



Development of a Wardrobe for Life in Space Vehicles and Habitats

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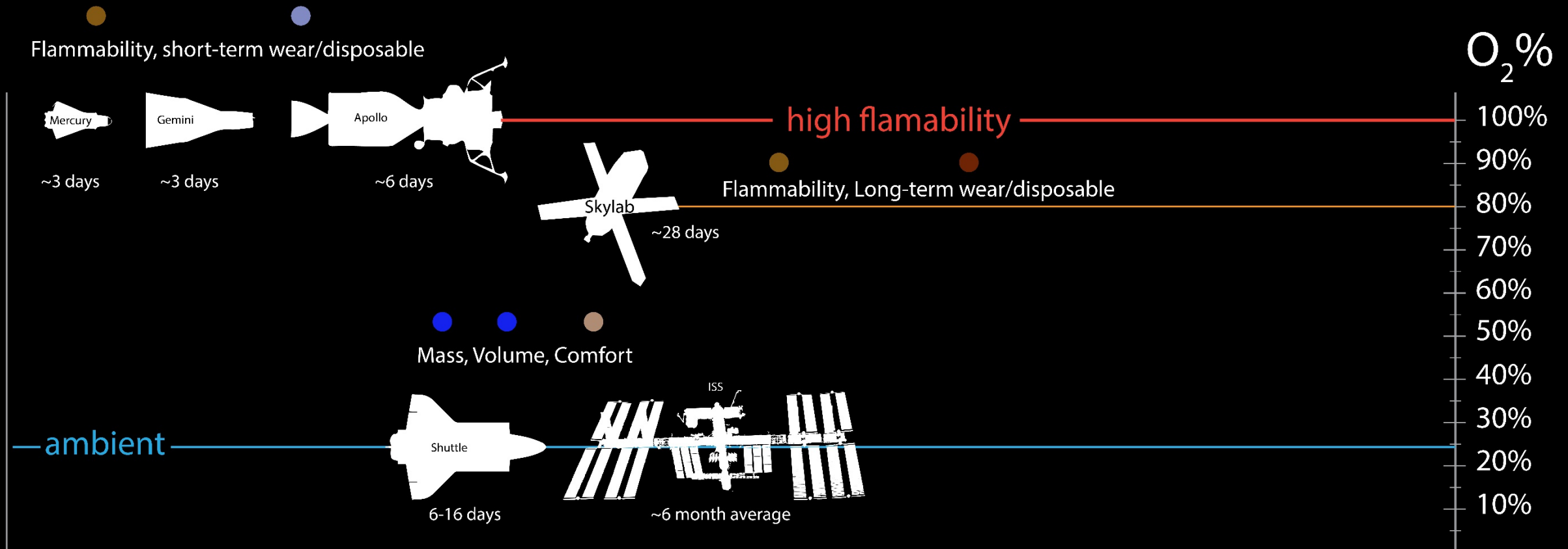
Textiles Research & Development, Lead

Engineering Directorate

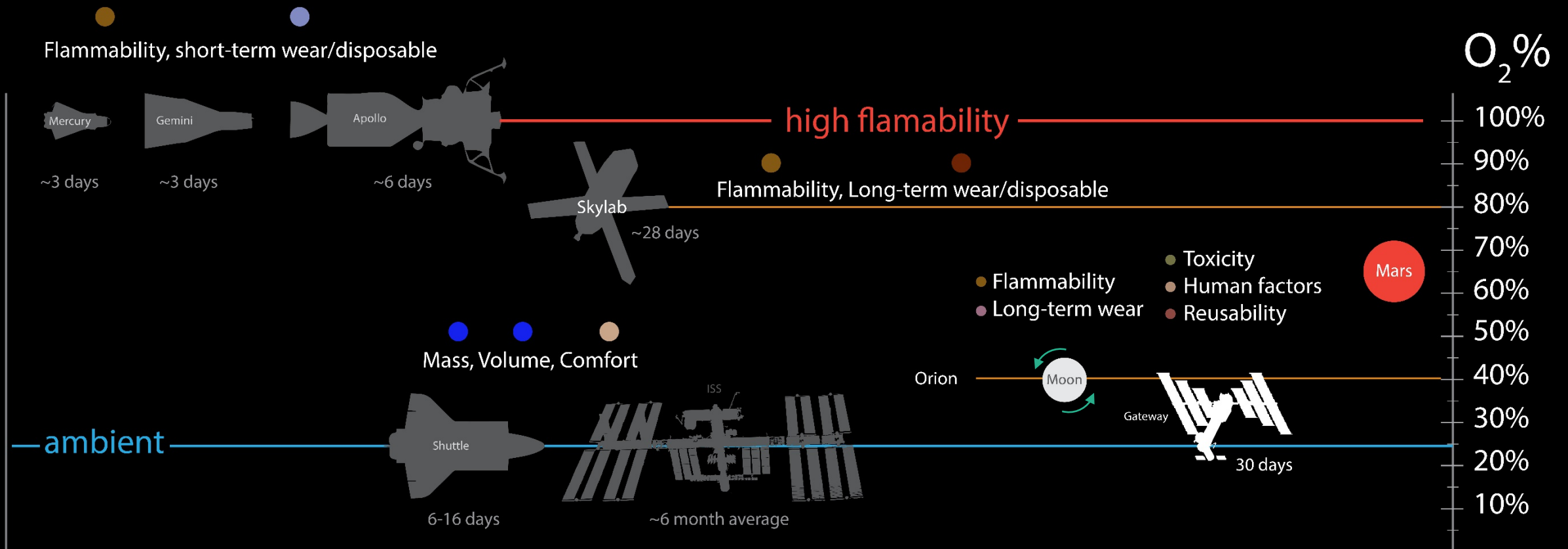
NASA, Johnson Space Center



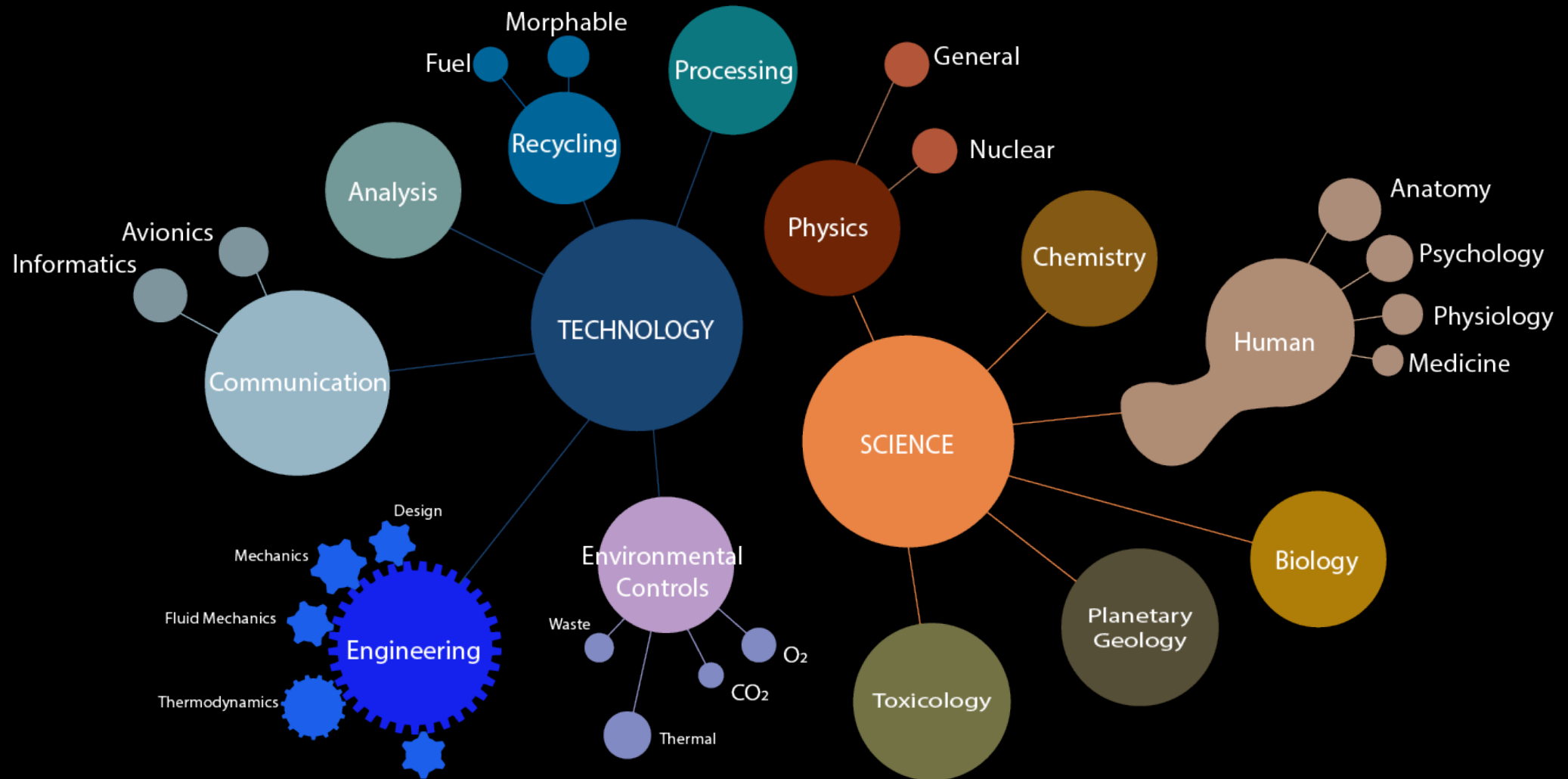
O₂, In The Beginning...



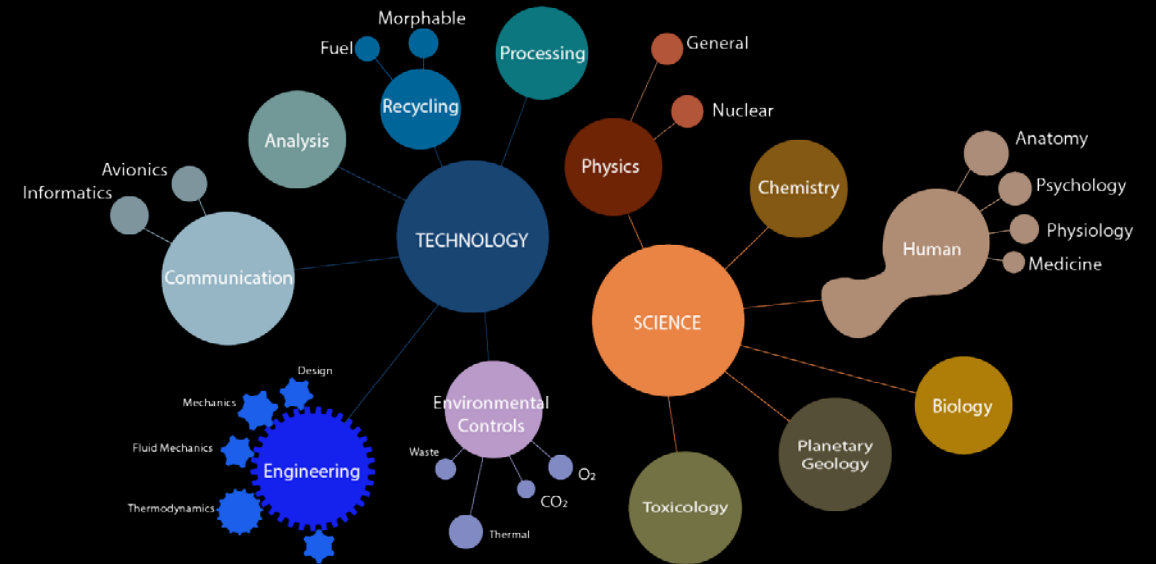
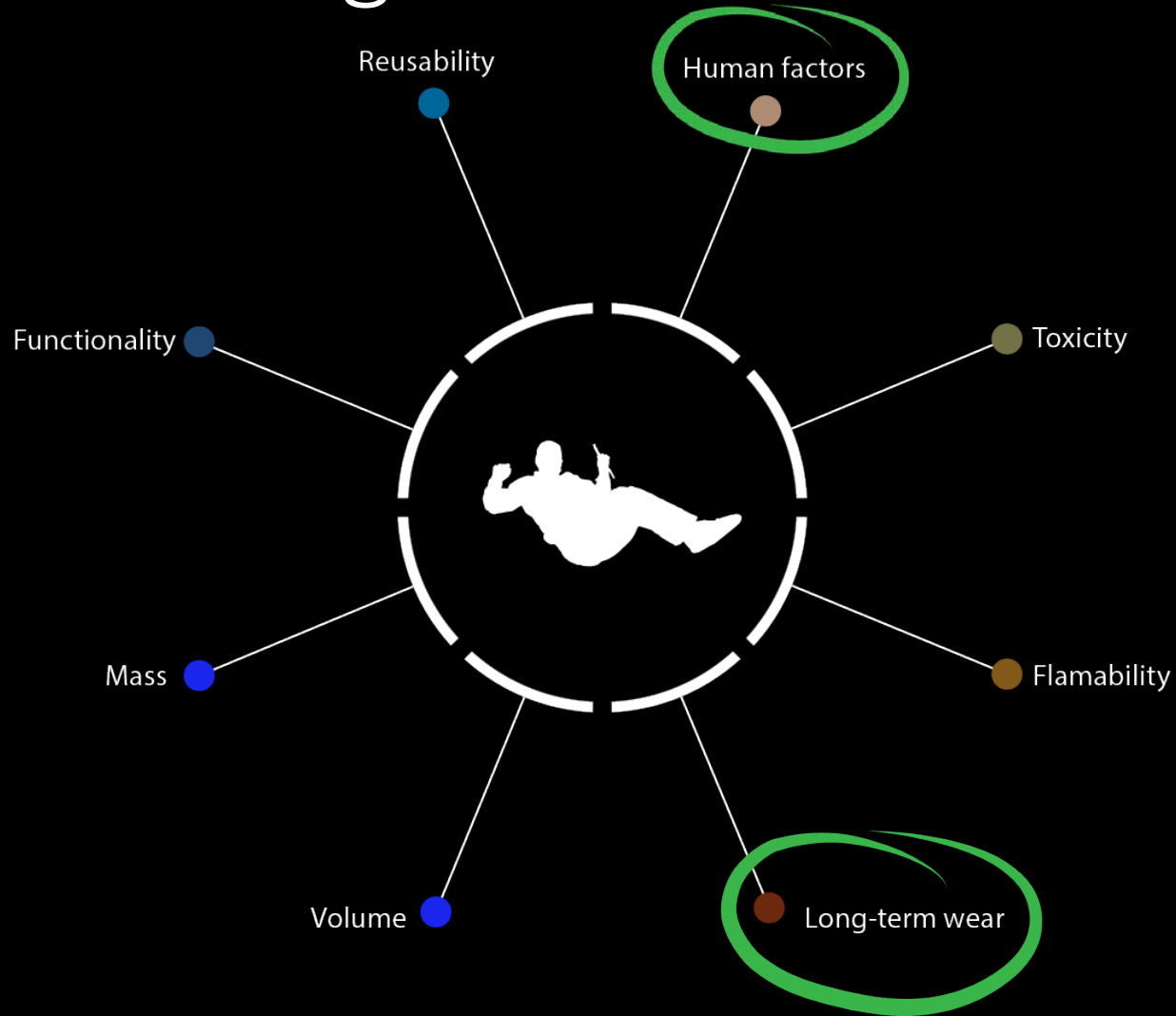
The Future is Somewhere in the Middle

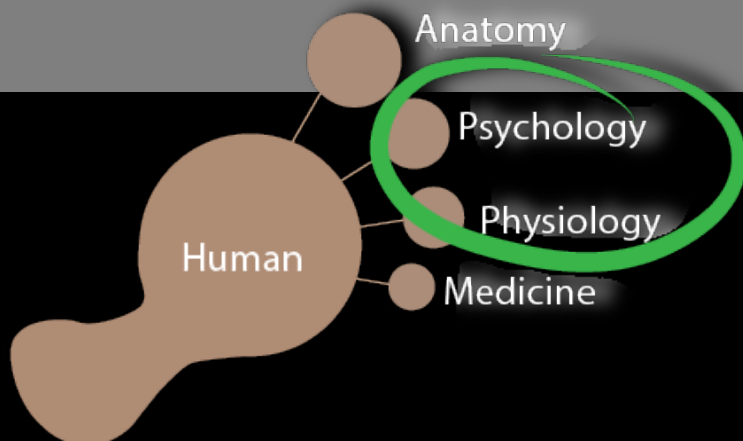


TOOLBOX



Design Parameters





Still in the study phase of development



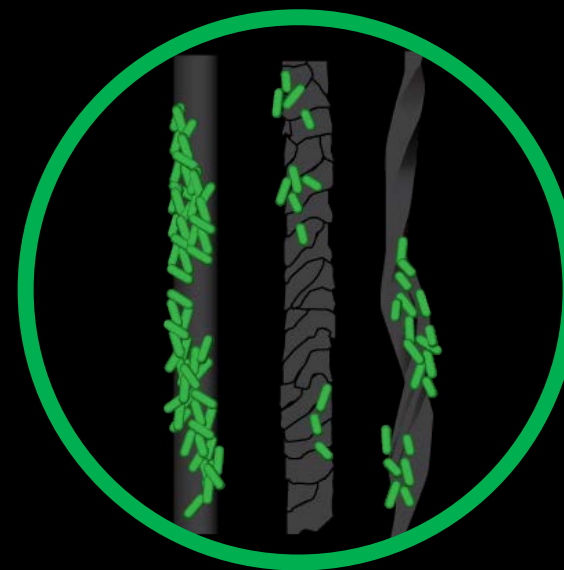
Blind study:
Acceptance of
wool vs. cotton



Length of wear study:
Odor (exercise clothing)



Lint study:
wool vs. other fibers



Microbial study:
packaging and storage

Blind Study

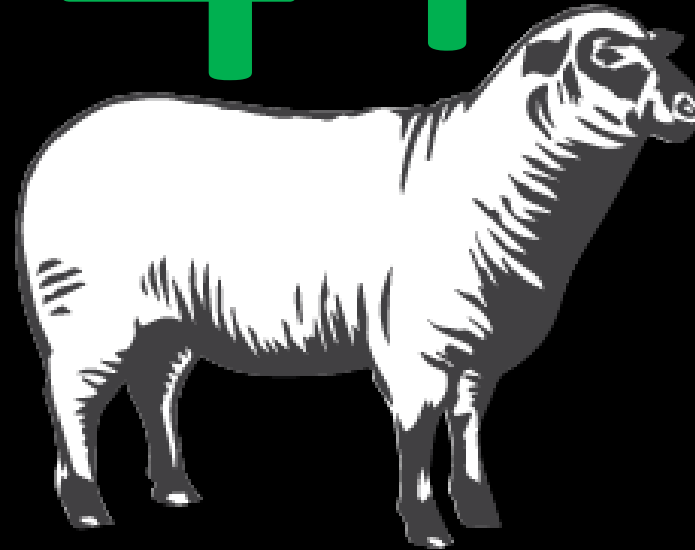


Most participants could not tell the difference
-or- preferred wool over other fibers

Length of Wear Study



4+



Hours longer than other fibers tested

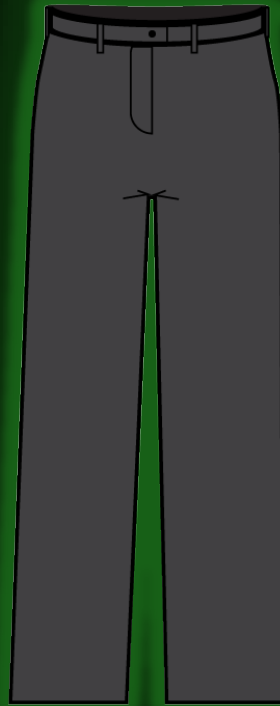
Current Studies: Usage Rate

Understanding usage rate and wear pattern of clothing in a space station

shirts ~15 days



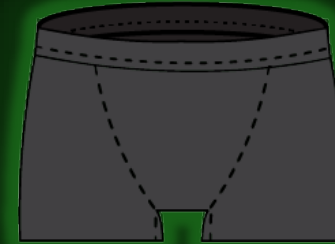
Pants ~30 days



socks ~7 days



undergarments ~2 days



Athletic clothing ~7 days



Current Study: Cleaning/life of garment

Evaluate cleaning and sanitation techniques to use in microgravity



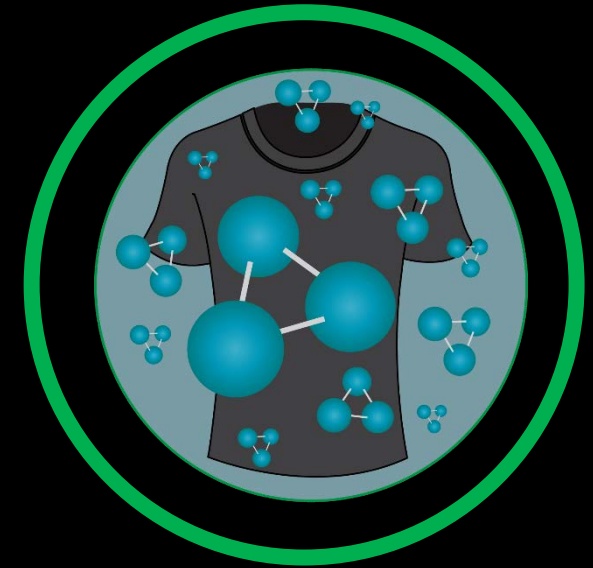
Clean with soap and water



Stretch and twist results



Clean with hydrogen peroxide (fade results)



Clean with ozone (odor results)

Completed Study: Lint Study

ISS cotton crew socks and anklets compared to other type of crew socks with respect to lint production.



No
difference

Lint
makers

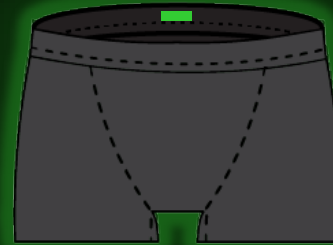
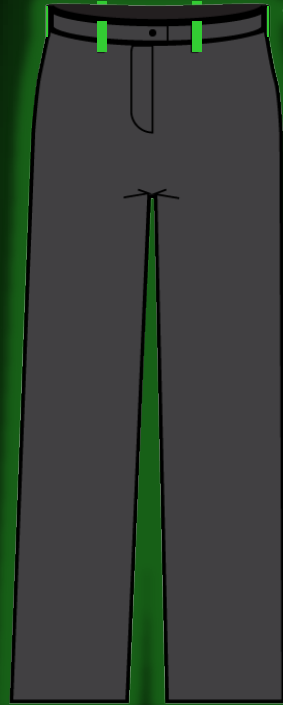
Completed Study: Microbial Study

Fiber integrity did not
change when packaged in
a clean environment



Work in Progress: Logistics Tracking

- ISS and Gateway clothing experiments
 - Tracking of RFID tags on clothing



Near-term Work: Continuation

- ISS and Gateway clothing experiments
 - Water based clothes cleaning in microgravity in combination with oxidative and physical methods of sanitation



GOAL

- Our goal is logistics reduction for long-duration space travel
 - Flammability issues
 - Toxicity issues
 - Long wear
 - Low odor development/bacterial growth
 - Human factors appeal
 - Moisture management
 - Lint management
 - Logistic process efficiency

Reference @ NASA Technical Report Server

Byrne, Vicky; Orndoff, Evelyne; Poritz, Darwin; Schlesinger, Thilini;
Advanced Exploration Systems (AES) Logistics Reduction and
Repurposing Project: **Advanced Clothing Ground Study Final
Report**, CTSD-ADV-1088, JSC-CN-31305, 2013

<https://ntrs.nasa.gov/search.jsp?R=20160010481&hterms=Adadvanced+Clothing+Ground+Study&qs=N%3D0%26Ntk%3DAll%26Ntt%3DAdadvanced%2520Clothing%2520Ground%2520Study%26Ntx%3Dmode%2520matchallpartial>