NSDL/NSTA Web Seminar
APS: Studying the Human Physiological Limits of Exploring Mars

Wednesday, May 13, 2009

Resource list for tonight’s presentation:
http://www.diigo.com/list/nsdlworkshops/web-sem-mars
Today’s NSDL Expert

Jim Pawelczyk, Ph.D.
Associate Professor of Physiology & Kinesiology, College of Health and Human Development, Pennsylvania State University

http://nsdl.org
International Space Station

http://spaceflight.nasa.gov/realdata/sightings/
What research is necessary for humans to travel to Mars?

Type your responses in the chat
The Exploration Vision

**2014**
4-6 crew to low earth orbit
*Crew Exploration Vehicle*: LEO Environment
Earth entry, water (or land) recovery

**2015-2020**
4-6 crew to lunar surface
*Lunar Lander*: Lunar surface operations 14-30 days

**2020**
4-6 crew to lunar surface for long-duration stay
*Lunar Habitat*: Lunar surface operations 60-90 days

**2025+**
Crew to Mars orbit
*Transit vehicle*: Earth-Mars cruise – 6-9 months
Mars vicinity operations – 30-90 days
Mars-Earth cruise – 9-12 months

**2030+**
Crew to Mars surface
*Surface Habitat*
Mars flight profile - 2014

- Mars @ Departure: Jan. 24, 2016
- 161 day Transit Out, 154 day Return
- Return Inbound Trajectory
- Mars @ Arrival: June 30, 2014
- Earth @ Departure: Jan. 20, 2014
- Earth @ Arrival: June 26, 2016
- Mars Perihelion: January 22, 2013, December 10, 2014
- Mars Surface Stay Time: 569 days
- Earth Orbit
- Mars Orbit
- Piloted Trajectories
- Stay on Mars Surface

http://nsdl.org
Summary of human long-duration spaceflight

As of 12-Oct-2008

http://nsdl.org
Let’s pause for questions from the audience....
Which factor(s) pose the greatest human challenge to Mars exploration? Stamp your answer(s)

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Muscle</th>
<th>Cardiovascular</th>
<th>Neurological</th>
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The Martian environment

![Diagram showing Gravity, Avg Temp (°C), Atmospheric composition, and Pressure (mb)](http://nsdl.org)
Potential for near surface water on Mars

Image courtesy of Malin Space Systems / NASA

http://nsdl.org
Sabatier Reaction

\[ 2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2 \]

\[ \text{CO}_2 + 4\text{H}_2 \rightarrow \text{CH}_4 + 2\text{H}_2\text{O} \]

*(in situ resources)*
Dust devils on Mars

Image courtesy of Malin Space Systems / NASA

http://nsdl.org
Dust devils on Mars

Image courtesy of Malin Space Systems / NASA

http://nsdl.org
Dust devils on Mars

Image courtesy of Jet Propulsion Laboratory / NASA and Eric Hartwell

http://nsdl.org
Let’s pause for questions from the audience....
Poll Question:

During spaceflight, osteopenia …

A. Doesn’t occur
B. Occurs slower than in the elderly
C. Occurs at a rate similar to the elderly
D. Occurs more quickly than in the elderly
Osteoporosis / Osteopenia
Skylab – A repository of physiological data

http://nsdl.org
Spaceflight accelerates bone loss

Bone mineral losses from spaceflight

LeBlanc et al., Bone
11:S323, 1996

Lang et al., J Bone Mineral Res
19:1006-1012, 2004

+0.6% / month
+0.1% / month
-1.1% / month
-1.4% / month
-1.2% / month
-1.6% / month
-1.3% / month
-1.5% / month
Chronic bone mineral loss is debilitating

LeBlanc et al., J. Bone Mineral Res. 11:S323, 1996
Poll Question:

During spaceflight, osteopenia ...

A. Doesn’t occur
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D. Occurs more quickly than in the elderly
Fracture risk


http://nsdl.org
The occupational risks of spaceflight

If astronauts went to Mars today ...

- 100% would have >15% bone mineral loss
- ~80% would have >25% bone mineral loss
- >40% would lose >50% of their bone mineral
- ~20% would have >25% loss in exercise capacity
- ~40% would have >30% loss in muscle strength
Information and technology critical for human Mars missions

- Site selection for human missions
- Extend stay time
- Demonstrations of critical technologies to “live off the land”
- Protection from physical/environmental hazards
- Understand and minimize physiological hazards to human explorers

http://nsdl.org
Earth is the cradle of humanity, but one cannot remain in the cradle forever.

Konstantin Eduardovich Tsiolkovsky
Let’s pause for questions from the audience....
Drill-Down Listing of the Archive

Use these lists to find all teaching resources in a given category. You can also do a more simplified keyword search or a more advanced search which will allow you to specify values for all specific fields for the teaching resource.

Please note! For some variables, the number of items currently in the Archive in that category are noted in brackets ([ ]) beside the variable. If you select items with more than 200 items in the category, your browser may need additional time (1-3 minutes) to present the long list of items for your review. Your screen may be blue or white during this waiting period. Please be patient. This is not a function of the Archive search engine but of your specific web browser. For more information, go to Frequently Asked Questions.

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Keyword Search Results

Found 8 teaching resources. Click the icon for the description; click on any teaching resource’s title for detailed information. You must be logged in to the left in order to save searches or resources. Once you save a search, go to My Saved Searches to e-mail those results to someone.

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<th>Title/Author/Resource Type/Format/Description</th>
<th>Level(s)</th>
<th>Partner</th>
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<td>Bone Health: Determination of Bone Density with Bone Specimens - Analysis Questions Student Handout</td>
<td>K</td>
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<tr>
<td>UTHSCSA Faculty, The University of Texas Health Science Center at San Antonio Assignment/activity (non-laboratory)(Portable Document Format - PDF)</td>
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Jim Pawelczyk, Ph.D.
jap18@psu.edu

THANK YOU!

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http://www.diigo.com/list/nsdlworkshops/web-sem-mars

http://nsdl.org
Learn about new tools and resources, discuss issues related to science education, find out about ways to enhance your teaching at:

http://expertvoices.nsdl.org/learningdigitalK12

Resources from this seminar:

http://www.diigo.com/list/nsdlworkshops/web-sem-mars

Search for “diigo nsdl workshops mars”

http://nsdl.org
Welcome to Your Professional Development

The Learning Center is NSTA’s e-professional development portal to help you address your classroom needs and busy schedule. You can gain access to more than 3,300 different resources that cater to your preference for learning. Over 925 resources, such as journal articles, science objects and web seminars are available for free. A suite of practical tools such as My Library, My Transcript, and My Professional Development Plan and Portfolio tool help you organize, personalize, and document your growth over time. If desired, you may review an archived Web Seminar overview of the NSTA Learning Center, or download the “How to Guide” PDF (2.7 MB).

Explore Learning Opportunities

By Subject
- Earth & Space Science
- Life Science
- Physical Science

By Grade Level
- Elementary
- Middle School
- High School
- College

By State Standards

Do-It-Yourself Learning

Live Online Seminars & Classes

Learn at your own pace online with these 1-2 or 6-10 hour interactive activities.

Learn online from certified instructors with your colleagues: 1-2 hour seminar, week and month long courses are available. Earn state...

http://learningcenter.nsta.org
National Science Teachers Association
Dr. Francis Q. Eberle, Executive Director
Zipporah Miller, Associate Executive Director
Conferences and Programs
Al Byers, Assistant Executive Director e-Learning

NSTA Web Seminars
Paul Tingler, Director
Jeff Layman, Technical Coordinator

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