


### ASTR 4800 - Space Science: Practice & Policy

Today: **The International Space Station**

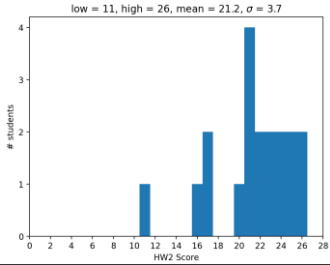
- Exam #1 on Monday, October 10.
  - Includes all readings & lectures through Oct. 8.
  - See PowerPoint class notes on class website
  - Also allowed to bring one page (front & back) with notes.



Astronomy 4800 - Space Science: Practice & Policy

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### Results from Homework #2



low = 11, high = 26, mean = 21.2,  $\sigma = 3.7$

# students

HW2 Score

Homework #2 solutions are posted on class website under Schedule for Oct. 3.

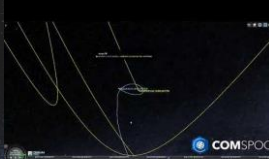
HW2 Score	# students
11	1
15	1
16	2
19	1
21	4
22	2
23	2

2

### China's Shijian-21 Towed Dead Satellite to a High Graveyard Orbit

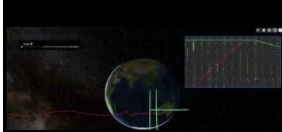
<https://spacenews.com/china-shijian-21-spacecraft-docked-with-and-towed-a-dead-satellite/>

- China's SJ-21 rocket launched in October of 2021 as "space fuel tanker"
- Now described as a "space debris mitigation" satellite



COMSpOC

- SJ-21 performed a RPO w/ the Beidou-G2 defunct satellite, docked, dropped it 3k km above GEO belt, and then returned to the GEO belt (ComSpOC, Space Force)



Space Force

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THE INTERNATIONAL SPACE STATION (ISS)

BY: JAKE SPIES

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### A BRIEF TIMELINE


1984-1998

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### THE BEGINNING

1984

- Reagan mentions during his state of the union address the beginnings of an international space station
- Wants it to be permanently manned
- Encouraged international collaboration and gave birth to project "Space Station Freedom"



State of the Union 1984

This was President Reagan's third State of the Union address. He gave the speech while preparing for his 1988 re-election bid.

1984

Reagan was the 33rd President of the United States (1981-1985)

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**IMMEDIATE DELAY**

**1986**

- Challenger shuttle launch fails after 73 seconds
- Initial plan to complete by 1994 was thwarted

**1989**

- George H. W. Bush unveils a plan to return to the moon and extend to Mars
- Doesn't revitalize the project, but certainly gives some attention




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**USSR COLLAPSE**

**1991**

- The USSR had collapsed, leaving Russia with its space program
- Seeking international partners for a space program
- Mir Space Station
- U.S. and Russia create an alliance through astronaut/cosmonaut exchanges




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**RESILIENCE**

**1993**

- June
- Congress votes on the termination of the project, fails by one vote
- High costs primary concern of the Clinton administration
- October
- Russia and NASA merge space station development efforts
- Led to the first rendezvous of a U.S. shuttle with Mir



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**MIR DEPARTURE**

**1995**

- First of 7, U.S. Cosmonaut Norman Thagard boards Mir (March)
- First successful docking of a U.S. shuttle (Atlantis) with Mir (June)

**1997**

- Mir is damaged by an unmanned cargo vessel
- Mir is eventually de-orbited in 2001




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**THE ACTUAL BEGINNING**

**1998**

- January
- 15 officials from different nations gathered in Washington to sign agreements concerning the development of the ISS
- November
- The first module, "Zarya", is launched
  - Built and designed by Russia, funded by NASA
- December
- Second module, "Unity", is launched
  - Created by NASA



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**OTHER NOTEWORTHY EVENTS**

- 2000
- First crew aboard the ISS (141 days)
- 2001
- First Russian to assume command
- First private space tourist
- 2003
- Columbia disaster puts halt on ISS assembly
- 2007
- First woman to assume command
- Solar Truss Module is badly damaged, 7hr space walk
- 2009
- 3 person crew expanded to 6
- 2011
- Shuttle program in U.S. shuts down, creating reliance on Russian spacecraft
- China is banned
- 2012
- SpaceX sends first commercial module to ISS
- 2013
- Spacesuit malfunction, call for improvement



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### HOW MANY? WHO'S MAKING THEM?

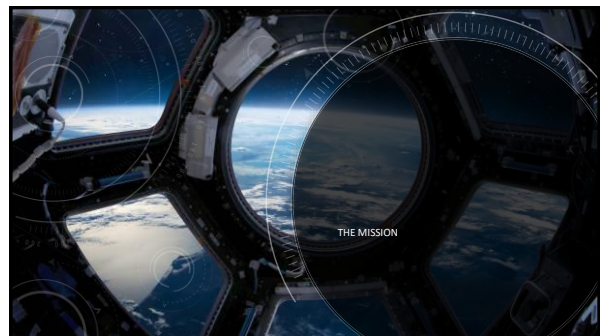
- The ISS is comprised of 39 modules altogether, 16 of those being pressurized
- Pressurized modules by contributor:
  - 6 Russian Modules
  - 8 U.S. Modules
  - 1 Japanese Module
  - 1 European Module

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### IMPORTANT MODULES

- Zarya (First module, FCB)
- Unity (Node 1)
- Harmony ("Utility Hub")
- Integrated Truss Structure (backbone)
- Bigelow Expandable Activity Module (expandable habitat technology)
- Mobile Space System (navigating the truss)
- Destiny (U.S. Research)
- Columbus (European-Destiny)
- Kibo (Japanese-Destiny)

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### SELLING TO REAGAN (1983)

- Logical extension of American efforts in Space
- The U.S. would accomplish:
  - Stimulate commercial endeavors into space
  - Place in orbit the first American outpost in space (counterpart to Mir)
  - Become a national technology laboratory in space
  - Demonstrate U.S. leadership in space

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### GOING GLOBAL

- NATO debate over deployment of medium-ranged nuclear weapons in Europe
- Reagan approved international efforts in hopes of unifying western technology

How does this work against the initial plans of the ISS?

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**NASA MISSION STATEMENT**



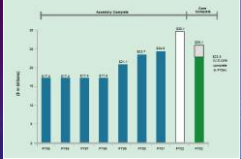
"The International Space Station (ISS) is a complex of research laboratories in low Earth orbit in which American and International astronauts are conducting unique scientific and technological investigations in a microgravity environment. The primary objective of the ISS is to support scientific research and other activities requiring the unique attributes of humans in space. In concert with the new exploration vision, NASA will refocus U.S. Space Station research on activities, such as the development of countermeasures against space radiation and the long-term effects of reduced gravity, that prepare human explorers to travel beyond low Earth orbit."



**How does this compare to what was sold to Reagan?**

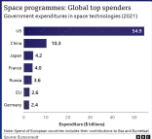
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**FOREVER EXPANDING COST**

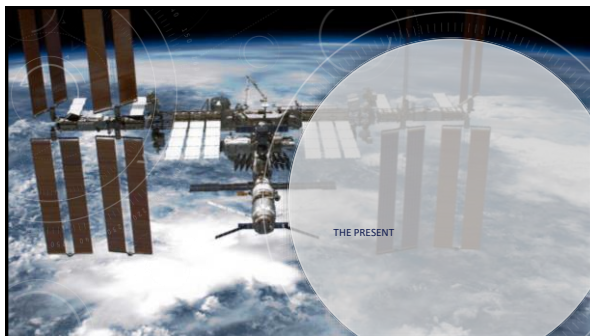


- Initial cost proposed to Reagan: **\$8 billion**
- \$11.2 billion** spent by 1993
- Clinton administration estimated costs of **\$17.4 billion**
- Current estimated cost: **\$150-160 billion**

**Class Exercise: Was it worth it? Did the ISS achieve the financial goals it set out for?**




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**CURRENT FOCUSES**

- 5 main branches of ISSNL
- Physical Sciences
- Life Sciences
- Technology Development
- Remote Sensing
- Education



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**DID WE ACHIEVE OUR GOALS?**




**International Cooperation**

- As of today, no countries have withdrawn
- Preserved longer than most international cooperative efforts
- China was banned in 2011
- Primary focus is western technology, heavily focused on U.S. and Russia

**Research (NASA "Breakthroughs")**

- Fundamental disease research
- Water purification systems
- Understanding the human body under the influence of microgravity
- Growing food in microgravity
- 3D printing in microgravity
- Data/discovery of multitudes of space phenomena



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