

Report 82: Environmental Light: Is NIEHS research focused enough on environmental light and its interaction with chemicals, compounds and organisms in the environment?

Convener: Paul C. Howard (FDA)

Brief History: There are points to consider why role of sunlight and other light sources (it is more than sunlight and more than UVB!) in the human interaction with the environment is important at this time and for the next several years:

- Sunlight is not homogenous in the environment and human interaction is altered by sunlight latitude, season, time of day, atmospheric conditions; other light sources are quite diverse;
- Sunlight is known to have biological activity that is dose and wavelength-dependent, and examples are induction of human and animal skin cancer, induction of human skin photoaging, support of photobiology (*e.g.* plants and photosynthesis), biological development of vision and photoreceptors, and induction of human diseases (*e.g.* seasonal affective disorder);
- Sunlight is known to have chemical/photochemical activity, examples are photoactivation (or photodecomposition) of atmospheric pollutants or bioactive compounds (such as pesticides), photobleaching of plastics and other chemicals, photovoltaic cells;
- Human exposure to sunlight and other light sources is changing, with concomitant increases in adult leisure time (demographics; kids indoors) and skin cancer rates, but at the same time altering patterns of youth time outside in sunlight.

Discussion Highlights: There was discussion regarding the evidence that environmental light does affect biological and chemical systems, and the rationale or reasoning that NIEHS should emphasize (where appropriate) controlling for environmental light in studies. Topics that were discussed were:

- Approximately 25% of the genome oscillates with light exposure;
- Asthma and multiple sclerosis rates are latitude dependent, raising the question whether these are affected by environmental light;
- Some toxicities are chronologically-dependent, for instance, acetaminophen toxicity is greatest during fasting states (lower GSH) than following caloric consumption (higher GSH), and feeding is driven by circadian rhythms, which is driven by light-dark cycling;
- There has been considerable research on circadian biology, but is this translating into environmental health research?;
- There is considerable interest in the circadian rhythms and health effects on shift workers, which could be light-dependent or light-codependent;
- Vitamin D is an essential vitamin, is produced in skin as result of environmental light, and there are questions regarding adequate dosing of children (especially indoor-dwelling children);
- Light and photoproducts (*e.g.* DNA photodimers) are immunosuppressive, yet is this role of light controlled for in environmental health studies?;
- Sunlight is a powerful source of energy catalyzing oxidation/reduction reactions of organics and transition metals;

- Since we know that animals respond to environmental light to control circadian rhythms, are our animal models that use nocturnally-active animals, representative and/or translational to humans?;
- Photochemistry of pollutants and other chemicals is widely published.

Recommendations: It is felt that the possible role of light in quantitative environmental assessments may be underestimated or under-appreciated. More attention should be programmatically placed on:

- controlling for environmental light* in environmental fate studies (*e.g.* PAH in gulf);
- controlling for environmental light in epidemiology studies, and experimental studies (are the light considerations adequate);
- light as risk or confounding factor in occupational risk, especially shift-workers;
- understanding of role of light in disposition of environmental chemicals or pollutants (some is known but not in all areas);
- research on light pollution (*i.e.* major metropolitan centers never truly reaching darkness) and effect on environment (fauna and flora);
- enhance research on the possibility of light as a green catalyst in environmental mediation (*e.g.* expand on green light-based photo remediation)

** environmental light being defined as sunlight and other light sources, and recognizing that light sources differ by wavelength and dose.*

Discussion Participants: Bruce Androphy, Chris Bradford, Barry Dellinger, Andrea Hicks, Paul Howard (convener), Richard Kwok, Martha Nolan, Michael Pino, Kris Thayer