

## A Wiki-Based Data Management System for Toxicogenomics

Stephen W. Edwards BioIT World Conference & Expo, April 21, 2010

This talk does not necessarily reflect the views or policies of the U.S. Environmental Protection Agency or represent EPA endorsement of any trade names or commercial products.



Office of Research and Development National Health and Environmental Effects Research Laboratory

April 23, 2010





- Background
  - -Mode of action in risk assessment
  - -How systems approaches can facilitate risk assessment
- Data management needs to enable systems approaches to enhance risk assessment



**Human Health Risk Assessment** 



Office of Research and Development National Health and Environmental Effects Research Laboratory

http://www.epa.gov/risk/health-risk.htm



## **Mode of Action**

- Toxicity pathways
  - NAS/NRC, "Toxicity Testing in the 21<sup>st</sup> Century", 2007
- Key Events
  - Biomarkers (bioindicators)
- Apical endpoint
  - -i.e. Adverse outcome



Gallagher, et al., (2010) in "Biomarkers in Medicine, Drug Discovery and Environmental Health"

Office of Research and Development National Health and Environmental Effects Research Laboratory

Meek, ME, (2008) Environ. Mol. Mutagen. 49:110



### Systems biology & the MOA framework



Edwards & Preston (2008), Tox Sci, 106(2):312-318







- Background
- Data management needs to enable systems approaches for enhancing risk assessment
  - -Platform
  - -Underlying object model
  - –Action shots



### **Platform Requirements**

- Must be easy to use
- Must be customizable
  - -Must capture a wide variety of study designs
  - –Must adapt to ever-changing experiments & methods
- Must meet our IM/IT requirements
  - -Must keep long-term maintenance costs low
  - -Must interface with other Agency databases
  - -Must fit into Agency-wide data management system
  - –Must support users throughout the U.S.
- Want a single data source for power & casual users



## The solution is...

- A system that is quickly constructed and easily revised
- A system that can handle many data types
- A modular and transparent system
- A Web-based system





http://www.bioteam.net/



### **Traditional LIMS vs WikiLIMS**

- Traditional LIMS
- Complex and unfamiliar interfaces
- Proprietary languages
- Commercial technology platforms
- Complex data schemas
- High cost

#### WikiLIMS

- Simple user interface
- Use any popular language
- Open-source
- Data is the schema
- Low cost





### WikiLIMS Architecture





http://www.bioteam.net/



## **Conceptual Model for Our WikiLIMS**





## **Top Level Organization is via Projects**

WIKIL IMS	Steve Air Gen	omics Test 1				
=	Project Name	Steve Air Genomics Test				
	Project Lead	Stephen Edwards (				
navigation	Participants	Susan Hester (Charte), Beena Vallanat (Carter), Bill Van Etten (Carter), Nina Rountree (Charter), Geremy Knapp (Carter), Harriet Ashcroft (Marter), ClarLynda Williams-DeVane (Carter)				
<ul> <li>Main Page</li> </ul>	Readers	Abdul Malek Khan (🗤 👘 ), Lyle D. Burgoon (🗰 👘 )				
<ul> <li>Community portal</li> <li>Current events</li> </ul>	Multi-year Plan	Clean Air Research				
<ul> <li>Recent changes</li> </ul>	Long-term Goal	1 Reduce uncertainty in standard setting and air quality management decisions due to advances in air pollution science				
<ul><li>Random page</li><li>Help</li></ul>	Annual Performance Goal	6 Evaluate the importance of key biologic pathways in explaining how air pollutants cause adverse health outcomes				
categories People	Annual Performance Measure	22 Identify the mechanisms by which air pollutants cause adverse health effects				
Projects	Proposal	Air Test Project Proposal				
<ul> <li>Studies</li> <li>Subjects</li> </ul>	Study(ies)	Microarray Test, Microarray Test2, SWE New Ozone, SWE Ozone Outcome 2, SWE Ozone Outcomes, Steve Ozone Test Add Study				
<ul> <li>Documents</li> <li>Protocols</li> <li>Stressors</li> <li>Suppliers</li> <li>Controlled Vocabularies</li> </ul>	This project is for testing WikiLIMS functionality by test loading a series of studies by Urmila Kodavanti. – Mechanisms of susceptibility to air pollutants: Understanding the mechanisms and roles of genetic oxidative stress in susceptibility to ozone. (Unpublished) – One-Month Diesel Exhaust Inhalation Produces Hypertensive Gene Expression Phenotype in Healthy Rats (Gottipolu et al. (2009) Environ Health Perspect. 117(1):38-46). – The Role of Particulate Matter Associated Zinc in Cardiac Injury in Rats (Kodavanti et al. 2008 Environ Health Perspect. 116(1):13-20)					



### A Study Corresponds to an Individual Experiment

	page discus	ssion ec	dit with form edit	history de	lete move prot	ect watch	refresh			
	SWE Oz	SWE Ozone Outcome 2								
VVIKILIMIS										
Contraction of the local division of the loc										
	Study Stud	y Variables	Study Design	Study Phase	Study Outcome	Study Analyses	Groups	Subjects		
navigation										٦
Main Page	Project	Steve Air G	enomics Test 1							
Community portal	Start Date	2010/02/24	01:36:49 PM							
Current events		Individuals o	compromised with	preexisting cond	itions, such as dise	ases, are likely mor	e susceptib	le to environ	mental exposures, and often the	
Recent changes		uncertainty	factor employed i	n risk assessmer	nt may not be adequ	late to protect these	individuals	. Although di	iseases such as congestive heart failure	
Random page		atheroscler	osis, Parkinson's	and Alzheimer's	diseases, diabetes,	infertility, and cance	er have dive	rse etiologie:	s, they have one common element,	
Help		namely the	presence of oxida	tive stress. Ofter	the disease pathol	ogy and oxidative st	ress are int	erdependent,	, such that alleviation of one improves th	3
categories		other condit	tion, and thus, the	individual's susc	eptibility to environn	nental exposures ma	ay relate to	each of thes	se conditions. However, the complex	
People	Introduction	Interactions	between disease	development and	i oxidative stress ar	e not well understoo	d but are lik	ely linked to	genetic abnormalities that underlie	
Projects		individual su	usceptibility. To ui	iderstand the me	chanism of suscepti	ibility, and the role o	d underlying	j oxidative st	ress as a common susceptibility	
<ul> <li>Studies</li> </ul>		attribute, re	ievant animai moc	eis exnibiting gei	netic predisposition	to oxidative stress c	an be empi	oyed. In this	proposal, we nypotnesize that rat	
Analyses		induced ext	ilbiting prienotypic	predisposition to	oxidative stress and	o a variety of carolov	ascular uis	eases (CVD) revietu ef dier	) will be more susceptible to ozone-	
<ul> <li>Subjects</li> <li>Documents</li> </ul>		Charles Div	or will be tected for	r thoir cuccontibi	lity to oir nollutonto	and genetic express	cion profilor	compored t	eases which are available through	
Protocols		mechanicm	ei will be testeu it ie	i tileli susceptibi	nty to an ponutants,	and genetic expres	sion promes	s compareu i		
<ul> <li>Stressors</li> </ul>	Distallar	E	15.							
Suppliers	Discipline	Exposure								
Controlled	Duration									
Vocabularies	Duration Unit									
Tutorials	Purpose	To understa	and the mechanisr	ns and the roles	of genetic oxidative	stress in susceptibil	ity to ozone	э.		
forms	Principal									
Add Project	Investigator	Stephen Ed	iwards (	)						
Add Study	Design Type	Factorial								
Add Analysis	Subject Type	Lob Animal								
Add Subject	Subject Type	Lab Animar								
Add Document	Time Type	Study								
<ul> <li>Add Protocol</li> <li>Add Stressor</li> </ul>	Group Size	8								
<ul> <li>Add Supplier</li> </ul>	IRP	My IRP								
special	Publication(s)	None: Add	Publication							



### **Study Variables – Data Input Form**

	page discussion edit with form edit history delete move protect watch refresh
	Edit Study: SWE Ozone Outcome 2
Station of the second	Study Variables Study Design Study Phase
navigation	
Main Page	name Values(multiple values separated by ,) unit
Community portal	OZONE 0.0.25.0.5.1.0
<ul> <li>Current events</li> </ul>	
<ul> <li>Recent changes</li> <li>Deader news</li> </ul>	Remove
<ul> <li>Random page</li> <li>Help</li> </ul>	
- molp	Add another Stressor
categories	Gender none
People	Male
<ul> <li>Projects</li> <li>Studios</li> </ul>	Female 🗸
<ul> <li>Studies</li> <li>Subjects</li> </ul>	Strain: none
Documents	WKY
Protocols	Wistar
<ul> <li>Stressors</li> </ul>	SHR
<ul> <li>Suppliers</li> </ul>	JCR III
Controlled	SHRSP
Tutorials	SHHF
forms	Time: 0,18
<ul> <li>Add Project</li> <li>Add Shudu</li> </ul>	
<ul> <li>Add Study</li> <li>Add Subject</li> </ul>	Create Study Design
<ul> <li>Add Document</li> </ul>	
Add Protocol	Summary:
Add Stressor	



### **Study Design – Data Input Form**

	page	discussion	edit with f	orm	edit history	delete	move pr	rotect	watch	refresh
	Edit S	tudy: SW	E Oz	one (	Outcome	2				
	Study	Study Variables	Study	Design	Study Phase					
navigation Main Page	Create Gr	oup? 🗖								
Community portal	G	oup Name	Size	values	combination					
<ul> <li>Recent changes</li> </ul>	CageC	ontroISD	2	null	Male		SD	18		
<ul><li>Random page</li><li>Help</li></ul>	Remo	ve								
categories										_
People	G	oup Name	Size	values	combination					
Projects	CageC	ontroISHHF	2	null	Male		SHHF		18	
<ul> <li>Studies</li> <li>Subjects</li> </ul>	Dama									2
<ul> <li>Documents</li> </ul>	Lemo									
Protocols										
Stressors	G	oup Name	Size	values	combination					
<ul> <li>Suppliers</li> <li>Controlled</li> </ul>	CageC	ontroISHRSP	2	null	Male		SHRSP		18	
Vocabularies										1
Tutorials	Remo	ve								
forms										
Add Project	G	oup Name	Size	values	combination					
Add Study	CageC	ontrolJCR	2	null	Male		JCR	18	3	
Add Subject			L							1
Add Document	Remo	ve								
Add Protocol										



### **Study Variables Table Summarizes the Overall Design of the Experiment**

	page discussion ed	lit with form edit	history de	lete move prot	ect watch	refresh					
	SWE Ozone Outcome 2										
	Study Study Variables	Study Design	Study Phase	Study Outcome	Study Analyses	Groups					
navigation	M Study variable name	🗵 Study varia	ble value		✓ Study variable	unit					
<ul> <li>Main Page</li> <li>Community portal</li> </ul>	OZONE	0,0.25,0.5,1.0			ppm						
Current events	gender	Male			none						
Recent changes	strain	none									
Random page	time	0,18		hours							
categories											
People	Please specify an Excel file o	f End Point data t	o upload:								
<ul> <li>Projects</li> <li>Studios</li> </ul>			Browse								
<ul> <li>Subjects</li> </ul>	Upload Excel file										
Documents	p										
Protocols											
Stressors											
Suppliers	Category: Studies										
Controlled											
Tutorials											



### Study Design Page Explicitly Defines the Groups Based on that Overall Design

_	page discussion (	edit with form edit	history de	lete move pro	otect watch
	SWE Ozone O	utcome 2			
	Study Study Variables	Study Design	Study Phase	Study Outcome	Study Analyses
navigation	■ Group name is	🛛 Group size i	s 💌 Group	value is	
Community portal	CageControlWistar	2	null Male	Wistar 18	
Current events	CageControlWKY	2	null Male	WKY 18	
<ul> <li>Recent changes</li> <li>Random page</li> </ul>	CageControlSHR	2	null Male	SHR 18	
<ul> <li>Help</li> </ul>	00_GMale_SWKY_T0	8	0 Male W	'KY O	
categories	00_GMale_SWKY_T18	8	0 Male W	'KY 18	
People	00_GMale_SWistar_T0	8	0 Male W	′istar O	
Projects	00_GMale_SWistar_T18	8	0 Male W	′istar 18	
Studies	O0_GMale_SSHR_T0	8	0 Male St	HR O	
<ul> <li>Analyses</li> <li>Subjects</li> </ul>	O0_GMale_SSHR_T18	8	0 Male Sł	HR 18	
<ul> <li>Subjects</li> <li>Documents</li> </ul>	O0_GMale_SFHH_T0	8	0 Male Fł	нн о	
Protocols	O0_GMale_SFHH_T18	8	0 Male Fł	HH 18	
<ul> <li>Stressors</li> </ul>	O0_GMale_SJCR_T0	8	0 Male JO	RO	
<ul> <li>Suppliers</li> <li>Controlled</li> </ul>	O0_GMale_SJCR_T18	8	0 Male JC	R 18	
Vocabularies	00 GMale SSHRSP TO	8	0 Male St	HRSP 0	
Tutorials	00_GMale_SSHRSP_T18	3 8	0 Male Sł	HRSP 18	



### **Study Phase Allows Different Time Units for Different Phases of the Experiment**

	page discuss	sion ea	lit with form ed	it history dele	ete move prot	ect watch			
	SWE Ozone Outcome 2								
	Study Study	Variables	Study Design	Study Phase	Study Outcome	Study Analyses			
navigation	Mame	M Order	■ Duration	🗵 Duration Unit					
Community portal	Acclimation	1	14	days					
Current events	Exposure	2	5	hours					
Recent changes	Post-exposure	3	19	hours					
<ul> <li>Random page</li> <li>Help</li> </ul>	Post-sac	4							
categories									
<ul> <li>People</li> <li>Projects</li> <li>Studies</li> <li>Analyses</li> <li>Subjects</li> </ul>	Please specify an	Excel file o	f End Point data	to upload: Browse					
Subjects     Documents     Protocols     Stressors	Opidad Excern								
Suppliers     Controlled	Category: Studie	s							
Vocabularies									



# Study Outcomes Segregate the Experiment into Specific Units of Work

	page	discussion	lit with form edit	history de	lete move prot	ect watch				
=										
	Study	Study Variables	Study Design	Study Phase	Study Outcome	Study Analyses				
navigation Main Page Community portal Current events Recent changes Random page Help categories	SWE CONSULT OF CONSUL OF CONSUL OF CONSUL OF CONSULT OF CONSULT OF CONSULT OF	)zone Outcome 2 O )zone Outcome 2 O )zone Outcome 2 O )zone Outcome 2 O )zone Outcome 2 O	utcome Husbandry utcome Exposure utcome Recovery utcome Necropsy utcome Lung Mea	/ surements						
<ul> <li>People</li> <li>Projects</li> <li>Studies</li> <li>Analyses</li> <li>Subjects</li> <li>Documents</li> <li>Protocols</li> </ul>	SWE C SWE C SWE C	)zone Outcome 2 Oi )zone Outcome 2 Oi )zone Outcome 2 Oi )zone	utcome Blood Me utcome Microarra <u>;</u> utcome qPCR - 10	asurements / )001gk						



### **Outcomes Are Made Up of Protocols**

	page discussion edit	with form edit	history	delete move	protect	watch refresh	
	SWE Ozone Out	come 2 N	lecrops	SV			
WIKILIMS				- <b>J</b>			
-							
	Summary Input Protoco	Endpoints	Results				
avigation							
Main Page	Protocol	Phase Phase	💌 Group	🗹 Timepoint	M Comment		
Community portal	Anesthesia	Post-exposure		19			
Current events	Aorta Collection	Post-exposure		19			
Recent changes	Blood Collection	Post-exposure		19			
Random page	Heart Collection	Post-exposure		19			
- Troip	Lung Collection	Post-exposure		19			
ategories	Lung Lavage	Post-exposure		19			
People	Sample Disposition Protocol	Post-exposure		19			
Studies	Gross Observation Protocol	Post-exposure		19			
Subjects	Anesthesia	, Post-exposure		1			
Documents	Aorta Collection	, Post-exposure		1			
Stressors	Blood Collection	Post-exposure		1			
Suppliers	Heart Collection	Post-exposure		1			
Controlled	Lung Collection	Post-exposure		1			
Vocabularies		Post-exposure		1			
ratorials	Sample Disposition Protocol	Poet-exposure		. 1			
rms	Crass Observation Protocol	Deet exposure		1			
Add Project	Gross Observation Protocol	Host-exposure		1			
Add Study							



## Outcome Endpoints are the Results from All Protocols

	page discussion edit with form edit history delete move protect watch refresh
<b>WIKIL</b>	SWE Ozone Outcome 2 Necropsy
<u>=</u>	Summary Input Protocol Endpoints Results
navigation <ul> <li>Main Page</li> <li>Community portal</li> <li>Current events</li> <li>Recent changes</li> <li>Random page</li> </ul>	Lung ID BALF ID Blood ID Aorta ID
Help      categories      People      Projects      Studies	Heart ID Body Weight, Aorta Weight, Calendar Time Date, GSI, HSI, Heart Weight, Liver Weight, Lung Weight, Gonad Weight, Whole Brain Weight, Brian Weight No Pituitary, Pituitary Weight, Kidney Weight
Subjects Documents Protocols Stressors	Category: Outcome
<ul> <li>Suppliers</li> <li>Controlled</li> <li>Vocabularies</li> <li>Tutorials</li> </ul>	



# Outcome Results Captures and Summarizes All Data Generated

	page discussion edit with form edit hi	story delete move protect watch refresh							
	SWE Ozone Outcome 2 Necropsy								
	Summary Input Protocol Endpoints Re	esults							
navigation Main Page Community portal Current events Recent changes Random page	1. Protocol: Anesthesia Time/Groups: Post-exposure:19; Results: Anesthesia_Post-exposure_19 Results Directory ☞ Comments:	<ul> <li>wiki</li> <li>ABC_Mercury_Project</li> <li>Ash_1_1</li> <li>SCM409~A</li> <li>Steve_Air_Genomics_Test_1</li> <li>Microarray_Test</li> <li>Microarray_Test</li> </ul>							
<ul> <li>Help</li> <li>categories</li> <li>People</li> <li>Projects</li> <li>Studies</li> <li>Subjects</li> <li>Documents</li> </ul>	2. Protocol: Anesthesia Time/Groups: Post-exposure:1; Results: Anesthesia_Post-exposure_1 Results Directory & Comments:	<ul> <li>Microarray_lest2</li> <li>Steve_Ozone_Test</li> <li>SWE_New_Ozone</li> <li>SWE_Ozone_Outcome_2</li> <li>SWE_Ozone_Outcome_2_Outcome_1</li> <li>SWE_Ozone_Outcome_2_Outcome_2</li> <li>SWE_Ozone_Outcome_2_Outcome_2</li> <li>SWE_Ozone_Outcome_2_Outcome_3</li> <li>SWE_Ozone_Outcome_2_Outcome_3</li> </ul>							
<ul> <li>Documents</li> <li>Protocols</li> <li>Stressors</li> <li>Suppliers</li> <li>Controlled Vocabularies</li> <li>Tutorials</li> </ul>	3. Protocol: Aorta Collection Time/Groups: Post-exposure:19; Results: Aorta Collection_Post-exposure_19 Results Directory @ Comments:	<ul> <li> → Anesthesia_Post-exposure_1</li> <li> → Anesthesia_Post-exposure_19</li> <li> → Aorta_Collection_Post-exposure_1</li> <li> → Aorta_Collection_Post-exposure_19</li> <li> → Blood_Collection_Post-exposure_1</li> <li> → Blood_Collection_Post-exposure_19</li> <li> → Blood_Collection_Post-exposure_19</li> <li> → Gross_Observation_Assay_Post-exposure_1</li> </ul>							
	1								



#### All Outcomes Except the First Have a Parent

	page discussion edit with form edit history delete move protect watch refresh
	SWE Ozone Outcome 2 Outcome Microarray
VVINILIMIS	
Contraction of the owner	Summary Input Protocol Endpoints Results
navigation	OutcomeStudy SWE Ozone Outcome 2
Main Page     Community portal	OutcomeParent SWE Ozone Outcome 2 Outcome Necropsy
Current events	Name Microarray
Recent changes     Random page	add Outcome
= Help	
categories	Category: Outcome
People	
Projects	
Studies	
Analyses	
Subjects     Documents	
Protocols	
Stressors	
Suppliers	
Controlled	
Vocabularies	
Tutorials	
1	



### **Parent Endpoints Serve as Input**

-	page         discussion         edit with form         edit         history         delete         move         protect         watch         refresh								
	SWE Ozone Outcome 2 Outcome Microarray								
	Summary Input Protocol Endpoints Results								
navigation Main Page Community portal Current events Recent changes	☑ Endpoint Lung ID								
<ul> <li>Random page</li> <li>Help</li> </ul>	Category: Outcome								
categories									
<ul> <li>People</li> <li>Projects</li> <li>Studies</li> <li>Subjects</li> <li>Documents</li> <li>Protocols</li> <li>Stressors</li> <li>Suppliers</li> <li>Controlled Vocabularies</li> <li>Tutorials</li> </ul>									



### **Microarray Outcome Protocols**

	page discussion	edit with form	edit hi	story delete	move protect	watch refresh			
	SWE Ozone Outcome 2 Outcome Microarray								
VVIKILIMS									
	Summary Input Prot	tocol End	points Re	esults					
navigation	Protocol	Phase	🛛 Group	🗹 Timepoint	☑ Comment				
<ul> <li>Iviain Page</li> <li>Community portal</li> </ul>	RNA Quality Check	Post-sac		1,2					
Current events	RNA Quantity Check	Post-sac		1,2,3					
Recent changes	RNA Isolation			1					
<ul> <li>Random page</li> <li>Help</li> </ul>	CRNA Amplification	Post-sac		1					
- Holp	CRNA Fragmentation	Post-sac		1					
categories	Affymetrix Hybridization	Post-sac		1					
People     Projects	Affymetrix Scanning	Post-sac		1					
<ul> <li>Studies</li> </ul>	Affymetrix Quality Check	Post-sac		1					
Subjects									
Documents									
Protocols									
<ul> <li>Suppliers</li> </ul>	Category: Outcome								
Controlled									
Vocabularies									
Tutorials									



### **Microarray Outcome Results**

	page discussion edit history delete move protect watch refresh							
	Affymetrix Scanning Post-sac 1							
	Return to Outcome page: SWE_Ozone_Outcome_2_Outcome_Microarray#tab=Results							
	Contents [show]							
navigation Main Page	Results from Affymetrix Gene Expression Study							
<ul><li>Community portal</li><li>Current events</li></ul>	Data Directory ☞							
Recent changes	QA Results							
<ul><li>Random page</li><li>Help</li></ul>	QC_report.pdf 🗎							
categories	Cel Files							
People     Projects	Single zip file for batch download 🗗							
Studies	Individual files 🗗							
<ul><li>Analyses</li><li>Subjects</li></ul>	Gene Pattern Data							
<ul> <li>Documents</li> <li>Distancia</li> </ul>	Perform Analysis in GenePattern 🗗							
<ul> <li>Protocols</li> <li>Stressors</li> </ul>	GenePattern Files 🗗							
<ul> <li>Suppliers</li> </ul>								
Controlled	Resets							
Vocabularies	affy_rma_eset.RData 🚱							
Tutorials								



## **Results Directory with Raw Data Files**





## **Integrated GenePattern Application**

page discussion edit history delete move protect watch refresh							
MIKI TMS Affymetrix Scanning Post-sac 1	Affymetrix Scanning Post-sac 1						
Return to Outcome page: SWE_Ozone_Outcome_2_Outcome_Microarray#tab=Results							
Contents [show]							
navigation Main Page Results from Affymetrix Gene Expression Study							
Community portal     Data Directory B       Current events     Data Directory B							
Recent changes     QA Results							
■ Random page ■ Help QC_report.pdf ■							
categories Cel Files							
People     Single zip file for batch download							
■ Projects Individual files ∰							
Analyses							
Subjects Gene Pattern Data							
■ Documents Perform Analysis in GenePattern ®							
Stressors GenePattern Files @							
Suppliers							
Controlled Resets							
Vocabularies affy_rma_eset.RData 🗗							
Tutorials							



### **Integrated GenePattern Application**

	page discussion edit with form edit	history delete move protect watch refresh							
	Evaluation of microarray results in GenePattern								
	Study SWE Ozone Outcome 2								
navigation									
Main Page	Outcome	Result							
Community portal	SWE Ozone Outcome 2 Outcome Microarray	SWE Ozone Outcome 2 Outcome Microarray Affymetrix Hybridization Post-sac 1							
Current events									
<ul> <li>Recent changes</li> <li>Random hade</li> </ul>	Analysis Eiles 2								
<ul> <li>Help</li> </ul>	Analysis Files Br								
categories									
People	Gene Pattern								
Projects									
<ul> <li>Studies</li> <li>Applyings</li> </ul>	Launch GenePattern 🗗								
<ul> <li>Analyses</li> <li>Subjects</li> </ul>	Job Besults								
<ul> <li>Documents</li> </ul>	Sob Results								
Protocols	Category: Analyses								
Stressors	Outegoly. Analyses								
Suppliers									
<ul> <li>Controlled</li> <li>Vocabularies</li> </ul>									
<ul> <li>Tutorials</li> </ul>									



### **Local GenePattern Installation**

Modules & Pipelines	Suites	Job Results	Resources	Downloads	Administration	Help
Modules & Pipelines • category	W	elcome to Ge	nePattern			
<ul> <li>Recently Used</li> <li>ComparativeMarkerSelection</li> <li>ConsensusClustering</li> <li>ExpressionFileCreator</li> </ul>	A	nalyzing g	genomic da	ata in Gen		ments/suggestion
<ul> <li>Annotation <ul> <li>GeneCruiser</li> <li>Clustering</li> <li>ConsensusClustering</li> <li>HierarchicalClustering</li> <li>NMFConsensus</li> <li>SOMClustering</li> <li>SubMap</li> </ul> </li> <li>Data Format Conversion <ul> <li>GctToPd</li> <li>PdToGct</li> </ul> </li> <li>Gene List Selection <ul> <li>ClassNeighbors</li> <li>ComparativeMarkerSelection</li> <li>ExtratComparativeMarkerResults</li> <li>GeneNeighbors</li> <li>GSEA</li> <li>SelectFeaturesColumns</li> <li>SelectFeaturesRows</li> </ul> </li> <li>Image Creators <ul> <li>HeatMapImage</li> <li>HierarchicalClusteringImage</li> </ul> </li> <li>Missing Value Imputation <ul> <li>ImputeMissingValuesKNN</li> </ul> </li> <li>Pathway Analysis <ul> <li>ARACNE</li> <li>MINDY</li> </ul> </li> <li>Prediction <ul> <li>CART</li> <li>CARTXValidation</li> <li>KNNXValidation</li> <li>NearestTemplatePrediction</li> <li>SVM</li> <li>WeightedVotingXValidation</li> </ul> </li> </ul>		What do         • Click a p         • Click Qu         Protocols for         • Protocols for	you want to rotocol to run an ick Start for instru- or running con an Analysis in or running con an Analysis in or running con ferential Expres d genes that are sin ples. (stering oup genes and/or s ediction eate a model, also rectly classifies un P Copy Number a mpute SNP copy nu-	o do? analysis. GenePat uctions on how to mmon analys GenePattern malysis in GenePa visualizing the rest sion Analysis gnificantly different amples by similar referred to as a c labeled samples in and Loss of Hete umber (CN) and lo lata for paired tar	ttern guides you step l run any module in Ge ses in GenePatt attern by preprocessin ulting data as a heat n ntially expressed betw r expression profiles. lassifier or class predint nto known classes. erozygosity Estimat oss of heterozygosity ( get/normal samples.	oy step. nePattern. ern: g gene hap. een classes of ctor, that ctor, that



### **Easy Access to Relevant Files**

GenePatter	rn						
Modules & Pipelin	es Su	ites	Job Results	Resources	Downloads	Admii	nistration Help
Modules & Pipelines Category Suite all open all   close all Recently Used ComparativeMarkerSelection ConsensusClustering ExpressionFileCreator Annotation GeneCruiser Clustering ConsensusClustering HierarchicalClustering KMeansClustering NMFConsensus SOMClustering SubMap Data Format Conversion GctToPd PdToGct Gene List Selection ClassNeighbors ComparativeMarkerSelection ExtractComparativeMarkerRe GeneNeighbors SelectFeaturesColumns	Rowse fr		GenePattern GenePattern Gaffy_rma.c Gaffy_rma.c Gaffy_rma.c CelFiles.zi	clm cls gct p		File	Show parameter descriptions version 5 leset properties   export   help owse Server File System
<ul> <li>SelectFeaturesRows</li> <li>Image Creators</li> </ul>					CLOJE	~	
<ul> <li>HeatMapImage</li> <li>HierarchicalClusteringImage</li> <li>Missing Value Imputation</li> <li>ImputeMissingValuesKNN</li> </ul>		clust	er by	Type of cluste	ring algorithm		



# Analysis Page Captures Results from GenePattern Jobs

	page discussion edit with form edit	history delete move protect watch refresh					
WIKIL	Evaluation of microarray results in GenePattern						
	Study SWE Ozone Outcome 2						
navigation							
Main Page	✓ Outcome	M Result					
<ul> <li>Community portal</li> </ul>	SWE Ozone Outcome 2 Outcome Microarray	SWE Ozone Outcome 2 Outcome Microarray Affymetrix Hybridization Post-sac 1					
Current events							
<ul> <li>Recent changes</li> <li>Random page</li> </ul>	Analysis Files 7						
<ul> <li>Help</li> </ul>	Analysis Files Br						
categories							
People	Gene Pattern						
Projects							
Studies	Launch GenePattern 🗗						
<ul> <li>Analyses</li> <li>Subjects</li> </ul>	Job Results						
Documents							
Protocols	Job 74, SelectFeaturesColumns						
Stressors	Job 75, SelectFeaturesColumns						
<ul> <li>Suppliers</li> <li>Controlled</li> </ul>	Job 76, ComparativeMarkerSelection						
Vocabularies							
<ul> <li>Tutorials</li> </ul>	Category: Analyses						
forms							



### Full Details of GenePattern Results Stored in Wiki

	special page						
WIKILIMS	Execution Log						
navigation Main Page Community portal	Created on       Fri Apr 09 10:20:47 EDT 2010 by         Job Number       76         Server       http://www.server.server.server.gp/         Module       ComparativeMarkerSelection         Module Detail urn:Isid:broad.mit.edu:cancer.software.genepattern.module.analysis:00044:6						
<ul> <li>Current events</li> <li>Recent changes</li> </ul>	Parameters						
<ul> <li>Random page</li> <li>Help</li> </ul>	input.file	http://					
categories	cls.file	http://					
People     Projects	test direction	<del>د</del> ۲					
Studies	test etatistic	2 N					
Analyses	min etd						
<ul> <li>Subjects</li> <li>Documents</li> </ul>	number of nermutations	1000					
Protocols	complete	false					
Stressors	balanced	false					
<ul> <li>Suppliers</li> <li>Controlled</li> </ul>	random.seed	779948241					
Vocabularies	smooth.p.values	true					
Tutorials	phenotype.test	one versus all					
forms	output.filename	affy_rma.slice.comp.marker.odf (.comp.marker.odf)					
Add Project							
<ul> <li>Add Study</li> <li>Add Analysis</li> </ul>							



## **Acknowledgements**

- EPA Wiki Development
  - ClarLynda Williams-DeVane
  - Lyle Burgoon
  - Susan Hester
  - Harriet Ashcroft
  - Nina Rountree
  - Leonard Mole
  - Malek Khan
- EPA Feature Requirements & Test Data
  - Urmila Kodavanti
  - Geremy Knapp
  - Beena Vallanat
  - Anna Fisher
  - lan Gilmour
  - Tina Stevens

- Bioteam
  - Bill Van Etten
  - Jiesheng Zhang
  - Michele Clamp
  - Adam Kraut
  - Stan Gloss
- CEBS Team
  - Jennifer Fostel
  - Asif Rashid
  - Hui Gong
- EPA IM/IT Support
  - Richard Rhoderick
  - Govind Gawdi
  - Lynne Petterson



### Where we go from here



Office of Research and Development National Health and Environmental Effects Research Laboratory

#### Perkins, et al., (2010) Env Tox & Chem, In Press



### Putting it all together – Systems biology



Office of Research and Development National Health and Environmental Effects Research Laboratory

Gallagher, et al., (2010) in "Biomarkers in Medicine, Drug Discovery and Environmental Health"