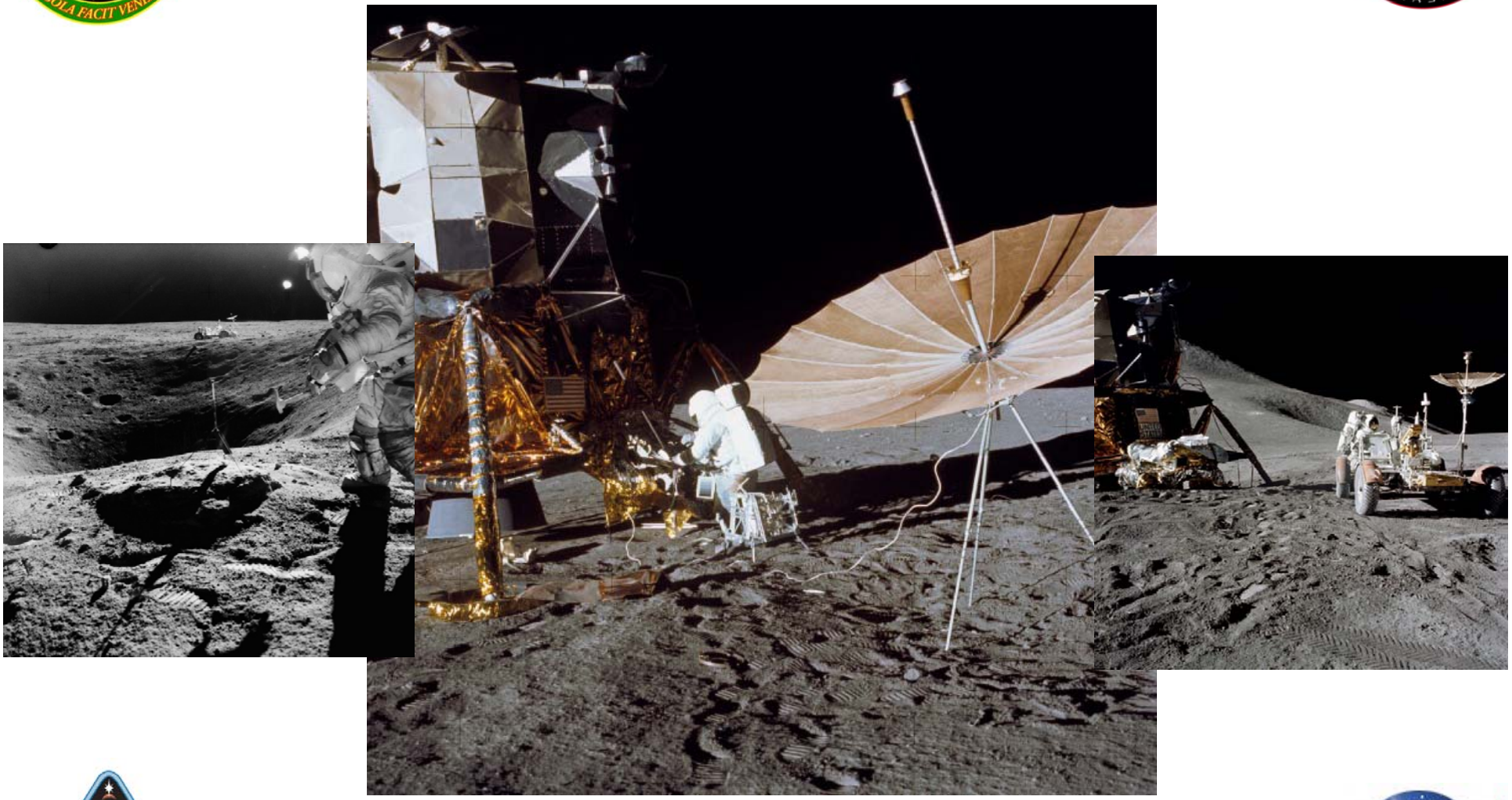
# Lunar Airborne Dust Toxicity Assessment Group (LADTAG)

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# LADTAG's Charge to the LDTRP

•The LADTAG (Lunar Airborne Dust Toxicity Assessment Group) recommendations for research are being implemented by the Lunar Dust Toxicity Research Program (LDTRP) The LDTRP was initially only concerned with *airborne lunar dust and its toxicity to the Respiratory system*, however, the group is also studying effects of *non-airborne dusts* on human health

- ***Dermal toxicity*** **(skin irritant/allergic responses, and abrasion effects –** ***Breach of water barrier?)***
- ***Ocular Toxicity*** **(eye irritant/allergic responses, and abrasion effects –** ***Scratches, Embedding?)***

•Effects of dissolution of lunar dust on toxicity in human system is being studied

•Development of acute and chronic (time based) exposure limit standards for inhalation (pulmonary) toxicity and human risk criteria will be developed no later than 2010.

•*Current HSIR standard for lunar dust is 0.05 mg/m$^3$ (set by LADTAG, Feb 2006).*

# LADTAG's Logic

**•LADTAG research studies are geared towards producing deliverables aimed at *reducing uncertainty* in contributing factors (size distribution, time, activity, dose, species)**

**•In 2006, LADTAG reviewed the available lunar dust literature and the technical expertise of the advisory group. The group recommended that in order to set a representative health standard, we must test multiple types of lunar dusts, specifically finest fraction (<10 μm) of lunar dust simulant and the immature and mature highland dust.**

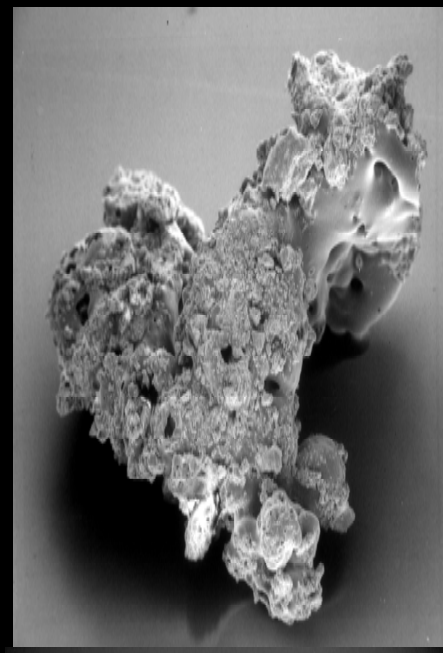
**•These highland soils were selected based upon NASA's plan to land in the polar region upon return to the lunar surface.**

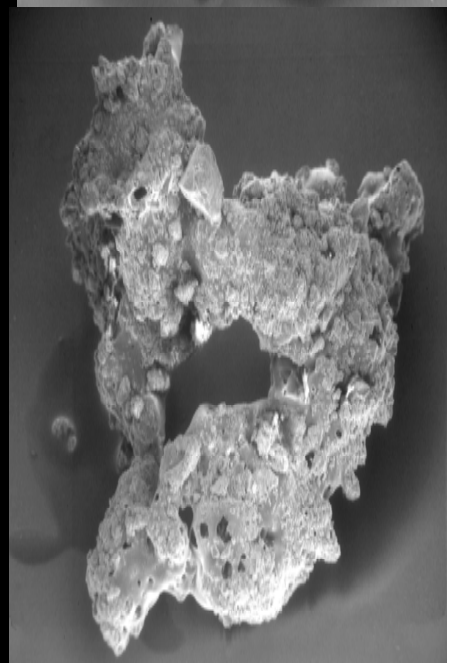
**•This particle size fraction was selected because it is considered to be the respirable size range.**

**•The respirable fraction has historically been extremely difficult to analyze, yet this data is key for evaluating the toxicological properties of lunar dusts.**

**• Modern technology has provided several new options for particle size analysis, particularly in this fine size range**

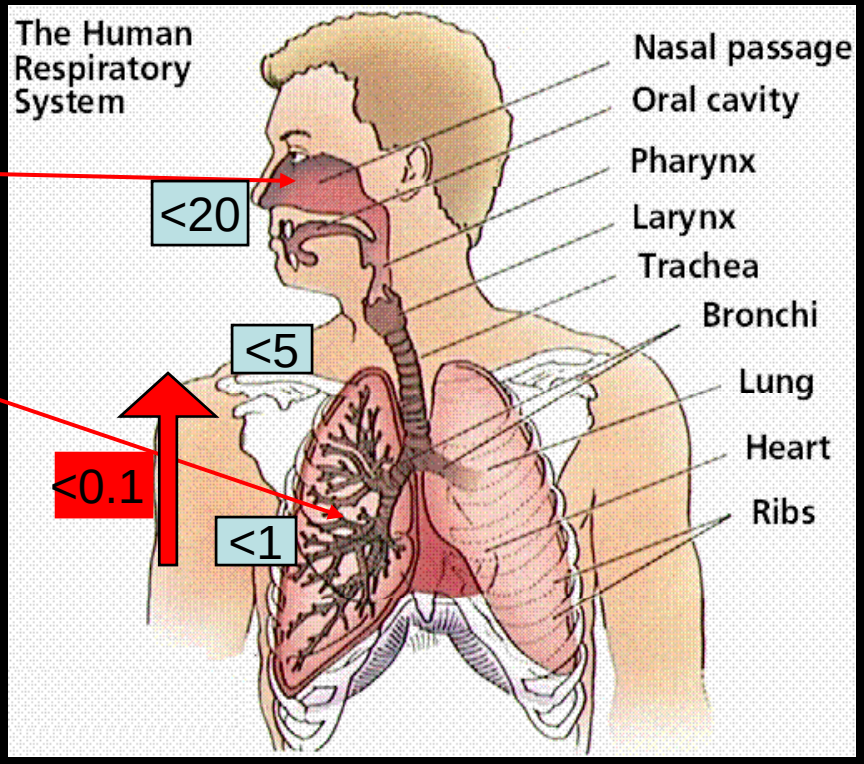
***• Dispel the rumors and scare tactics that are not based on scientific evidence!!!***





# Known Toxic Effects of Dusts

- Dermal irritation & penetration
- Eye irritation & corrosion
  - Chemical
  - Mechanical
- Respiratory injury
  - Upper air ways
  - Lower airways
    - Edema
    - Inflammation
    - Fibrosis
    - Cancer?
- *What effects will simulants produce?*




Courtesy: J.T. James, NASA (2005)

# Unknown Toxic Effects of Lunar Dusts

- Dermal irritation & penetration
- Eye irritation & corrosion
  - Chemical?
  - Mechanical?
- Respiratory injury?
  - Lung clearing of unusual particle shape?
  - Effective clearance mechanisms?
  - Effect in 1/6 g?
  - Effect of highly reactive/ activated particles?
  - Effect of inactive particles?
  - Rate of passivation?
  - Effect of nanophase Fe?
  - Cellular injury? Generation of Reactive Oxygen Sp (ROS)?

# Toxic Effects of Simulants???

- Simulants are high-fidelity (chemically and physically)
- The Lunar Simulant MSDS: Is the current Material Safety Data Sheet (MSDS) accurate for all simulants? - *The last MSDS that I reviewed in 2007 needed significant improvement – Occ Health agreed.*
- Parent Simulant (JSC-1 or JSC-1A): Potential for toxic effects will depend upon several variables:
  - Amounts (dosage) will vary depending upon type of experiment/test conducted
  - Size fraction the user is exposed to (fine, ultrafine) Will vary depending type of experiment/test conducted
  - Type of PPE employed during exposure? (need to protect from ultrafines at a minimum)
- I have personal experience breathing simulants (*not fun!)*
- Suggest respiratory protection
- Dermal protection (*case by case basis only – contingent upon type of use*)

# Questions for persons working with Simulants

- How much (quantity) of simulants are you working with?
- What is the size range of the simulants that you are working with?
- How long do you routinely expose yourself to simulants?
- Do you use PPE? What type (s) of PPE?
- Do you monitor your area for the amount of particulate in air when you work with simulants?
- Is one “generic” MSDS sufficient for all simulants?
  - Should each type of simulant have its own unique MSDS, that reflects the unique chemical make up and content?

# Preliminary Toxicity Data on Lunar Simulants

- Reactivation of JSC-1A

  Preliminary results show measurable activation of simulants by grinding
  - The activation was measured by the amount of free radicals generated: Activated simulants have generated Reactive Oxygen Species (ROS) i.e., production of hydroxyl free radicals
  - Simulants and controls appear highly charged upon grinding
- Dissolution of Simulants
  - Tests have shown that simulants leach chemicals into solution ($H_2O$)
  - Solutions of varying pH are also being tested (various pH will relate to varying pH found in respiratory defense mechanisms – ex: macrophages)
  - Simulants behave very differently from actual lunar dust in solution
- Abrasivity of simulants to dermis
  - Simulants appear to be as abrasive as “industrial” sandpaper

# Questions???

Sorry that I could not join you personally! E-mail me or call me! Noreen.n.khan-mayberry@nasa.gov
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