOR FLIGHTS

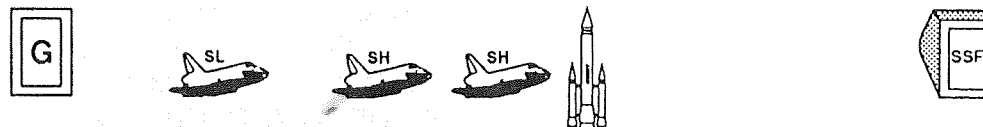
SPACE STATION FREEDOM PAYLOAD

1991 1992 1993 1994 1995 1996

Zeolite Crystal Growth (ZCG)

Battelle

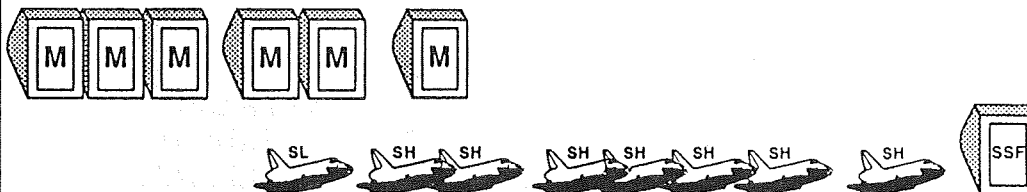
- Applications: Kidney dialysis, radioactive waste cleanup, petroleum processing
- Affiliates: Amoco Chemical Co., DuPont, Intek, Teledyne Brown



Protein Crystal Growth (PCG)

UAB

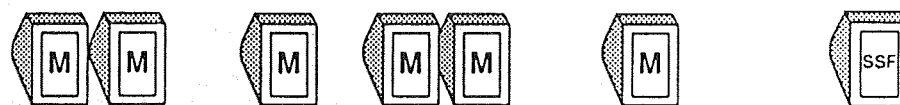
- Applications: Human gamma-interferon, isocitrate lyase
- Affiliates: Schering-Plough, Burroughs Wellcome, DuPont, Genentech, Vertex, SmithKline & French, Upjohn, Eli Lilly, Eastman Kodak, Biocryst, Space Industries, Inc.



Bioregenerative Water System (BWS)

WSCAR

- Applications: Controlled plant growth environments, water regeneration for space application
- Affiliates: Quantum Devices, Inc., Phyto farms of America, Inc., Automated Agriculture Assoc., Inc.



Module for Integrated Cell Research In Orbit (MICRO)

Bioserve

- Applications: Membrane formation, crystal growth, cell cultures, organism growth
- Affiliates: Alaza, Ball, Boeing, Central Biomedica, DuPont, Omni Data, Juvenile Diabetes Foundation



Legend: - Middeck - SpaceHab/SpaceLab; - Space Station Freedom; - Comet; - Sounding Rocket; - Gas Can

ADVANTAGES OF SPACE STATION FREEDOM FOR COMMERCIAL PAYLOADS

- ~ 27 user racks available for U.S. payloads at PMC
- Adequate power levels to support commercial payloads
- Adequate G-levels to support commercial payloads
- Payloads can operate on Space Station during untended periods - free flyer environment
- Crew presence during Shuttle visits for sample changeout, payload deployment, and/or repair
- Potential of external attached payloads pre-integrated into truss structure for long-duration operations

SPACE STATION FREEDOM EVOLUTION

COMMERCIAL INFRASTRUCTURE CONSIDERATIONS

- **Lab Support Equipment Development (X-Ray Diffraction, Etc.)**
- **Commercial Rack/Drawer Capability**
- **Spacehab Physical Integration and Use as a Logistics Carrier**
- **Wakeshield as SSF Serviced Free Flyer**
- **Comet Service Modules as SSF Serviced Free Flyers**
- **Comet Derived Maneuvering Service Vehicle (MSV)**
- **Comet Recovery System**
- **Ground Operations Capability for Comet and Wakeshield**

SUMMARY

**SPACE STATION FREEDOM WILL PROVIDE THE
IMPORTANT LONG DURATION LABORATORY
COMPONENT WHICH WILL ENABLE COMMERCIAL
TECHNOLOGIES TO TRANSITION TO NEW SPACE
BASED MARKETS**