Endocrine Disruptor Exposure in Firefighters

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Background Information

- Firefighters are exposed to smoke-derived chemicals, which may be absorbed in the
  - from inhaled particles
  - from smoke derived deposits on skin
  - from contact with contaminated clothing

(Gabia, T. et al.. Characterization of Firefighter Smoke Exposure. *Fire Technology* in press)

Risk of Firefighters

- Epidemiological studies suggested that firefighting is associated with an increase of cancer in several tissues, including the liver, bladder, prostate, thyroid, testis, and in woman, cervical cancer.
- What could be causing this increase?

(Hauser R. et al. *Human Reproduction*. 2007)
(Hauser R. et al. *Int J Androl. 2008)*
(Ma F. et al. JOEM. 2006)

Phthalate Esters and Polycyclic Aromatic Hydrocarbons (PAHs)

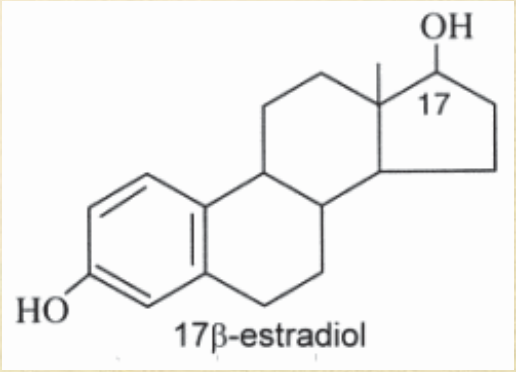
- Studies have shown an increases in cancer occurrences *in vivo*
- Both sets of compounds have displayed either estrogenic or anti-estrogenic activity
  - Tumor promotion or endocrine and developmental disruption

(Christiansen S. et al. *Reprod Toxicol. 2010)*
(Lam J.C 4th et al. *Toxicol Appl Pharmacol.* 1987)
(Harris C.A. et al. Env Hlth Perspective.s 1997)

(Hauser R. et al. *Human Reproduction*. 2007)
(Hauser R.et al. *Epidemiology. 2006)*

Significance of Estrogen

- Major hormone for male and female reproductive development
- Perturbation, alteration of function induced by external or internal mechanisms, of hormone homeostasis can result in carcinogenesis.
  - Caused by Phthalate esters and PAHs



(Christiansen S. et. al. *Reprod Toxicol. 2010)*
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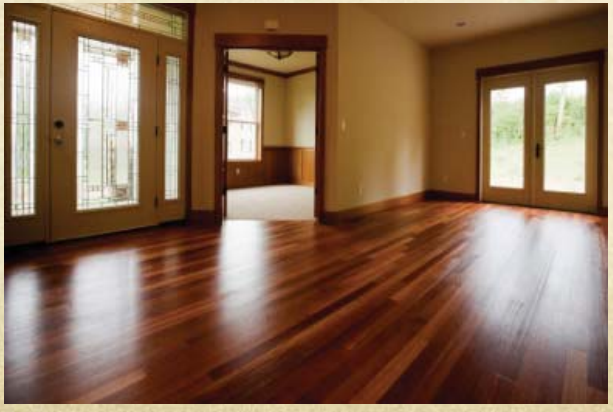
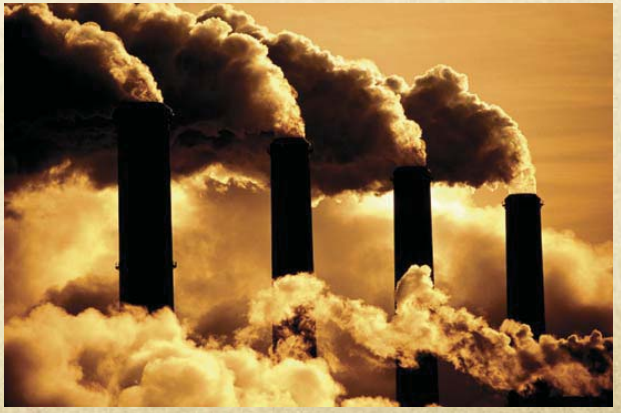
Where are these chemicals found?

- PAHs
  - Materials that are produced from fossil fuels
  - Treated wood products
  - Some foods
    - Coffee, grains, vegetables, fruits

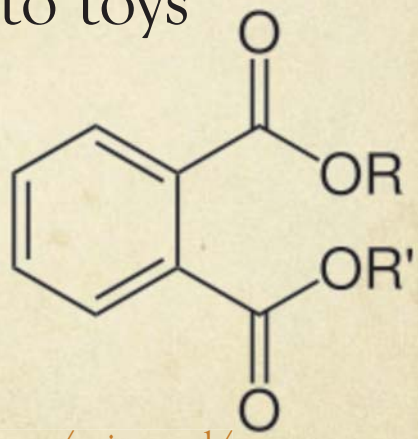




http://www.idph.state.il.us/envhealth/factsheets/polycyclicaromatichydrocarbons.htm
http://media-2.web.britannica.com/eb-media/41/91641-004-842864B7.jpg
http://www.hardwoodperfectflooring.com/f/design/t_header_left.jpg?1345471428645

Where are these chemicals found?

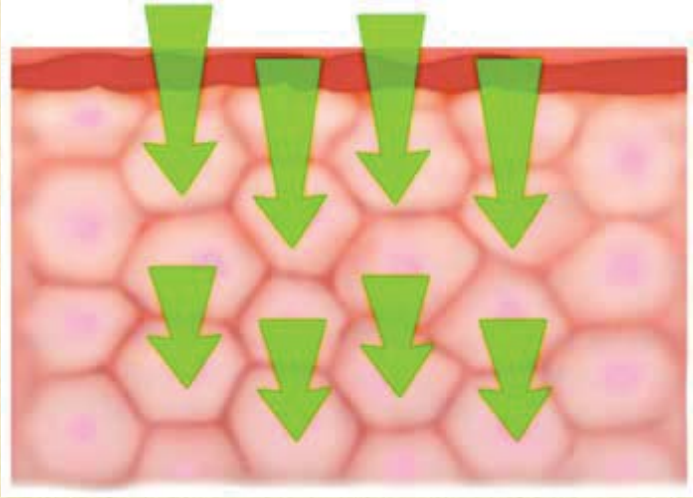
- Phthalate Esters
  - Plastic resins
    - Polyvinyl chloride
      - Ranging from shower curtains to toys to building material



(Sanders, J.M. et al.Toxicology, 2009)
http://www.greenpeace.org.uk/files/images/migrated/MultimediaFiles/Live/Image/4328.jpg
http://totalsource.squarespace.com/storage/PVC-U20PIPES.gif?__SQUARESPACE_CACHEVERSION=1277003613522
http://en.wikipedia.org/wiki/File:Phthalates.svg

Physical Property of Exposure

- Lipophilic
  - Easily absorbed through skin
  - Dissolves in fats, lipids, non-polar solvents



(Roberts, M.S. et al. *Pharm. Pharmacol.* 1977)
(Frasch H.F. et al. *J Toxicol Environmental Health A.* 2010)
(Danon A. et al. *Eur J Clin Pharmacol.* 1986)
http://www.ncbi.nlm.nih.gov/pubmed/8478978

Exposure

- Direct

- Indirect

http://www.monroefd.com/photos/overhaul.jpg
http://www.cleangearofct.com/145_op_744x556.jpg

Hypothesis

- Firefighters are exposed to chemicals in smoke-derived deposits on skin and clothing with measurable estrogenic or anti-estrogenic activity that may be a source of endocrine disruptor activity, as determined in yeast estrogen screen (YES).

Specific Aim

- Measure estrogenic activity of contaminates on firefighter gear that has been exposed to smoke and volatile chemicals with higher-sensitivity and higher throughput than current published methods

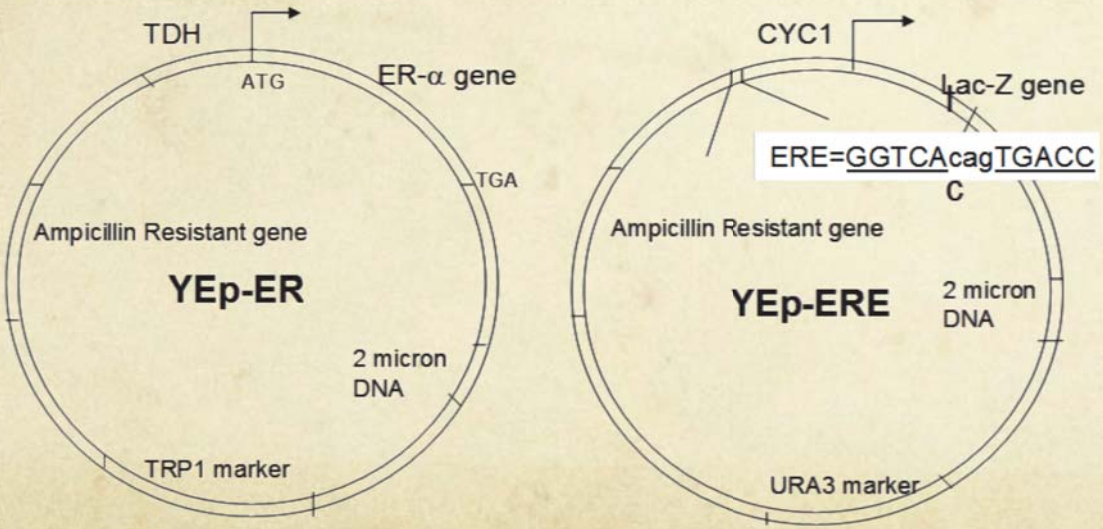
Our Developed Method

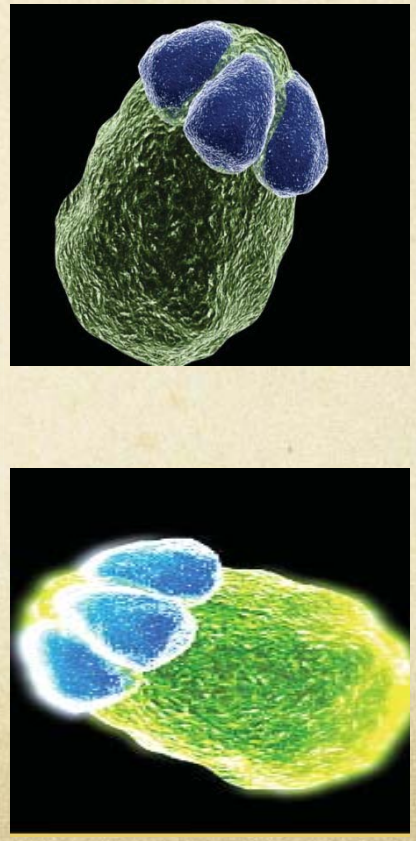
- Sample Collection
  - 3x3 inch square
  - Palm of gloves
  - Hoods

- Smoke-derived agents extracted
  - Methylene Chloride/Hexane
    - Allows for collection of organic compounds

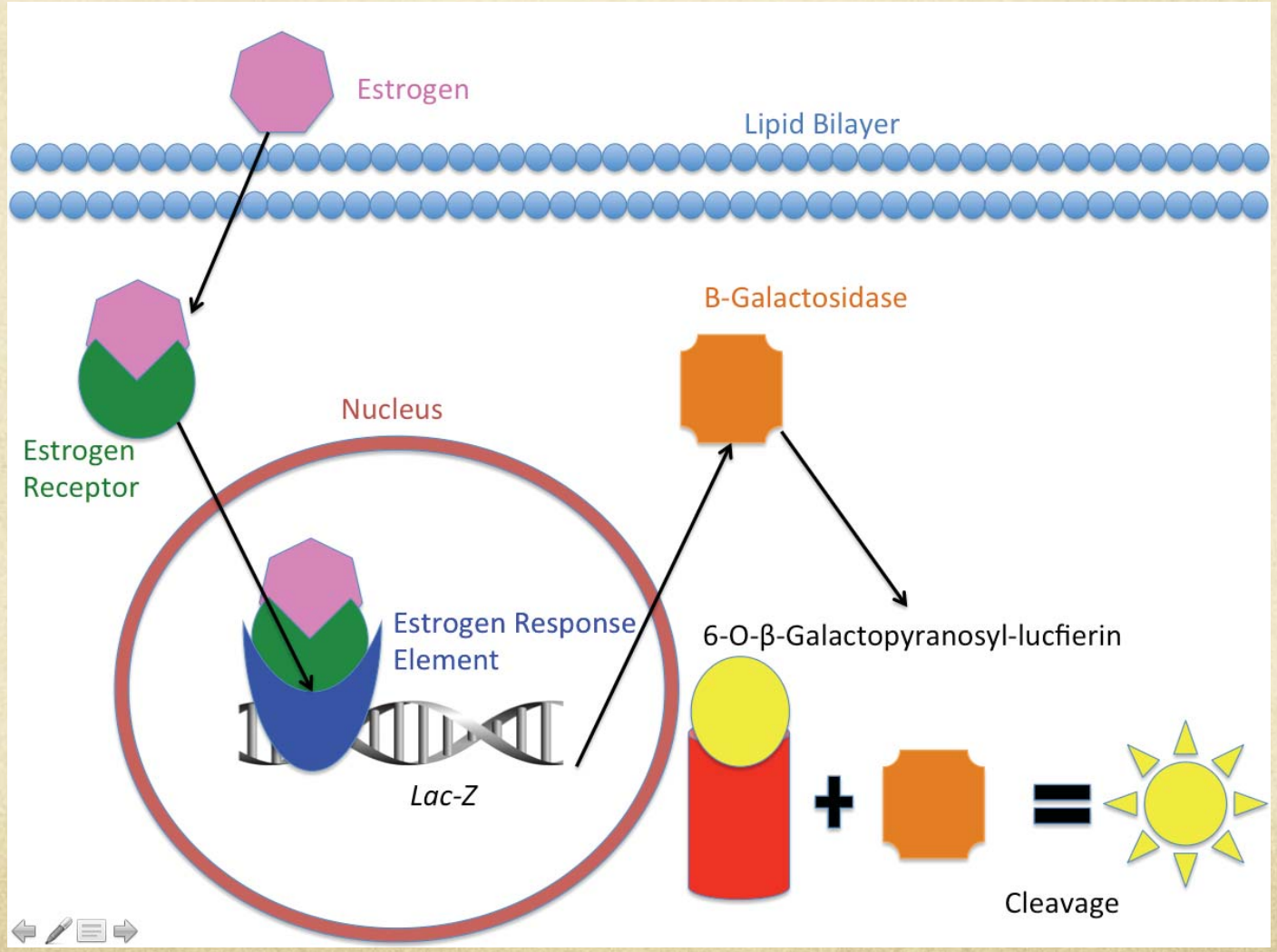
Our Developed Method cont.

- Genetically Engineered Yeast

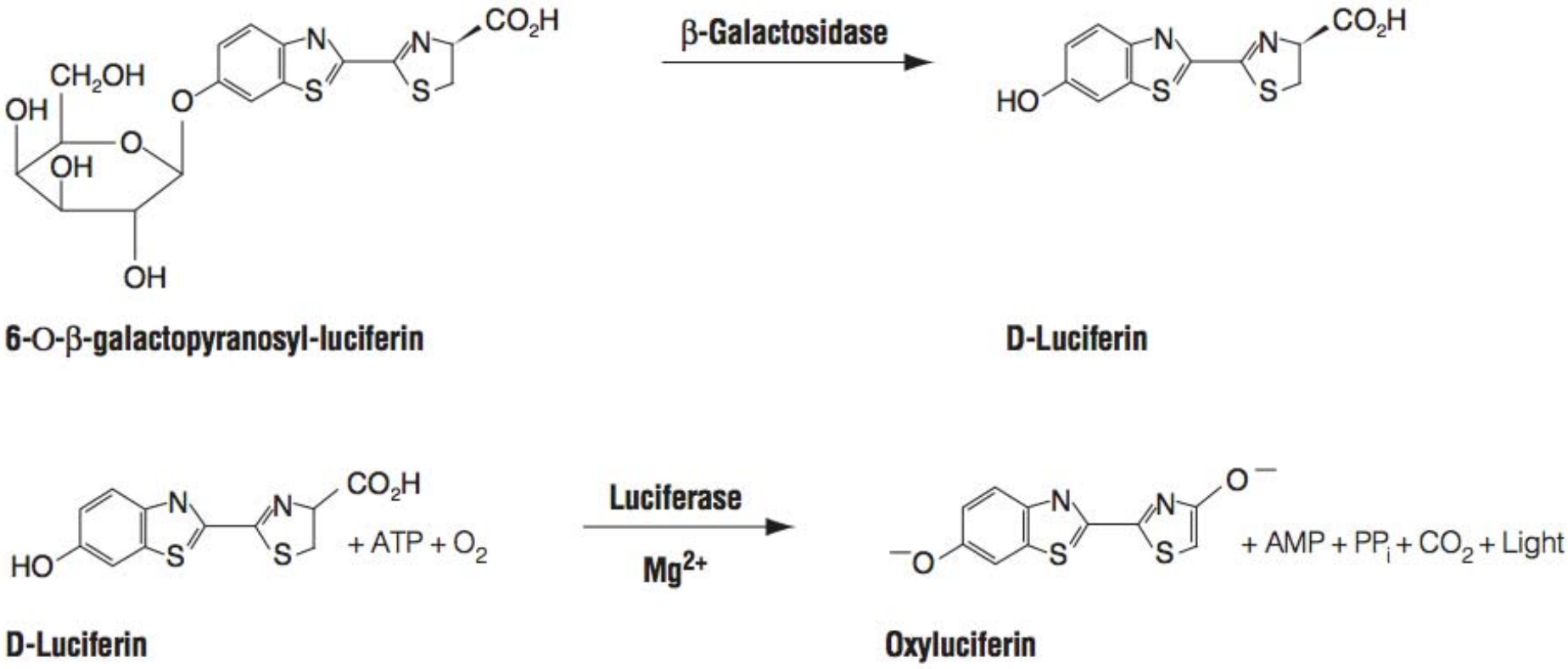




Basic Mechanism



Chemistry



6-O-β-galactopyranosyl-luciferin

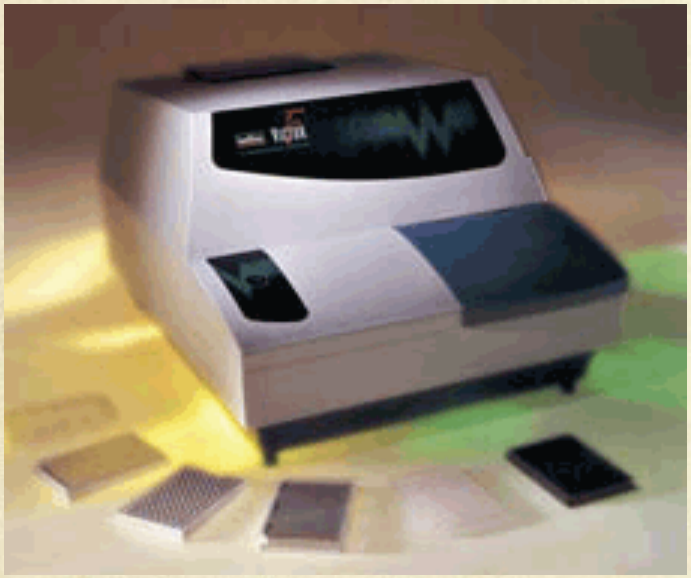
D-Luciferin

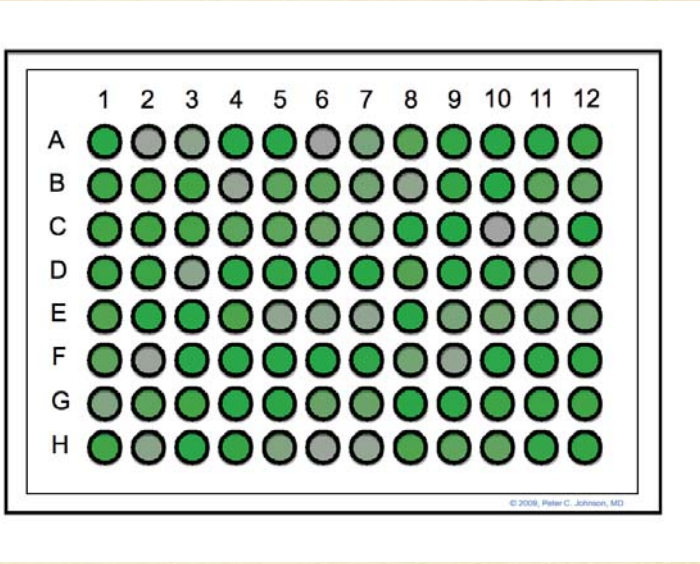
D-Luciferin

Oxyluciferin

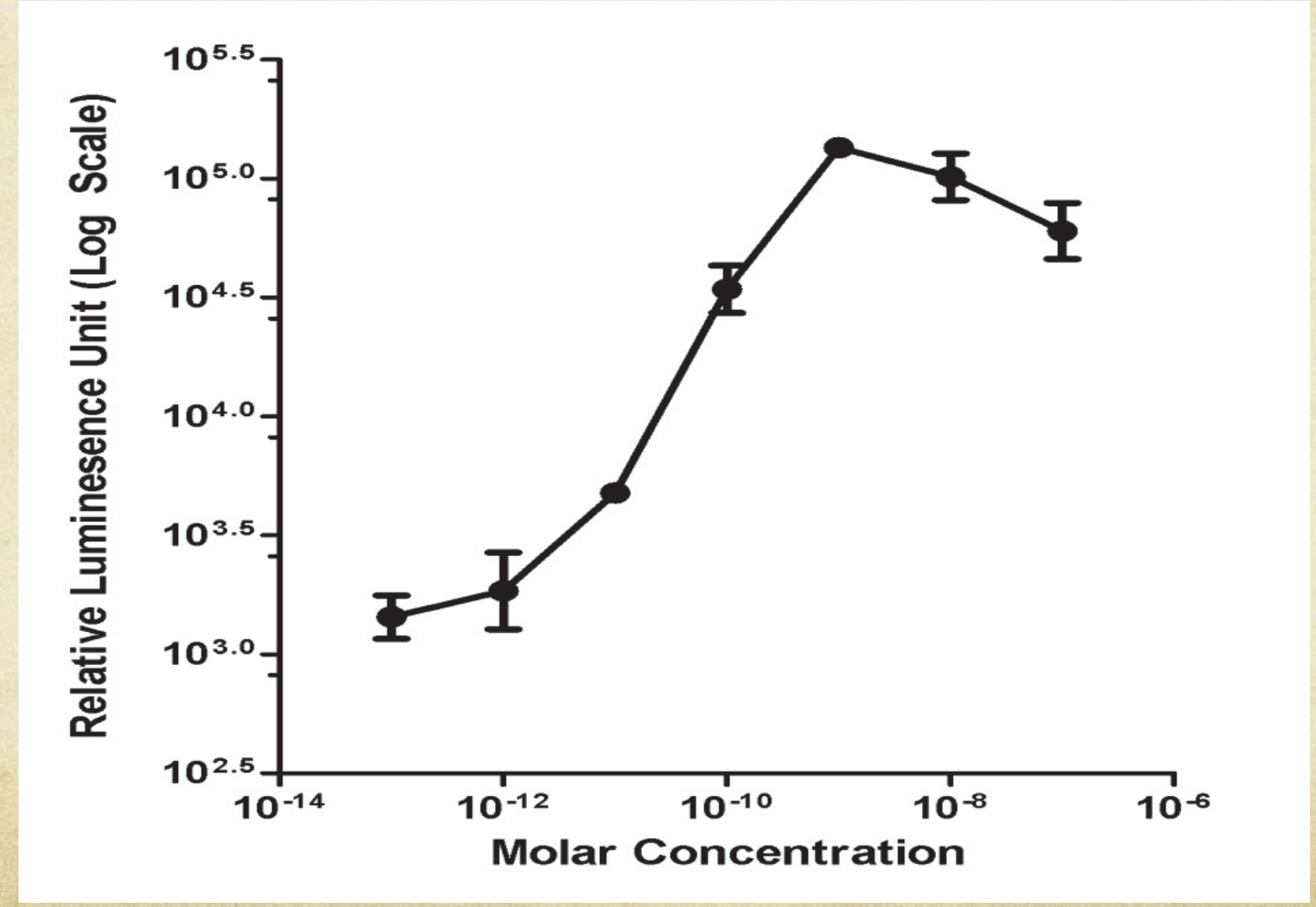
http://www.promega.com/~/media/files/resources/protocols/technical%20manuals/0/beta-glo%20assay%20system%20protocol.pdf?la=en

Determining Chemiluminescence Signal

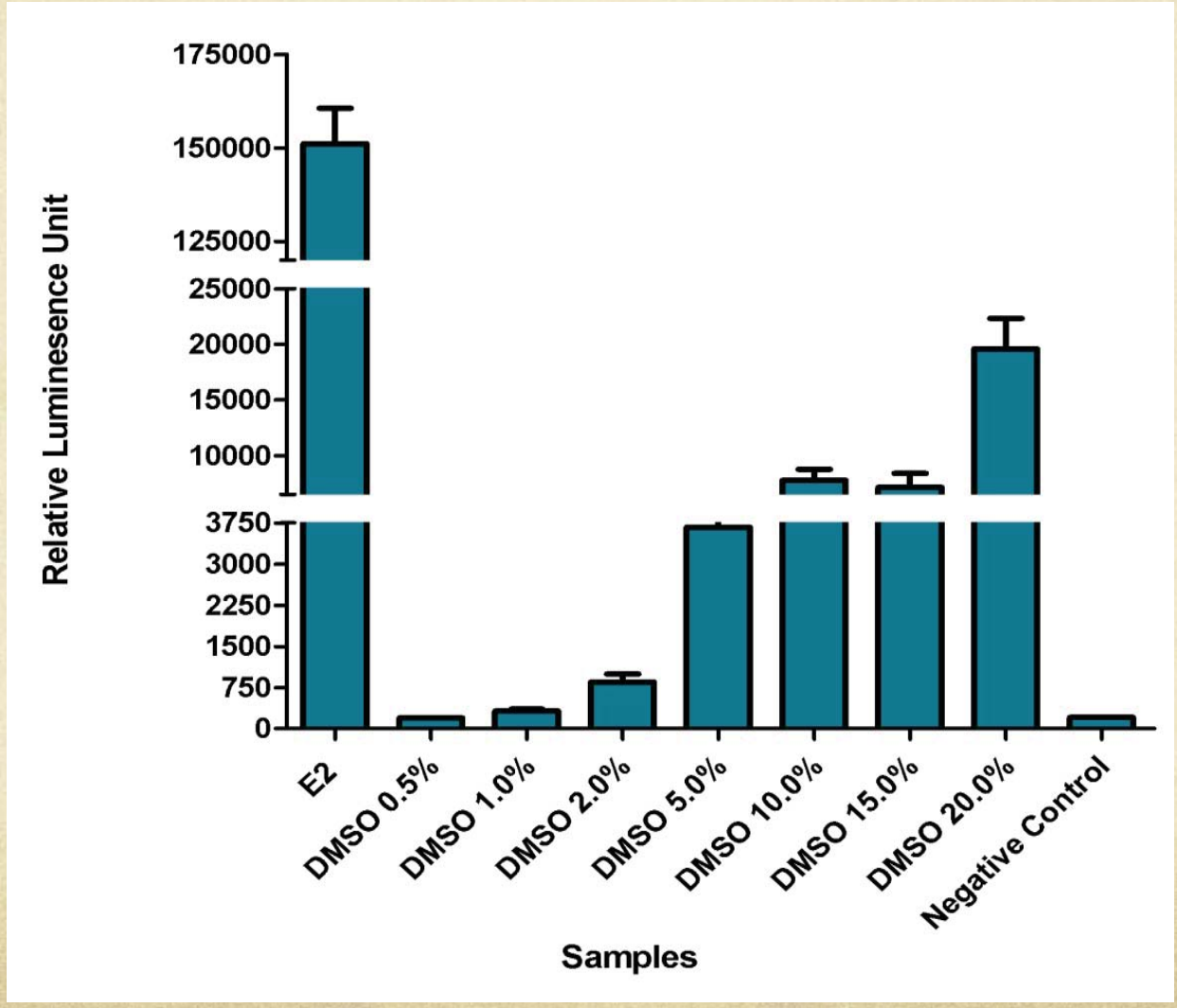




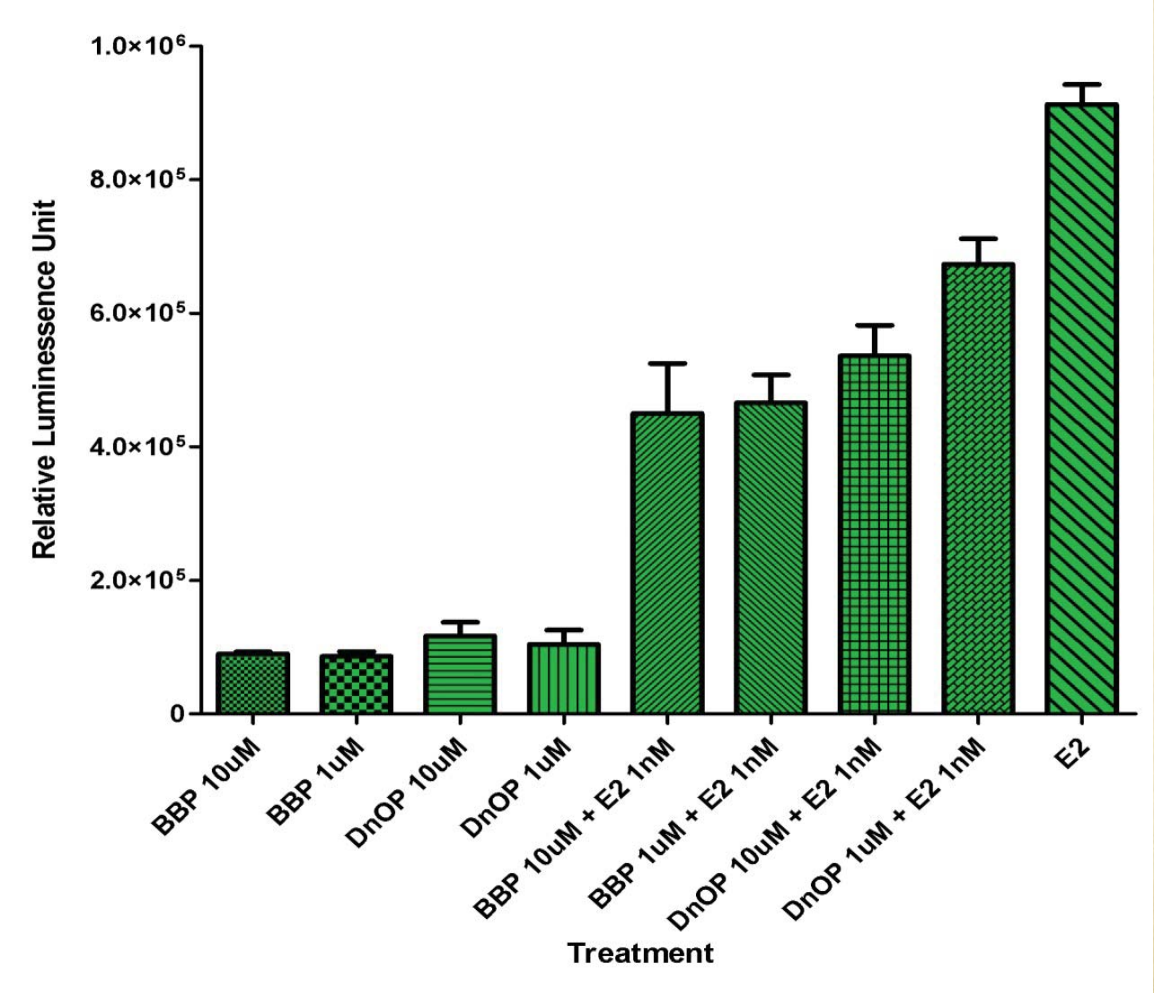
Standard Curve



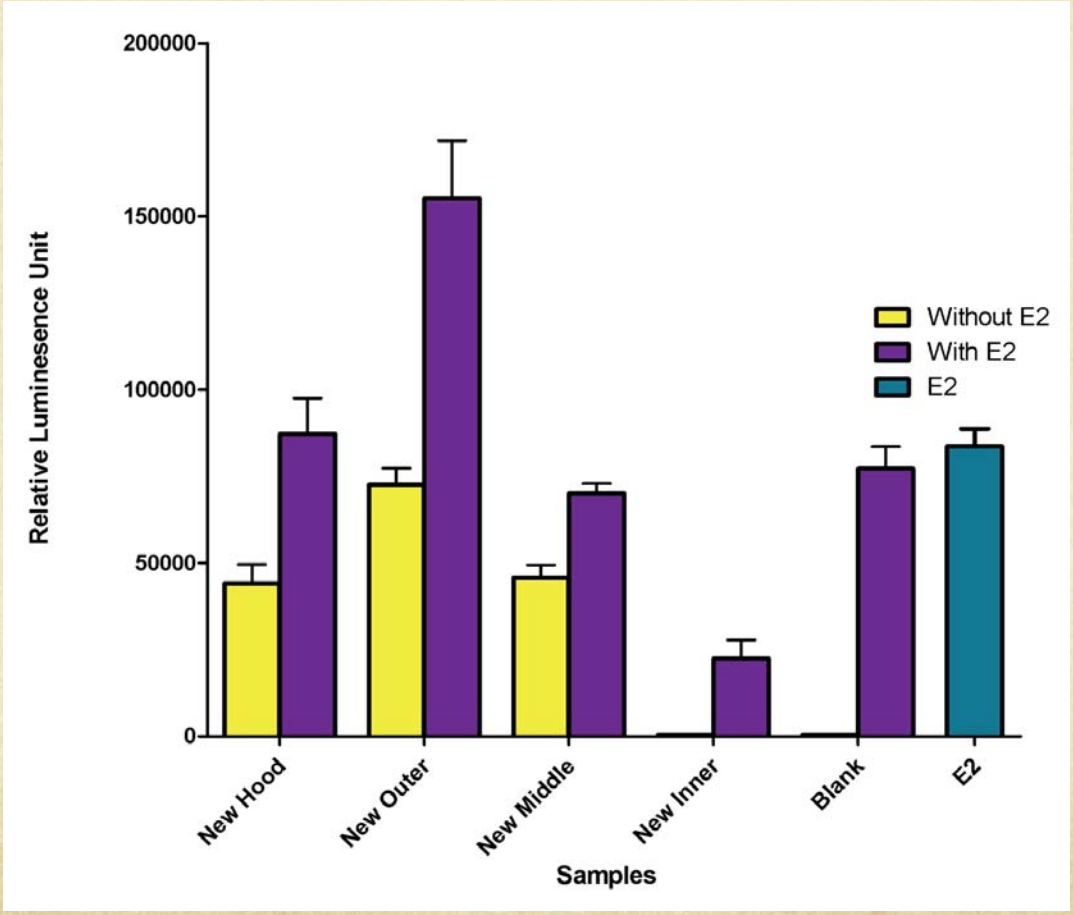
Effect of DMSO



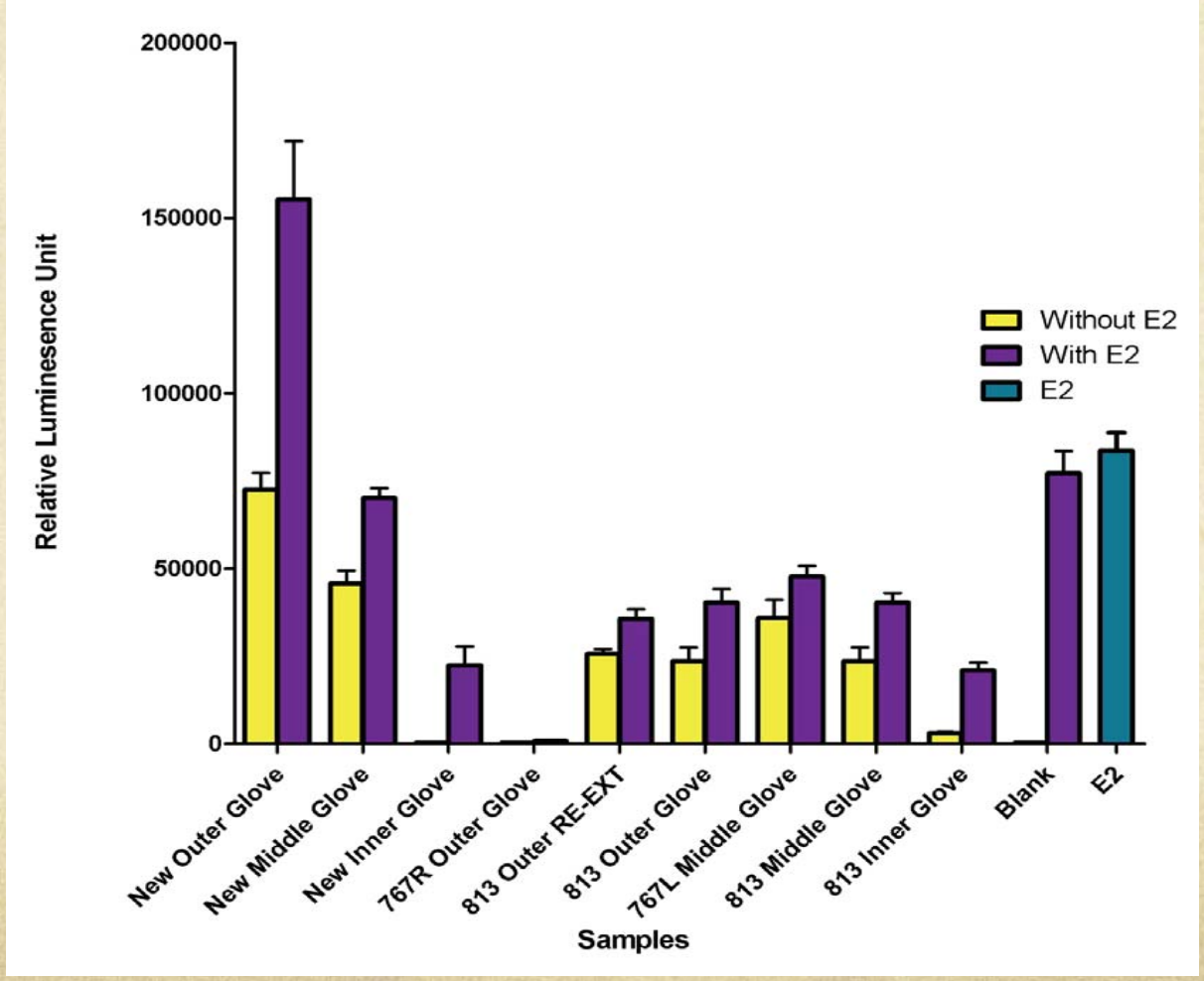
Effects of Known Phthalates



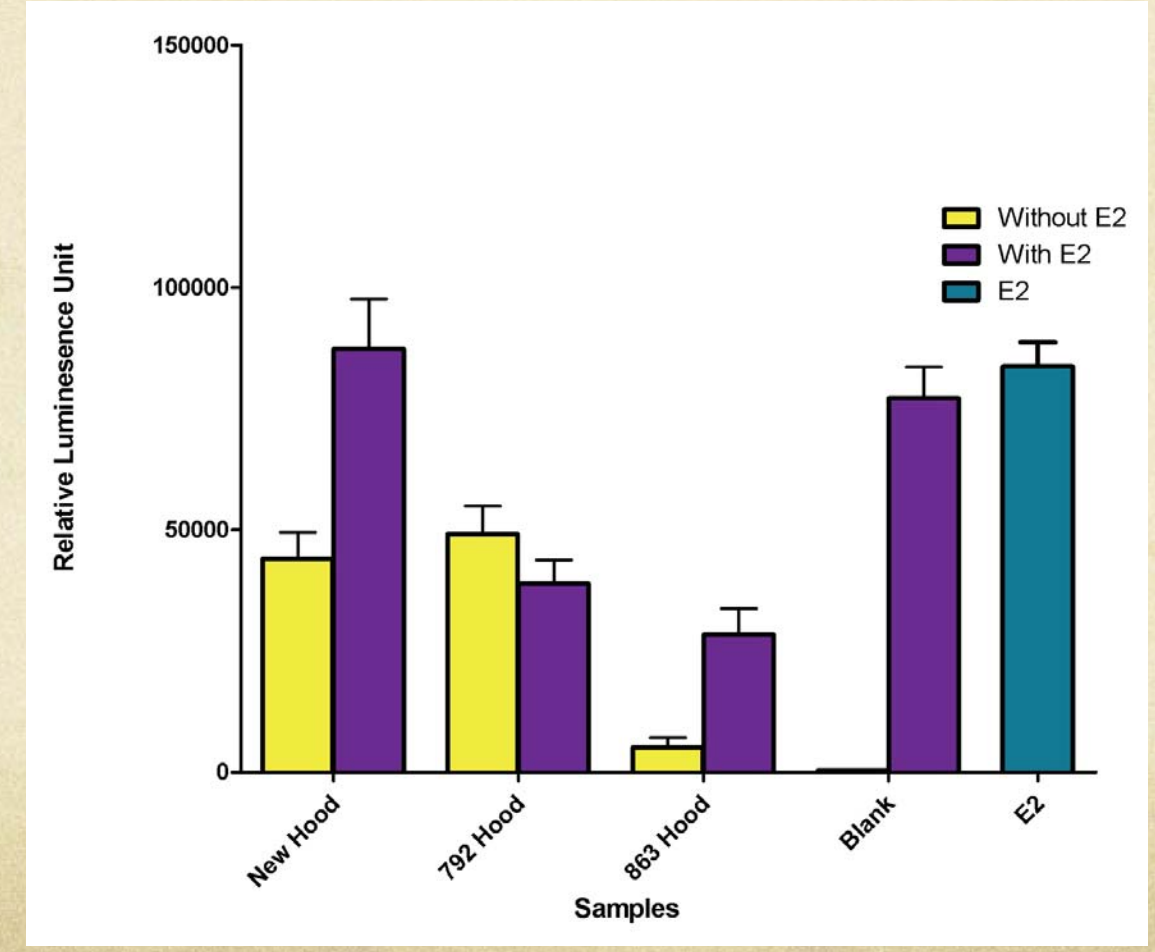
Smoke-Derived Samples: New Equipment



Smoke-Derived Samples: Used Gloves



Smoke-Derived Samples: Used Hoods



Summary

- The genetically engineered yeast are responsive
- Known phthalates have an inhibitory effect on estrogen receptors
- The unknown phthalates have an anti-estrogenic effect
- New firefighter equipment is estrogenic
  - Could be a result of flame retardants

Future Direction

- Determine the exposure during overhaul
- Determine different exposures at specific fire scenes
- Limiting the reliance and the amount of phthalate esters and other estrogenic or anti-estrogenic compounds used in household items and flame retardants

Acknowledgement

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FIN

University of Cincinnati
13th Annual
Pilot Research Project Symposium
October 4-5, 2012

Main Menu

Hosted by: The University of Cincinnati Education and Research Center
Supported by: The National Institute for Occupational Safety and Health. (NIOSH) Grant #: T42/OH008432-07

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- Steering Committee Members
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- Problems Viewing the Videos