



## Genes, Environment and Health Initiative

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# Exposure Biology Program

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# Genes, Environment, and Health Initiative: Exposure Biology Program

## EXPOSURE BIOLOGY PROGRAM



Develop technology  
and biomarkers

- Nutrition
- Physical Activity
- Environmental Exposures
- Psychosocial Stress/Addictive Substances

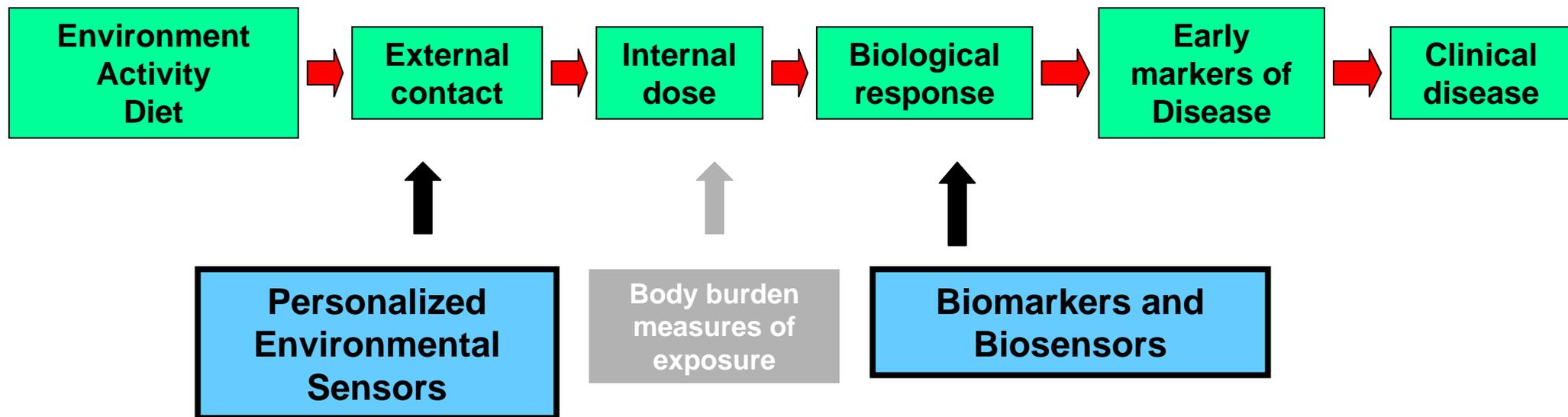
## GENOME WIDE ASSOCIATION STUDIES



Identify genetic  
variants

**GXE**

# Exposure Biology Program: Areas of Investment



**Links personal exposures to biology to disease**

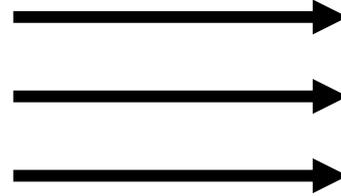
Adapted from National Research Council, 1987

# Exposure Biology Program: Deliverables

FY07                      FY08                      FY09                      FY10                      FY11

## Environmental Sensors

- Diet/Physical Activity
- Chemicals/Biologics
- Psychosocial Stress/Addictive Substances



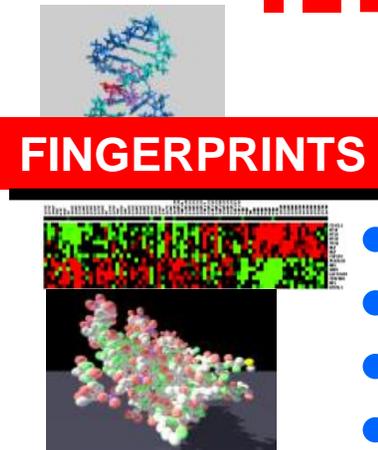
**DEVICES**



**Human Health Studies**

## Biological Response

- Biomarkers
- Centers – biomarkers/biosensors



**FINGERPRINTS**

Lab on a Chip

**DEVICES**

- Inflammation
- Oxidative stress
- Programmed cell death
- Epigenetic markers

# Environmental Sensors (U01) Applications

(NIEHS Lead, \$4M/yr, n=54 applications, 8 funded)

<b>Stressor</b>	<b>Application</b>	<b>Number of Applications Which Address</b>
Volatile organic compounds (VOCs)	<ul style="list-style-type: none"><li>• Portable air monitor</li><li>• Personal contact/air monitor badge</li></ul>	4
Particulates, Diesel Exhaust	<ul style="list-style-type: none"><li>• Personal contact/air monitor badge</li></ul>	4
Ozone	<ul style="list-style-type: none"><li>• Personal contact/air monitor badge</li></ul>	3
Allergens (e.g., dust mite, cockroach)	<ul style="list-style-type: none"><li>• Nasal air monitor</li></ul>	
Pesticides	<ul style="list-style-type: none"><li>• Personal contact/air monitor badge</li></ul>	1
Total		12

# Improved Measures of Diet and Physical Activity (U01)

(NHLBI/NCI lead, \$4M/yr, n=26 applications, 7 funded)

Deliverable	Dietary Factor	Physical Activity Measurement	No. Applications Funded
1. <b>Cell phone</b> with multiple wireless sensors for RT data capture/transfer		Motion, activity intensity, energy expenditure, location (GPS unit)	2
2. <b>Integrated sensor system</b>		Integrated RT measurement of motion, energy expenditure, ventilation	1
3. <b>Cell phone</b> for food intake recording, wireless	Photo imaging/video of portion size, voice intake recall, energy/nutrient content		2
4. <b>Refined software</b> for recording 24hr food intake	Target children (8-13 yr), English/Spanish		1
5. <b>Pendant sensor:</b> photos, record swallowing, respiration, wireless	Video camera to record portion size/code food types, voice intake recall	Accelerometer/respiration, swallowing	1

# Tools for Quantifying Exposures to Psychosocial Stress and Addictive Substances (U01)

(NIDA Lead, \$2M/yr, n=14 applications, 6 funded)

Deliverable	Substance Measurement	Stress Measurement	No. Applications Funded
1. <b>Handheld audio-assisted PDA</b> and sensor patches to measure drug use, stress response, and physical location	Opiates, cocaine, amphetamine <b>(sweat patch, hair analysis)</b>	RT reporting of stress events with concurrent measurement of heart rate, allostatic load; built in GPS	2 linked
2. <b>Skin patch</b> to measure alcohol and stress response with microprocessors, wireless	Alcohol <b>(interstitial fluid)</b>	Skin temp, heart rate, breathing rate, skin conductance	1
3. <b>Personal stress sensor</b> worn around the head		Light and personal activity meter to monitor sleep/wake cycles	1
4. <b>Hand-held monitor</b> for stress response		Colorimetric test for alpha amylase in <b>saliva</b> , read by hand held device; can be adapted for cortisol, etc.	1
5. <b>Wrist watch sensor</b> of stress response, wireless		Computer assisted, RT recall device to measure stress events	1

# Biological Response Indicators of Environmental Stress (U01)

(NIEHS Lead, \$4M/yr, n= 54 applications, 11 funded)

<b>Stressor</b>	<b>Biospecimen/Biomarker</b>	<b>No. Applications Funded</b>
Tobacco	<ul style="list-style-type: none"><li>• Airway epithelial cells, blood, urine (protein/DNA adducts, lipids, gene expression)</li></ul>	2
Endocrine Disruptors (Bisphenol A, Phthalate)	<ul style="list-style-type: none"><li>• Plasma, buccal cell (proteins)</li><li>• Tumor biopsy (epigenetic marks)</li></ul>	2
Alcohol	<ul style="list-style-type: none"><li>• Hepatocyte culture (gene expression)</li></ul>	2
Diet (macronutrients: fat, carbs)	<ul style="list-style-type: none"><li>• Plasma (proteins, metabolites)</li></ul>	1
Industrial Chemicals (PCBs)	<ul style="list-style-type: none"><li>• PMNs, blood, urine (gene expression)</li></ul>	1
Radiation	<ul style="list-style-type: none"><li>• Lymphoblastoid cells (DNA damage)</li></ul>	1
Pesticide	<ul style="list-style-type: none"><li>• Saliva, serum, erythrocytes (protein adducts)</li></ul>	1
Metals, cold, infection	<ul style="list-style-type: none"><li>• Plasma (“stress proteins”)</li></ul>	1
Total		11

# Biological Response Indicators of Environmental Stress (U01) Funded Applications

<b>Biological Pathway</b>	<b>No. Applications Funded</b>
Endocrine Disruption	2
Epigenetic Regulation	1
Oxidative Stress/Inflammation	2
DNA Damage/Repair	1
Organ-specific Toxicity (lung, liver, reproductive, neurotoxicity)	4
Mitochondrial function	1
Total	11

# Biological Response Indicators of Environmental Stress Centers (U54)

(NIEHS Lead, \$4.5M/yr, n= 6 applications, 2 funded)

<b>Stressor</b>	<b>Biomarker discovery/detection</b>	<b>Biosensor</b>
Tobacco smoke and obesity	Detect modifications to proteins in human and animal studies	ELISA-like platform for detecting modified proteins using nanoparticle-labeled Abs for improved signal detection
Benzene, PAHs, Alkylating Agents	Discover/detect protein adducts and genetic mutations in human studies	ELISA-like detection of PAH-protein adducts using magnetically-labeled Abs