Rat Genome Database

rgd.mcw.edu

PhenoMiner: Integrating Phenotype Measurement Values for Multiple Strains

Mary Shimoyama

XVIIIth International Workshop on Genetic Systems in the Rat – Kyoto, Japan

PhenoMiner Project

- Integrates phenotype data from multiple sources: Physgen, NBRP, Literature, Direct Submission
- Standardized formats using ontologies for sample, measurement, method and experimental conditions
- Data mining and presentation tool
- Links to originating data sources
- Comprehensive phenotype profiles for strains, substrains, congenics, knockouts, mutants
- Public repository for researchers to post data – funding agency interest
- Development of the rat phenome – linking phenotype to genotype

Accessing PhenoMiner

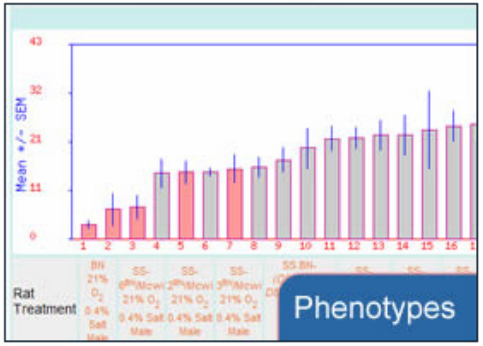
Accessing PhenoMiner

Phenotypes & Models at RGD

Welcome to the Phenotypes & Models Portal within RGD. This portal contains data related to rat strains and phenotypes, as well as essential information for conducting physiological research, identifying disease models, and community forums for gathering feedback from the scientific community.

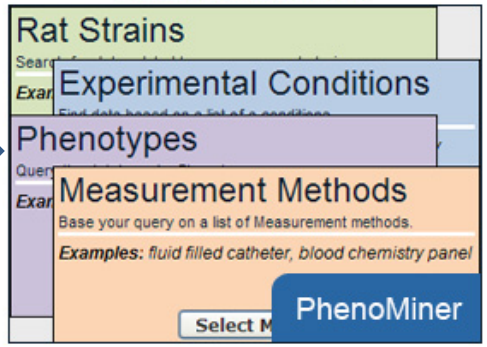
Please feel free to contact us with suggestions for additional data or tools that would help advance your research.

Go to Phenotypes

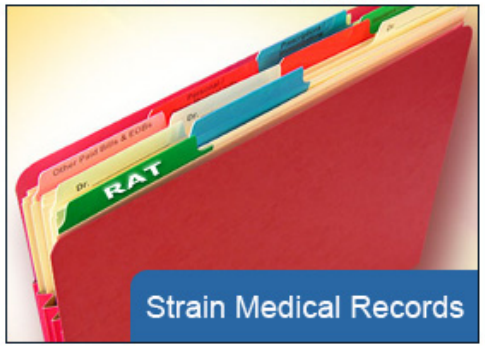


Go to Strains & Models

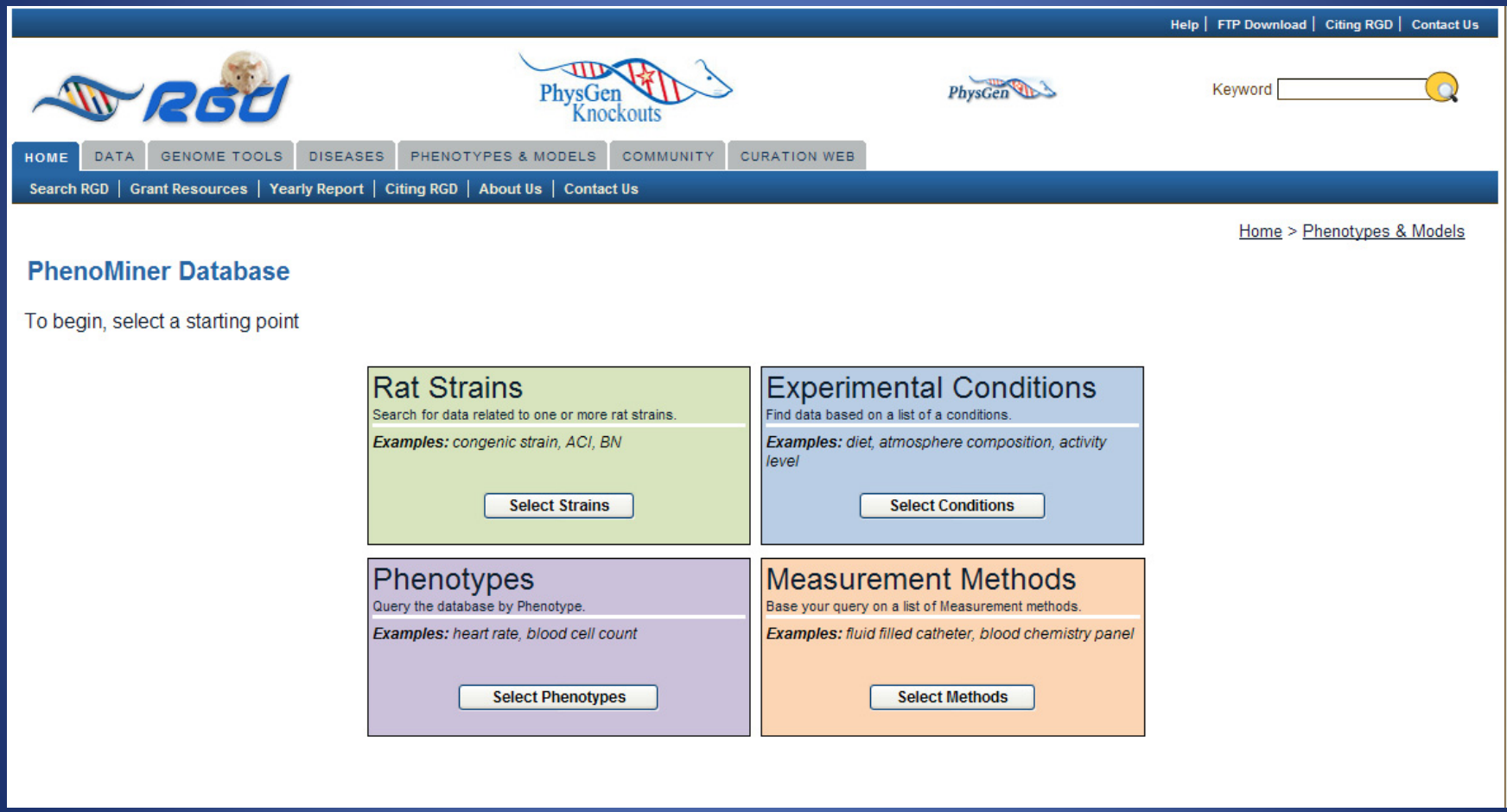
Go to PhenoMiner Tool



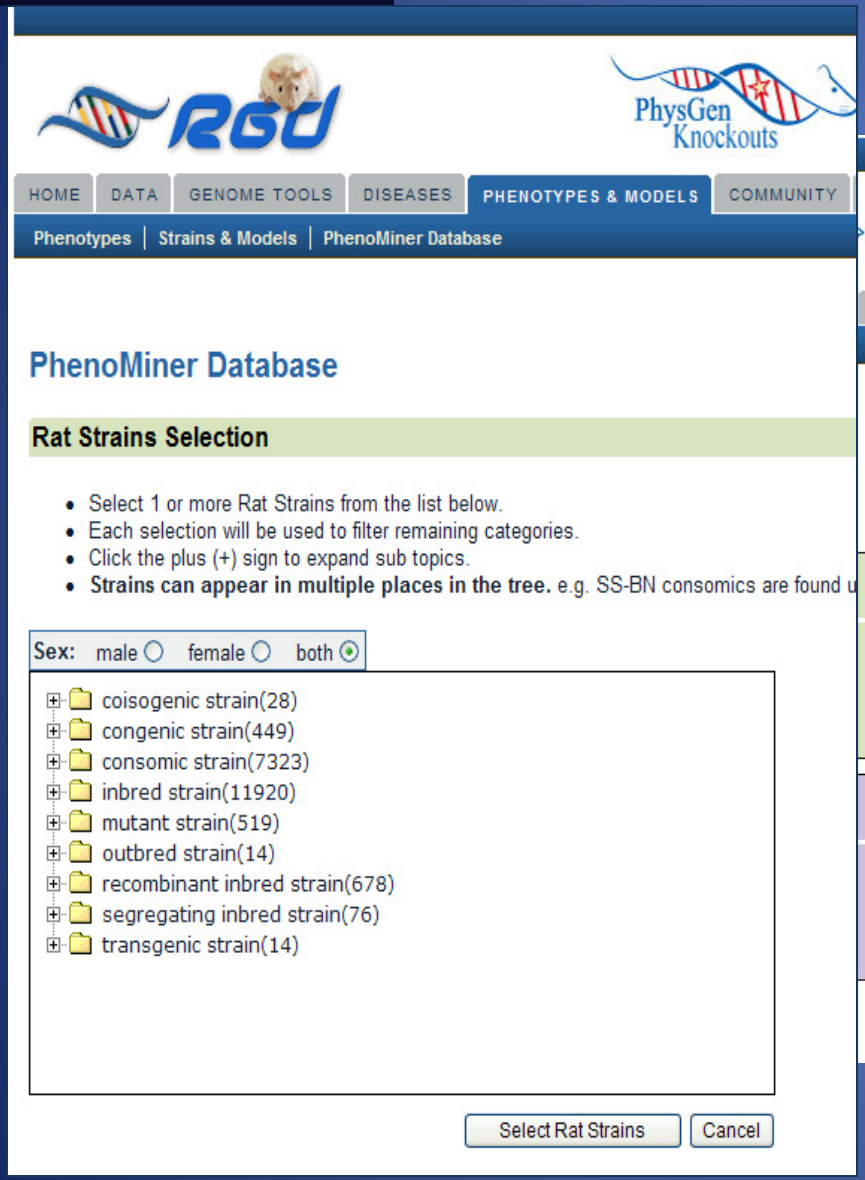
Go to Strain Medical Records

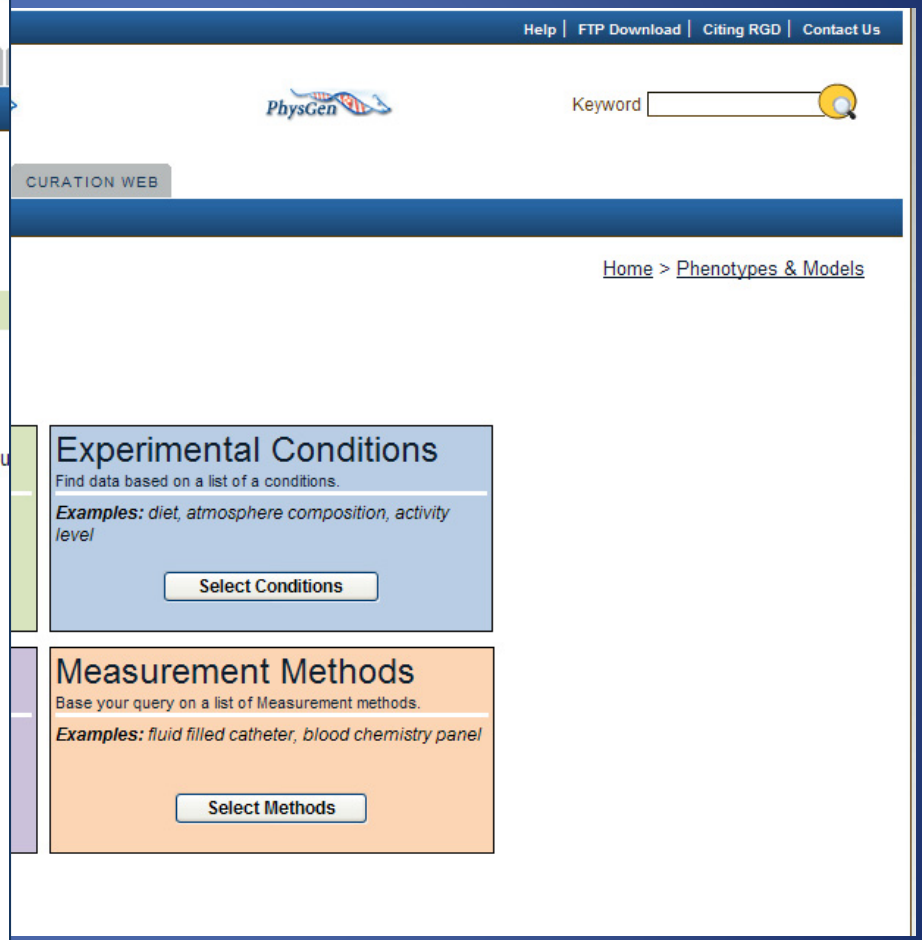


Creating a Query

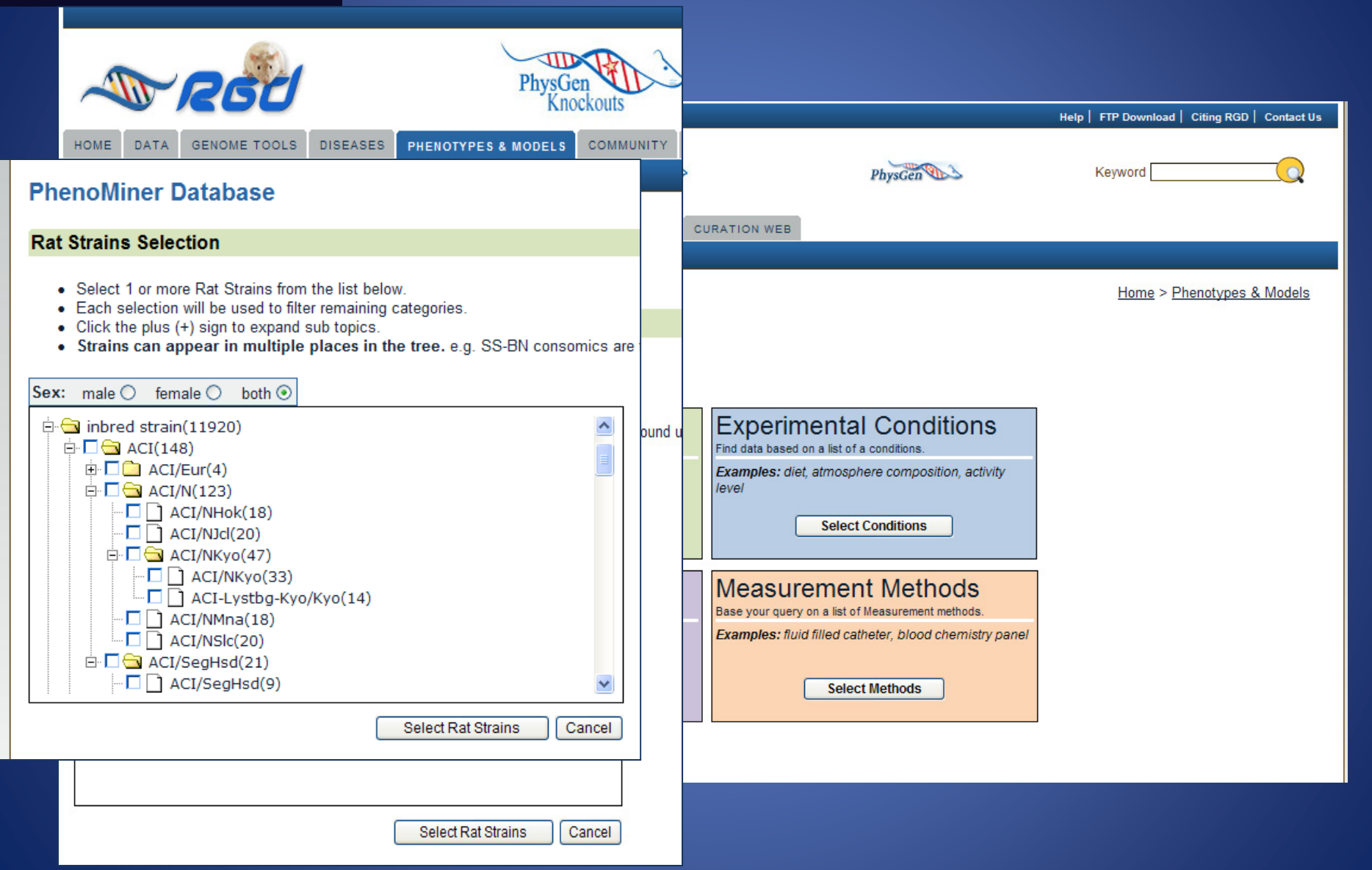


Creating a Query

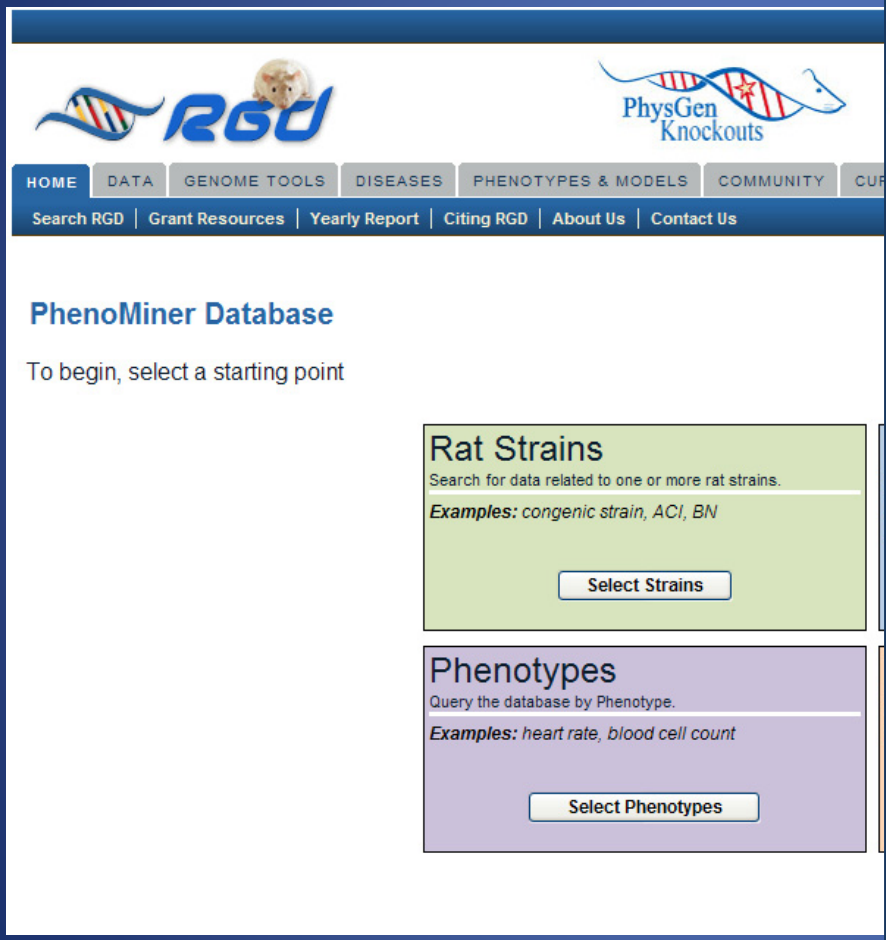


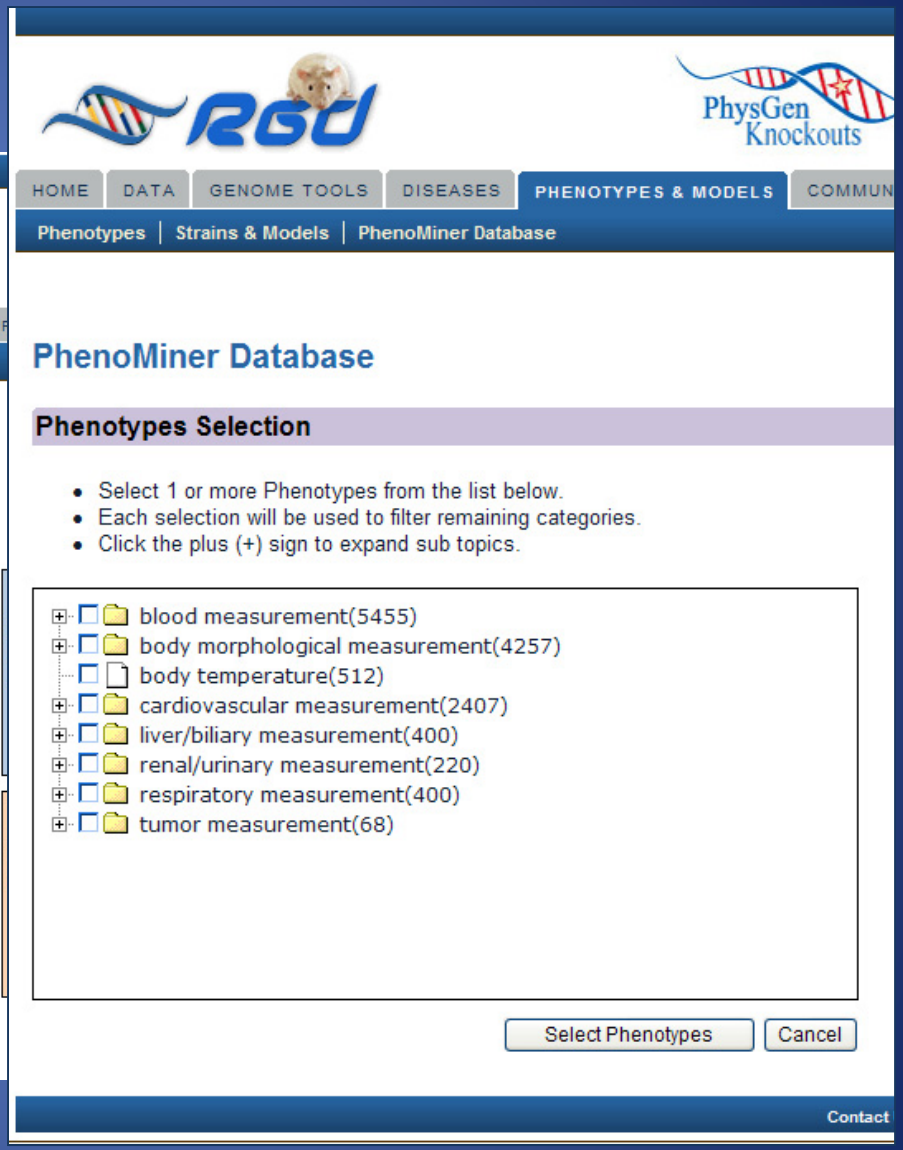


Creating a Query

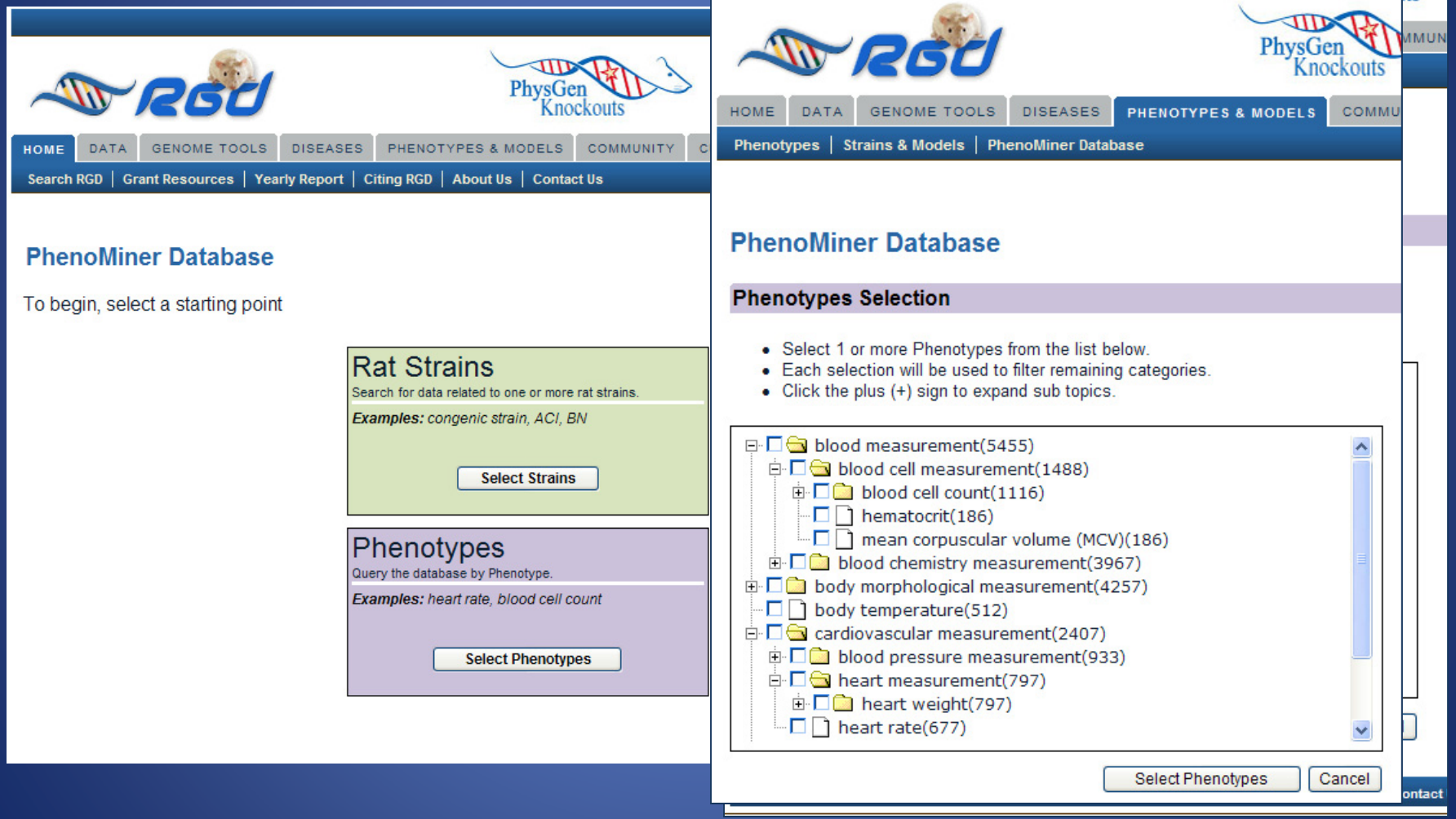


Creating a Query

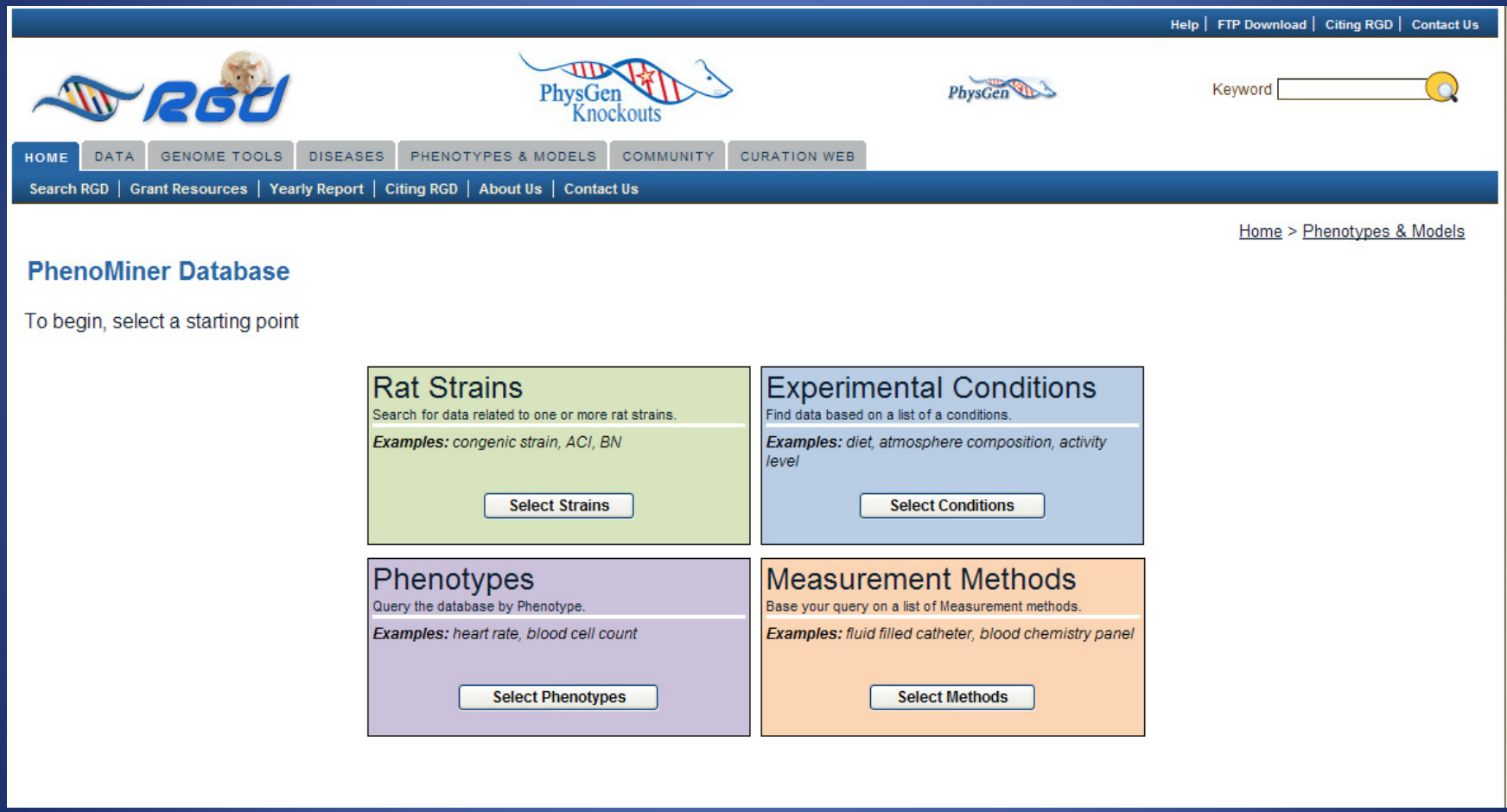




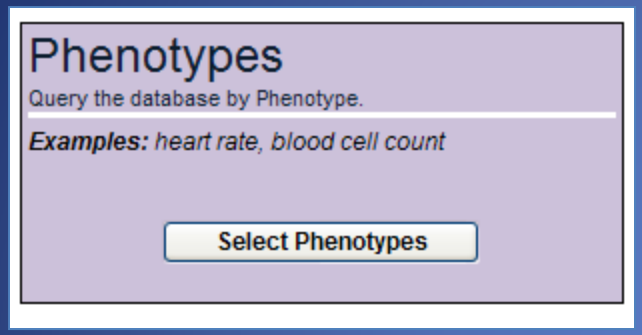
Creating a Query

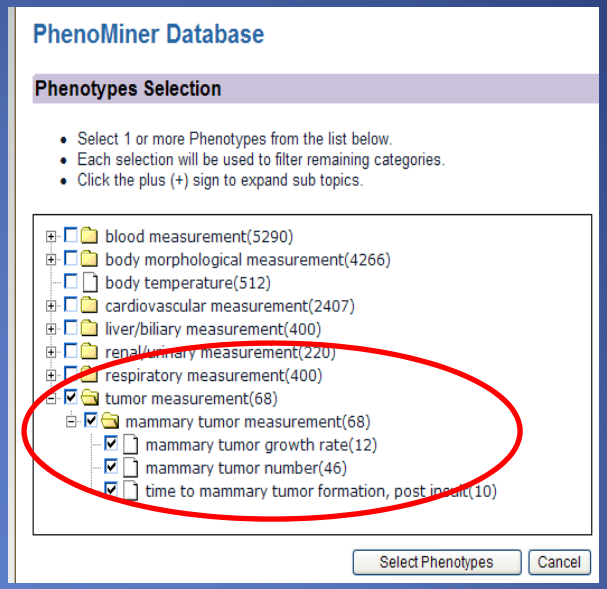


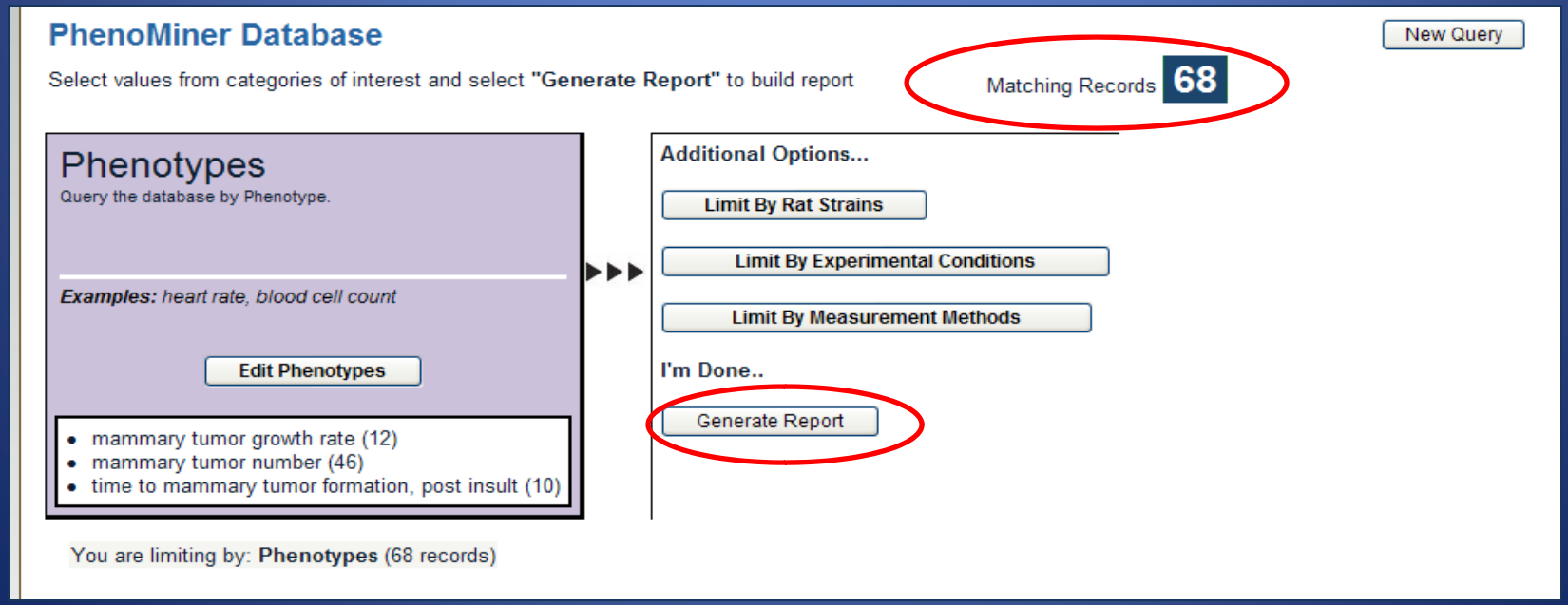
Creating a Query



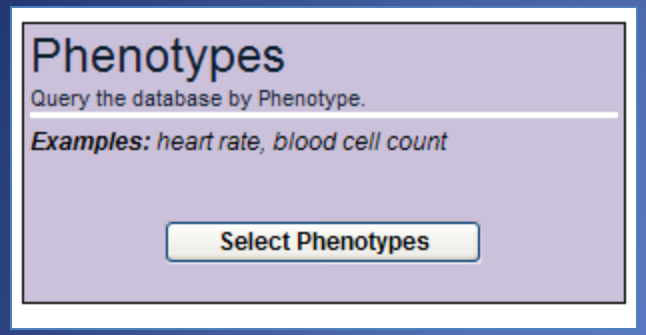
Creating a Query

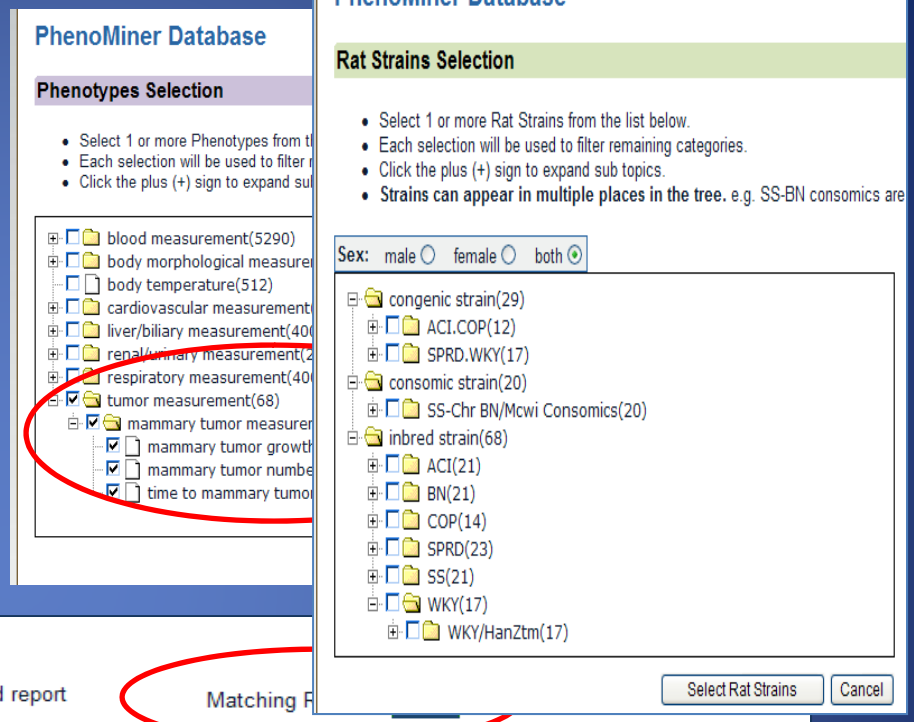


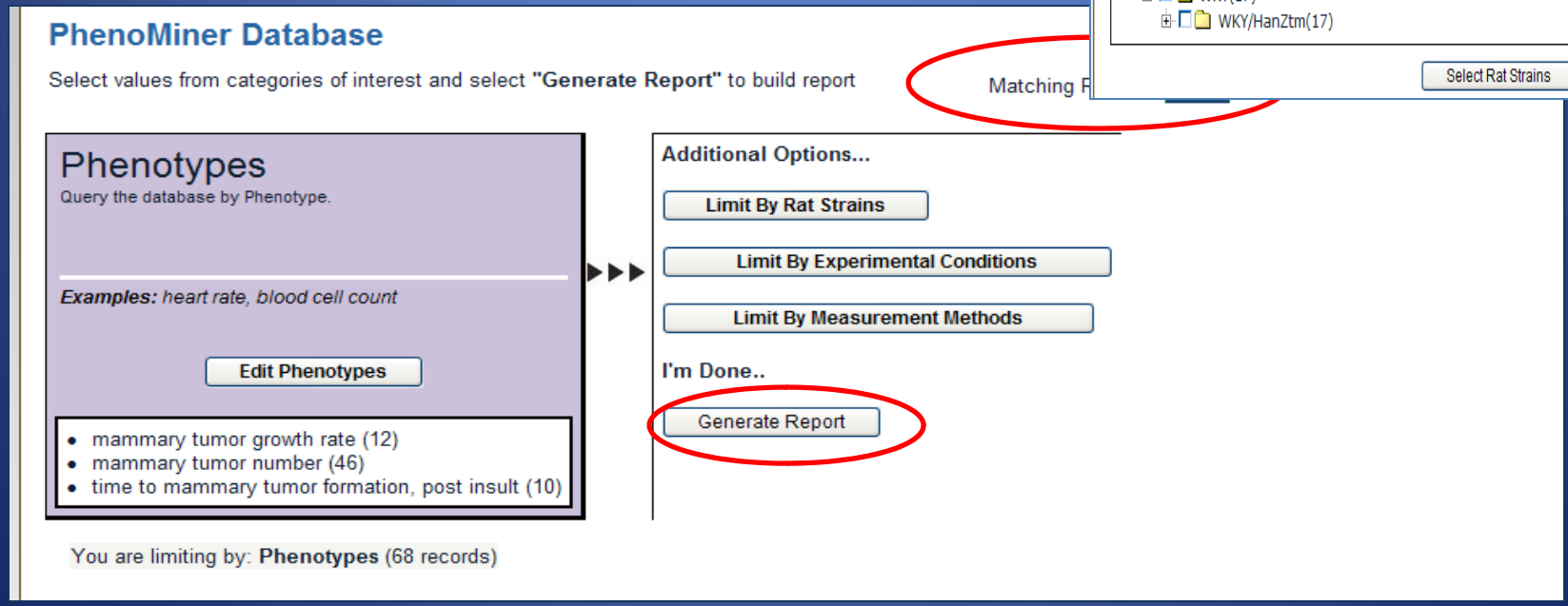




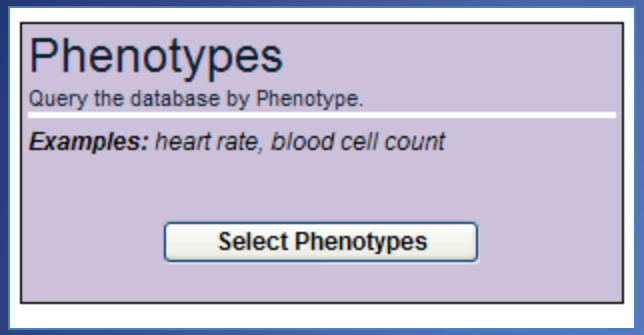
Creating a Query

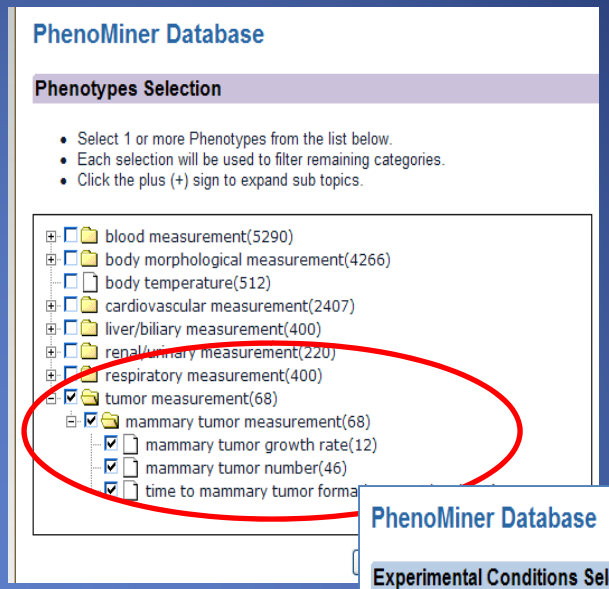


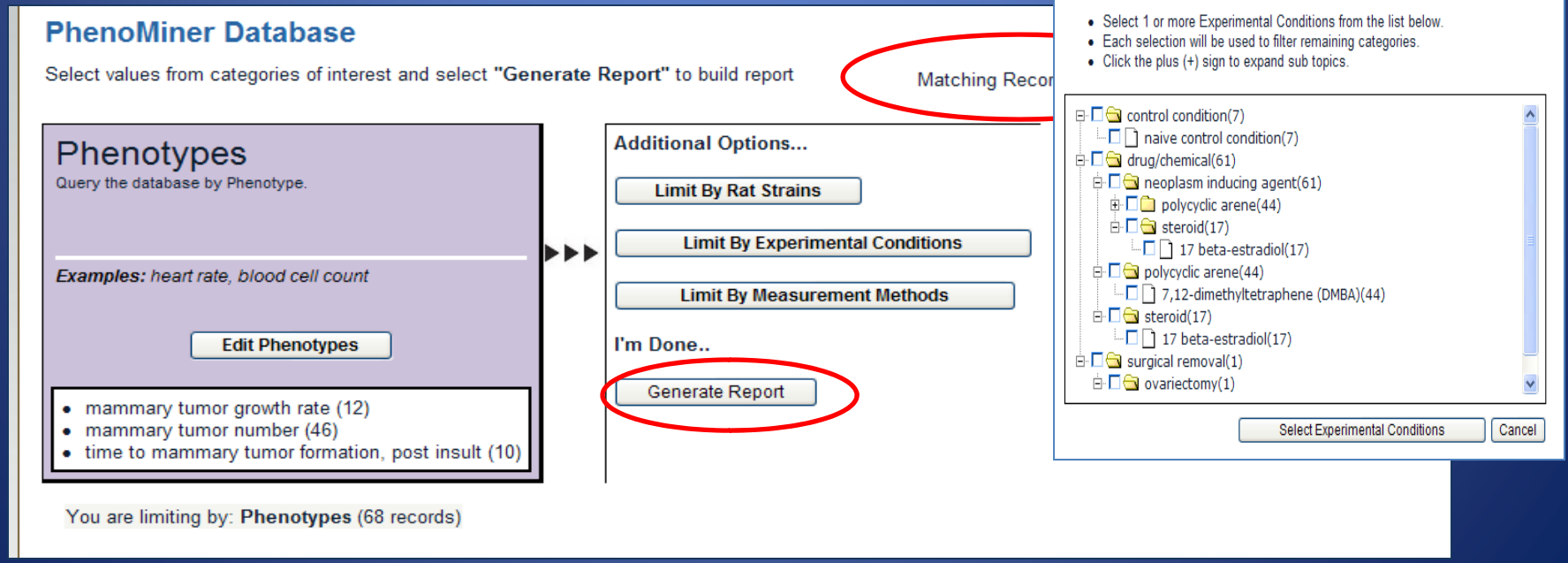




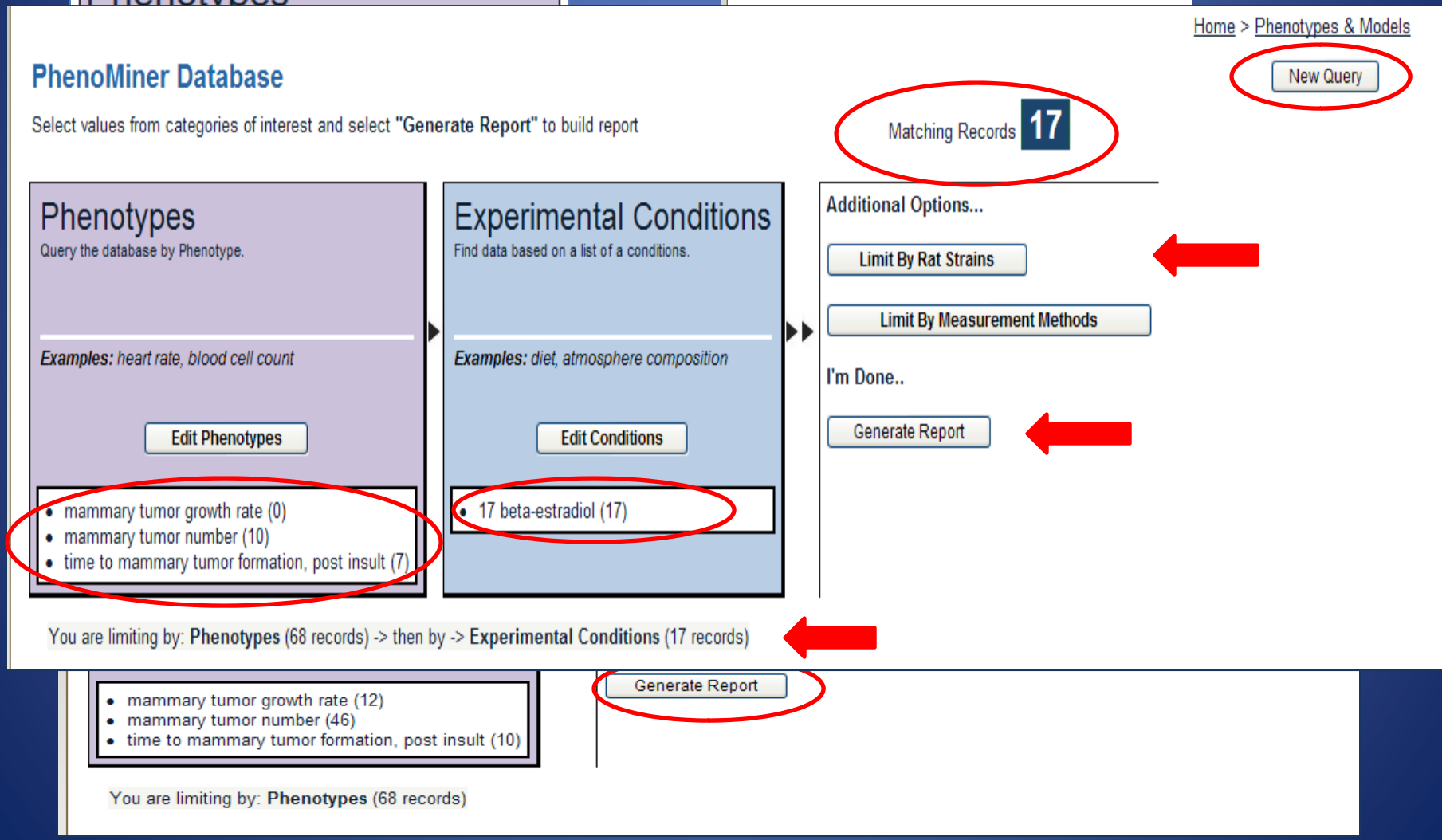
Creating a Query







Creating a Query



Results

Experiments by Phenotype | Refresh Chart | Customize chart | help

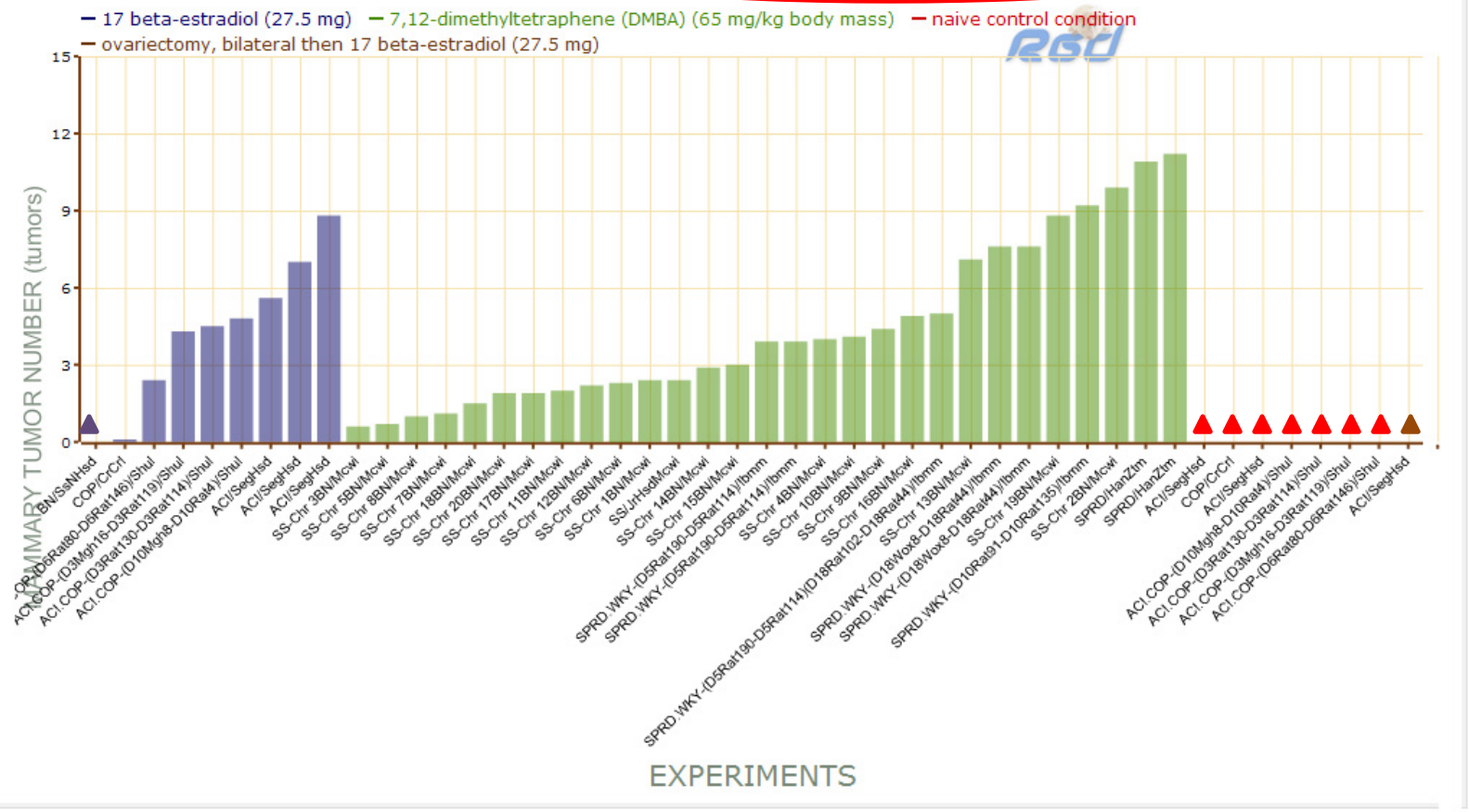
Phenotypes
mammary tumor number
Min: 0.0 Max: 11.2
Male Female
How To

Strains
- SS-Chr 20BN/Mcwi - 1
- SS-Chr 19BN/Mcwi - 2
- SS-Chr 18BN/Mcwi - 3
- SS-Chr 17BN/Mcwi - 4
- SS-Chr 16BN/Mcwi - 5

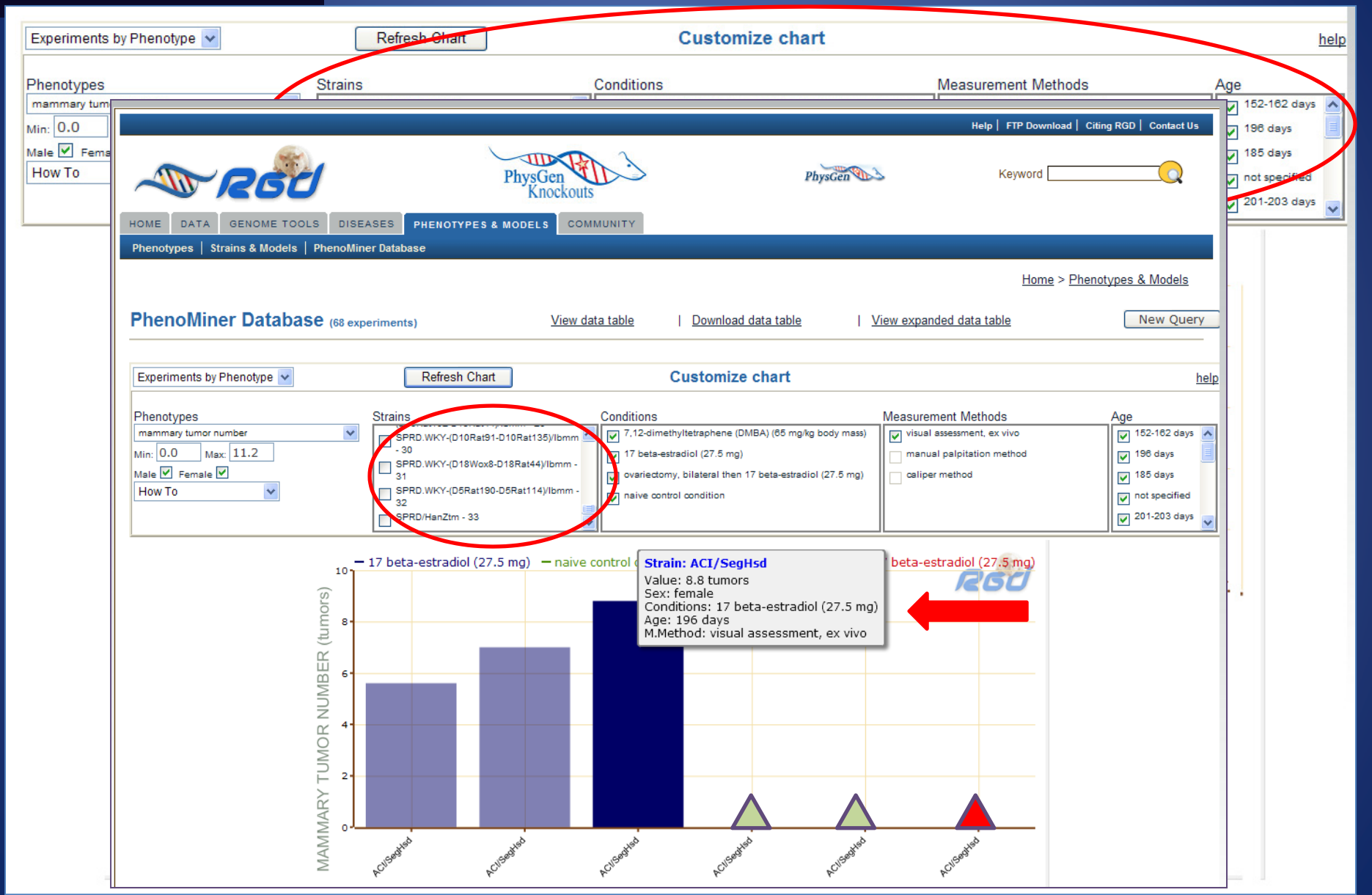
Conditions
- 7,12-dimethyltetraphene (DMBA) (65 mg/kg body mass)
- 17 beta-estradiol (27.5 mg)
- ovariectomy, bilateral then 17 beta-estradiol (27.5 mg)
- naive control condition

Measurement Methods
- visual assessment, ex vivo
- manual palpitation method
- caliper method

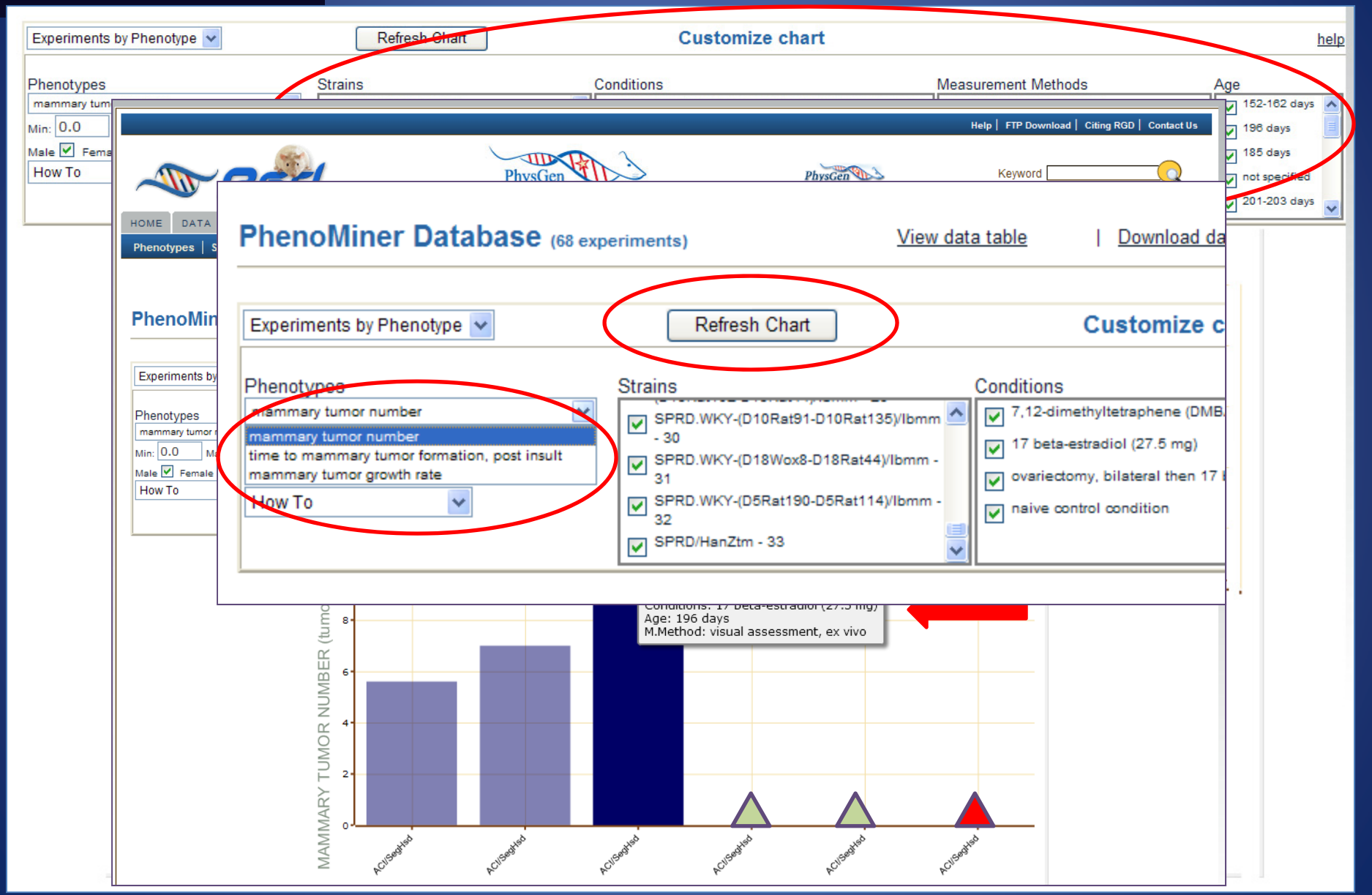
Age
- 152-162 days
- 196 days
- 185 days
- not specified
- 201-203 days



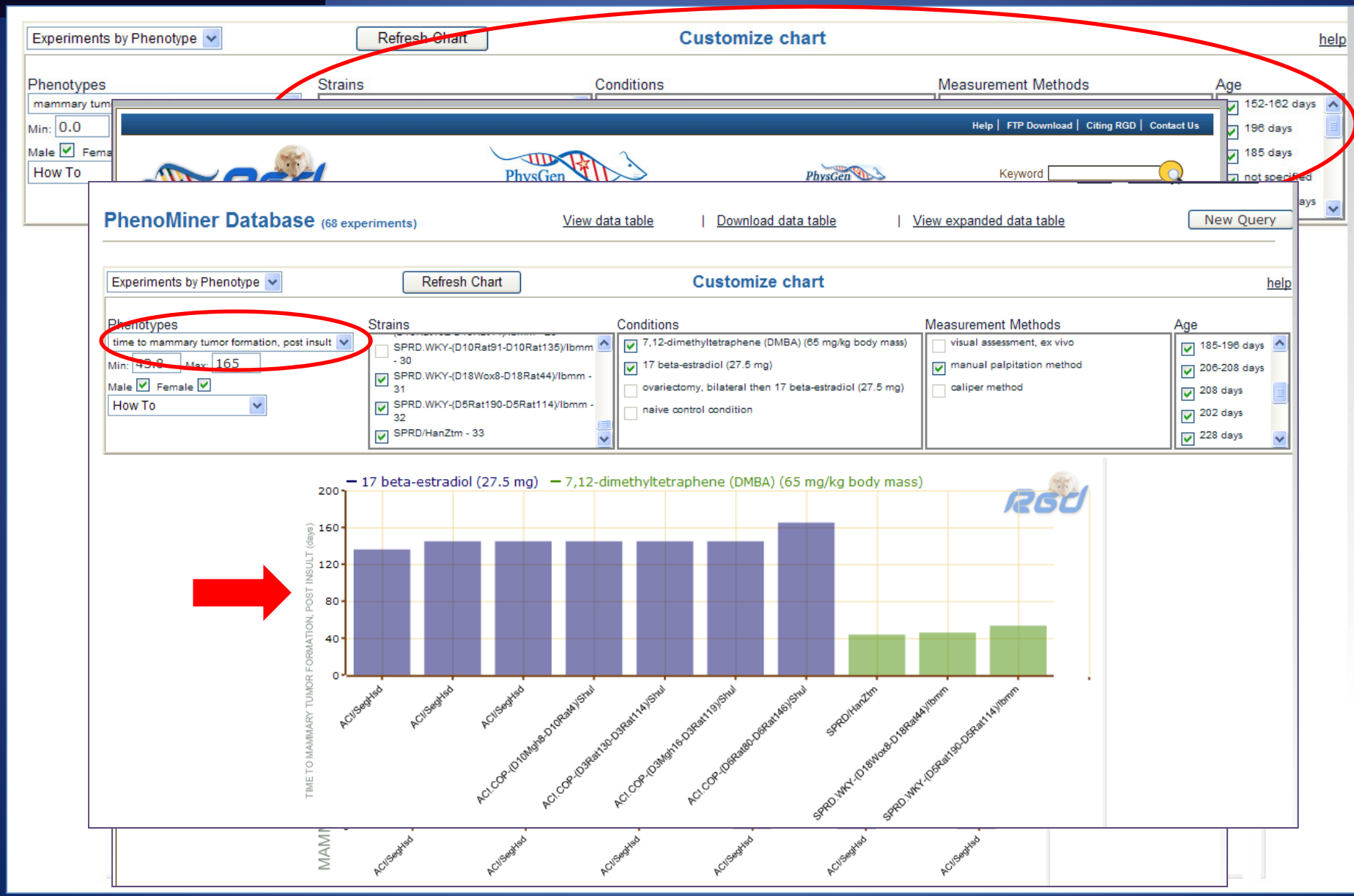
Results


Experiments by Phenotype
Refresh Chart
Customize chart
help
Phenotypes
Strains
Conditions
Measurement Methods
Age
Help | FTP Download | Citing RGD | Contact Us
PhysGen Knockouts
PhysGen
Keyword
HOME
DATA
GENOME TOOLS
DISEASES
PHENOTYPES & MODELS
COMMUNITY
Phenotypes | Strains & Models | PhenoMiner Database
Home > Phenotypes & Models
PhenoMiner Database (68 experiments)
View data table | Download data table | View expanded data table
New Query
mammary tumor number
Min: 0.0 Max: 11.2
Male Female
How To
SPRD.WKY-(D10Rat91-D10Rat135)/Ibmm - 30
SPRD.WKY-(D18Wox8-D18Rat44)/Ibmm - 31
SPRD.WKY-(D5Rat190-D5Rat114)/Ibmm - 32
SPRD/HanZtm - 33
7,12-dimethyltetraphene (DMBA) (65 mg/kg body mass)
17 beta-estradiol (27.5 mg)
ovariectomy, bilateral then 17 beta-estradiol (27.5 mg)
naive control condition
visual assessment, ex vivo
manual palpitation method
caliper method
152-162 days
196 days
185 days
not specified
201-203 days
17 beta-estradiol (27.5 mg)
naive control
beta-estradiol (27.5 mg)
Strain: ACI/SegHsd
Value: 8.8 tumors
Sex: female
Conditions: 17 beta-estradiol (27.5 mg)
Age: 196 days
M.Method: visual assessment, ex vivo
MAMMARY TUMOR NUMBER (tumors)
ACI/SegHsd

Results


Experiments by Phenotype
Refresh Chart
Customize chart
help
Phenotypes
Strains
Conditions
Measurement Methods
Age
Min: 0.0
Male
How To
Help | FTP Download | Citing RGD | Contact Us
Keyword
HOME
DATA
Phenotypes
PhenoMiner Database (68 experiments)
View data table
Download da
Experiments by Phenotype
Refresh Chart
Customize c
mammary tumor number
time to mammary tumor formation, post insult
mammary tumor growth rate
How To
SPRD.WKY-(D10Rat91-D10Rat135)/Ibmm - 30
SPRD.WKY-(D18Wox8-D18Rat44)/Ibmm - 31
SPRD.WKY-(D5Rat190-D5Rat114)/Ibmm - 32
SPRD/HanZtm - 33
7,12-dimethyltetraphene (DMB
17 beta-estradiol (27.5 mg)
ovariectomy, bilateral then 17
naive control condition
Age: 196 days
M.Method: visual assessment, ex vivo
MAMMARY TUMOR NUMBER (tumo
0
2
4
6
8
ACI/SegHsd
152-162 days
196 days
185 days
not specified
201-203 days

Results


Experiments by Phenotype
Refresh Chart
Customize chart
help
Phenotypes
Strains
Conditions
Measurement Methods
Age
Help | FTP Download | Citing RGD | Contact Us
Keyword
PhenoMiner Database (68 experiments)
View data table | Download data table | View expanded data table
New Query
time to mammary tumor formation, post insult
Min: 43.8 Max: 165
Male Female
How To
SPRD.WKY-(D10Rat91-D10Rat135)/Ibmm - 30
SPRD.WKY-(D18Wox8-D18Rat44)/Ibmm - 31
SPRD.WKY-(D5Rat190-D5Rat114)/Ibmm - 32
SPRD/HanZtm - 33
7,12-dimethyltetraphene (DMBA) (65 mg/kg body mass)
17 beta-estradiol (27.5 mg)
ovariectomy, bilateral then 17 beta-estradiol (27.5 mg)
naive control condition
visual assessment, ex vivo
manual palpitation method
caliper method
185-196 days
206-208 days
208 days
202 days
228 days
17 beta-estradiol (27.5 mg)
7,12-dimethyltetraphene (DMBA) (65 mg/kg body mass)
TIME TO MAMMARY TUMOR FORMATION, POST INSULT (days)
200
160
120
80
40
0
ACI/SegHsd
ACI/SegHsd
ACI/SegHsd
ACI.COP-(D10Mgh8-D10Rat4)/ShuI
ACI.COP-(D3Rat130-D3Rat114)/ShuI
ACI.COP-(D3Mgh16-D3Rat119)/ShuI
ACI.COP-(D5Rat80-D5Rat146)/ShuI
SPRD/HanZtm
SPRD.WKY-(D18Wox8-D18Rat44)/Ibmm
SPRD.WKY-(D5Rat190-D5Rat114)/Ibmm

Results

Options: View chart | Download data table | View expanded data table | Which do I want

Phenotype (Click to Sort)	Strain (Click to Sort)	Sex (Click to Sort)	Value (Click to Sort)	Units (Click to Sort)	Condition 1 (Click to Sort)	Condition 2 (Click to Sort)
mammary tumor number	ACI.COP-(D10Mgh8-D10Rat4)/Shul	female	4.8	tumors	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI.COP-(D10Mgh8-D10Rat4)/Shul	female	0.0	tumors	naive control condition	-
time to mammary tumor formation, post insult	ACI.COP-(D10Mgh8-D10Rat4)/Shul	female	145.0	days	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI.COP-(D3Mgh16-D3Rat119)/Shul	female	4.3	tumors	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI.COP-(D3Mgh16-D3Rat119)/Shul	female	0.0	tumors	naive control condition	-
time to mammary tumor formation, post insult	ACI.COP-(D3Mgh16-D3Rat119)/Shul	female	145.0	days	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI.COP-(D3Rat130-D3Rat114)/Shul	female	4.5	tumors	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI.COP-(D3Rat130-D3Rat114)/Shul	female	0.0	tumors	naive control condition	-
time to mammary tumor formation, post insult	ACI.COP-(D3Rat130-D3Rat114)/Shul	female	145.0	days	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI.COP-(D6Rat80-D6Rat146)/Shul	female	2.4	tumors	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI.COP-(D6Rat80-D6Rat146)/Shul	female	0.0	tumors	naive control condition	-
time to mammary tumor formation, post insult	ACI.COP-(D6Rat80-D6Rat146)/Shul	female	165.0	days	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI/SegHsd	female	8.8	tumors	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI/SegHsd	female	0.0	tumors	ovariectomy, bilateral	then 17 beta-estradiol (27.5 mg)
mammary tumor number	ACI/SegHsd	female	0.0	tumors	naive control condition	-
mammary tumor number	ACI/SegHsd	female	5.6	tumors	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI/SegHsd	female	7.0	tumors	17 beta-estradiol (27.5 mg)	-
mammary tumor number	ACI/SegHsd	female	0.0	tumors	naive control condition	-
time to mammary tumor formation, post insult	ACI/SegHsd	female	136.0	days	17 beta-estradiol (27.5 mg)	-
time to mammary tumor formation, post insult	ACI/SegHsd	female	145.0	days	17 beta-estradiol (27.5 mg)	-
time to mammary tumor formation, post insult	ACI/SegHsd	female	145.0	days	17 beta-estradiol (27.5 mg)	-
mammary tumor number	BN/SsNHsd	female	0.0	tumors	17 beta-estradiol (27.5 mg)	-
mammary tumor number	COP/CrCrl	female	0.1	tumors	17 beta-estradiol (27.5 mg)	-
mammary tumor number	COP/CrCrl	female	0.0	tumors	naive control condition	-
mammary tumor number	SPRD.WKY-(D10Rat91-D10Rat135)/Ibmm	female	9.2	tumors	7,12-dimethyltetraphene (DMBA) (65 mg/kg body mass)	-
mammary tumor growth rate	SPRD.WKY-(D10Rat91-D10Rat135)/Ibmm	female	0.5	cm/week	7,12-dimethyltetraphene (DMBA) (65 mg/kg body mass)	-
mammary tumor growth rate	SPRD.WKY-(D10Rat91-D10Rat135)/Ibmm	female	0.5	cm/week	7,12-dimethyltetraphene (DMBA) (65 mg/kg body mass)	-

Results

Sample Data

Search Parameter Summary

Phenotypes:

- mammary tumor growth rate (12)
- mammary tumor number (46)
- time to mammary tumor formation, post insult (10)

Rat Strains:

- All

Experimental Conditions:

- All

Measurement Methods:

- All

Number of records returned by search: **68**

Options: Download Expanded Data Table | View condensed data table

This data view is intended for external processing. To work with it please download it by clicking the above link.

Study Id	Study Name	Study URL	Experiment Name	Experiment Notes	Strain ont id	Strain	Sex	Age	# of animals	Sample notes
81	Schaffer BS, etal., Cancer Res. 2006 Aug 1;66(15):7793-800	/tools/references/references_view.cgi?id=1642522	mammary cancer	-	RS:32	ACI/SegHsd	female	196 days	22	-
81	Schaffer BS, etal., Cancer Res. 2006 Aug 1;66(15):7793-800	/tools/references/references_view.cgi?id=1642522	mammary cancer	-	RS:155	BN/SsNHsd	female	196 days	13	-
76	Shull JD, etal., Carcinogenesis. 1997 Aug;18 (8):1595-601	/tools/references/references_view.cgi?id=4145282	mammary cancer	-	RS:32	ACI/SegHsd	female	185 days	11	-
76	Shull JD, etal., Carcinogenesis. 1997 Aug;18 (8):1595-601	/tools/references/references_view.cgi?id=4145282	mammary cancer	-	RS:32	ACI/SegHsd	female	not specified	3	-
76	Shull JD, etal., Carcinogenesis. 1997 Aug;18 (8):1595-601	/tools/references/references_view.cgi?id=4145282	mammary cancer	-	RS:32	ACI/SegHsd	female	201-203 days	20	-
75	Kurz SG, etal., Endocrinology. 2008 Apr 17	/tools/references/references_view.cgi?id=2292503	mammary cancer	-	RS:185	COP/CrCrl	female	259 days	7	-
75	Kurz SG, etal., Endocrinology. 2008 Apr 17	/tools/references/references_view.cgi?id=2292503	mammary cancer	-	RS:185	COP/CrCrl	female	259 days	5	-

Results

Help | FTP Download | Citing RGD | Contact Us

RGD | PhysGen Knockouts | PhysGen | Keyword

HOME | DATA | GENOME TOOLS | DISEASES | PHENOTYPES & MODELS | KNOCKOUTS | COMMUNITY

Genes | QTLs | Strains | Markers | ESTs | Maps | Ontologies | Sequences | References | FTP Download | Submit Data

Related Tools:
PubMed
MGD

Reference Report

Ovary-intact, but not ovariectomized female ACI rats treated with 17beta-estradiol rapidly develop mammary carcinoma.

Shull JD, Spady TJ, Snyder MC, Johansson SL, Pennington KL,

Citation: Shull JD, etal., Carcinogenesis. 1997 Aug;18(8):1595-601.

Status: NON-CURATED REFERENCE

Abstract (?)

We have examined the ability of 17beta-estradiol (E2) to induce development of mammary cancers in the female ACI rat. Continuous treatment with E2, delivered through release from s.c. Silastic tubing implants containing 27.5 mg crystalline hormone, resulted in rapid development of palpable mammary tumors in ovary-intact ACI rats. In a population of 21 E2-treated rats, palpable tumors were first observed following 99 days treatment and 100% of the treated population developed tumors within 197 days. The median and mean times to appearance of first palpable tumor were 143 and 145 days respectively. All mammary tumors were classified as carcinomas and invasive features were observed. Circulating E2 levels in the treated animals at the time of sacrifice averaged 185 pg/ml serum. Mammary tumors were not observed in ovary-intact female ACI rats that were not treated with E2. This is the first report indicating that this naturally occurring estrogen is capable of inducing mammary cancers in the ACI rat strain. Mammary carcinoma did not develop in a population of 11 ovariectomized female ACI rats treated with E2 for a period of 140 days. Circulating E2 levels in the treated ovariectomized animals averaged 207 pg/ml. These data indicate that the ovary modulates estrogen-mediated mammary carcinogenesis in this rat strain. Both ovary-intact and ovariectomized female ACI rats displayed similar susceptibilities to E2-induced pituitary tumors and hyperprolactinemia. Pituitary weight was increased 6.0-fold in ovary-intact ACI rats and 5.3-fold in ovariectomized female rats. Circulating prolactin levels averaged 2318 ng/ml in E2-treated, ovary-intact rats and 2285 ng/ml in E2-treated, ovariectomized ACI rats. These data indicate that estrogen-induced hyperprolactinemia is not the sole factor leading to development of mammary cancers in the E2-treated ACI rat.

Show data curated from this reference

External Database Links

PubMed

Shull JD, etal., Carcinogenesis. 1997 Aug;18(8):1595-601. (9276635)

Results

Measurement and Methods

Phenotype ont id	Phenotype	Formula	Phenotype Notes	Value	Units	SEM	SD	Method ont id	Method	Method Site	Method duration (secs)	Method Notes
CMO:343	mammary tumor number	-	-	8.8	tumors	1.4	-	MMO:162	visual assessment, ex vivo	-	-	-
CMO:343	mammary tumor number	-	-	0.0	tumors	-	-	MMO:162	visual assessment, ex vivo	-	-	-
CMO:343	mammary tumor number	-	-	0.0	tumors	-	-	MMO:162	visual assessment, ex vivo	-	-	-
CMO:343	mammary tumor number	-	-	0.0	tumors	-	-	MMO:162	visual assessment, ex vivo	-	-	-
CMO:343	mammary tumor number	-	-	5.6	tumors	-	-	MMO:162	visual assessment, ex vivo	-	-	-
CMO:343	mammary tumor number	-	-	0.1	tumors	-	0.4	MMO:162	visual assessment, ex vivo	-	-	-
CMO:343	mammary tumor number	-	-	0.0	tumors	-	-	MMO:162	visual assessment, ex vivo	-	-	-

Results

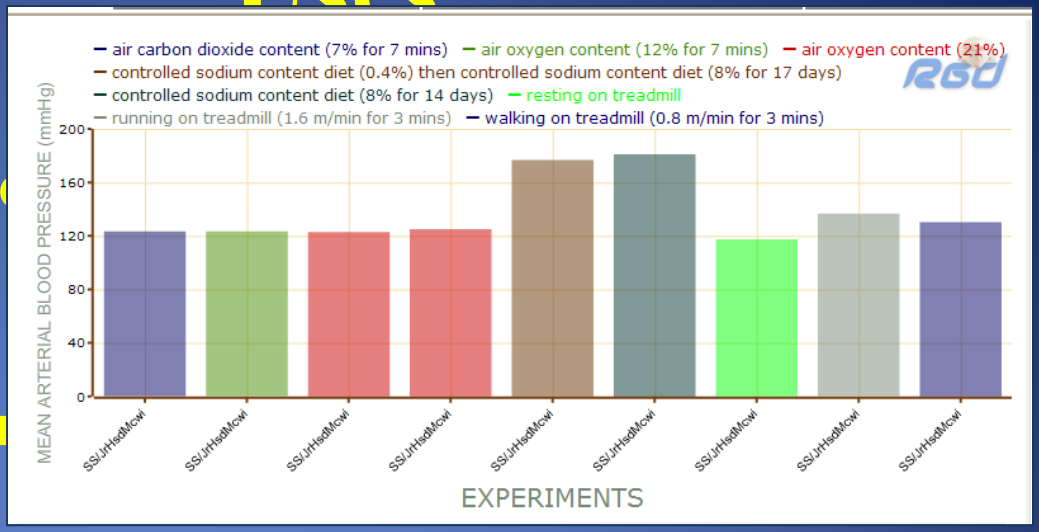
Experimental Conditions

	Condition 1								Condition 2								
	ont id	term	ordinality	duration	value	units	notes	applicationMethod	ont id	term	ordinality	duration	value	units	notes	applicationMethod	Method Notes
CMO:34	XCO:92	17 beta-estradiol	1	-	27.5	mg	-	cyrstalline implant	-	-	-	-	-	-	-	-	-
CMO:34	XCO:92	17 beta-estradiol	1	-	27.5	mg	-	cyrstalline implant	-	-	-	-	-	-	-	-	-
CMO:34	XCO:95	ovariectomy, bilateral	1	-	-	-	-	-	XCO:92	17 beta-estradiol	2	-	27.5	mg	-	crystalline implant	-
CMO:34	XCO:56	naive control condition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CMO:34	XCO:92	17 beta-estradiol	1	-	27.5	mg	-	crystalline implant	-	-	-	-	-	-	-	-	-
CMO:34	XCO:92	17 beta-estradiol	1	-	27.5	mg	-	crystalline implant	-	-	-	-	-	-	-	-	-
CMO:34	XCO:56	naive control condition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Uses

- Compare phenotypes across experiments for one or more strains
- Compare a phenotype across ages for one or more strains
- Compare phenotype values for a set of substrains
- Comprehensive phenotype values for a single or multiple strains
- Compare results from multiple methods

Uses



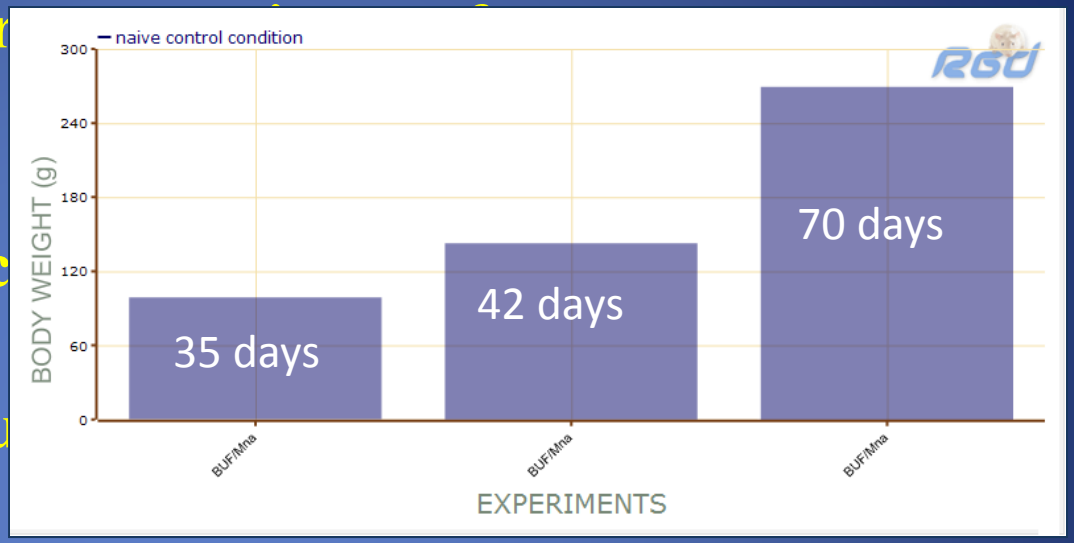
- **Compare phenotypes acr strains**
- **Compare a phenotype acr**
- **Compare phenotype values for a set of substrains**
- **Comprehensive phenotype values for a single or multiple strains**
- **Compare results from multiple methods**

Uses

- Compare phenotypes across experiments for one or more strains
- Compare a phenotype across ages for one or more strains
- Compare phenotype values for a set of substrains
- Comprehensive phenotype values for a single or multiple strains
- Compare results from multiple methods

Uses

- Compare phenotypes acr
strains
- Compare a phenotype ac
- Compare phenotype valu



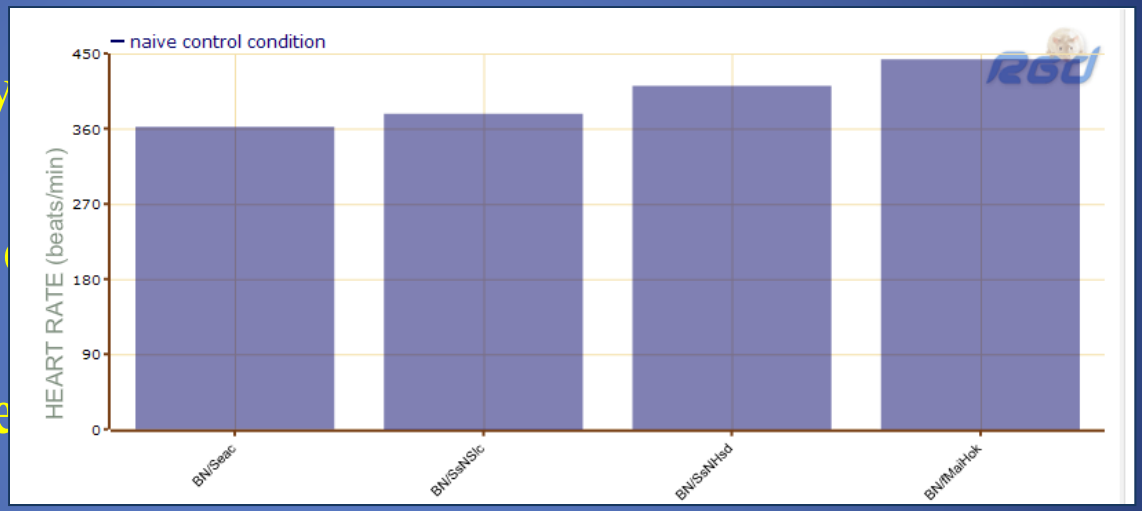
- Comprehensive phenotype values for a single or multiple strains
- Compare results from multiple methods

Uses

- Compare phenotypes across experiments for one or more strains
- Compare a phenotype across ages for one or more strains
- Compare phenotype values for a set of substrains
- Comprehensive phenotype values for a single or multiple strains
- Compare results from multiple methods

Uses

- Compare phenotypes across experiments for one or more strains
- Compare a phenoty
- Compare phenotyp
- Comprehensive phe strains
- Compare results from multiple methods

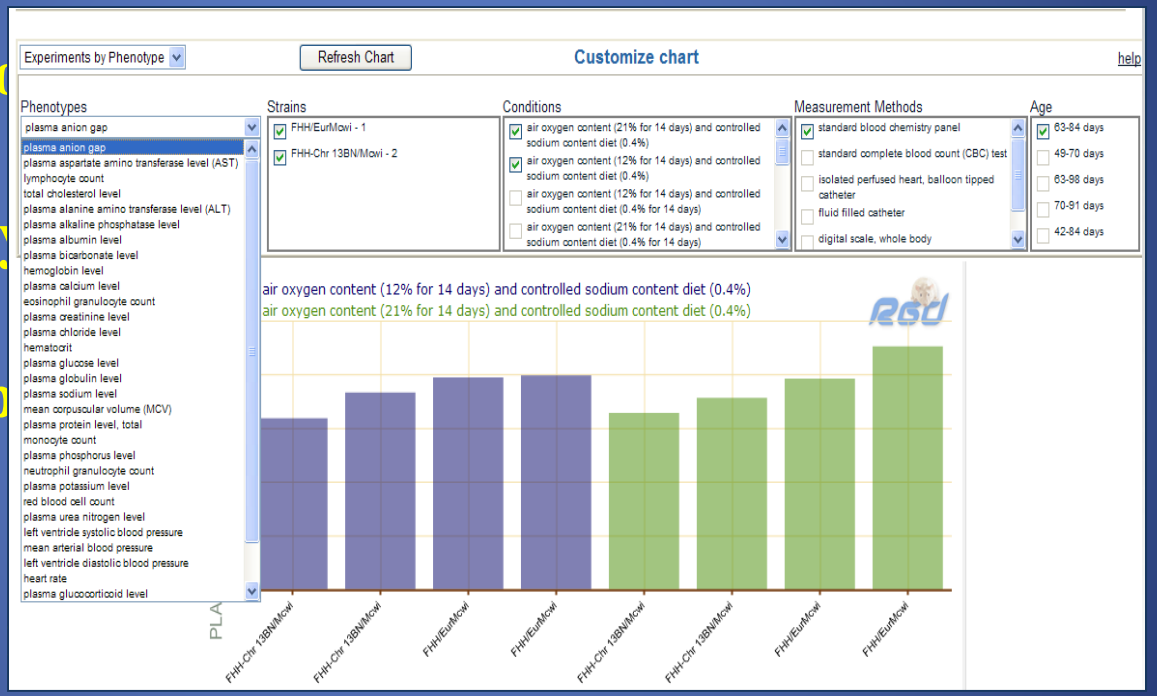


Uses

- Compare phenotypes across experiments for one or more strains
- Compare a phenotype across ages for one or more strains
- Compare phenotype values for a set of substrains
- Comprehensive phenotype values for a single or multiple strains
- Compare results from multiple methods

Uses

- Compare phenotypes across experiments for one or more strains
- Compare a phen
- Compare phenot
- Comprehensive p strains
- Compare results

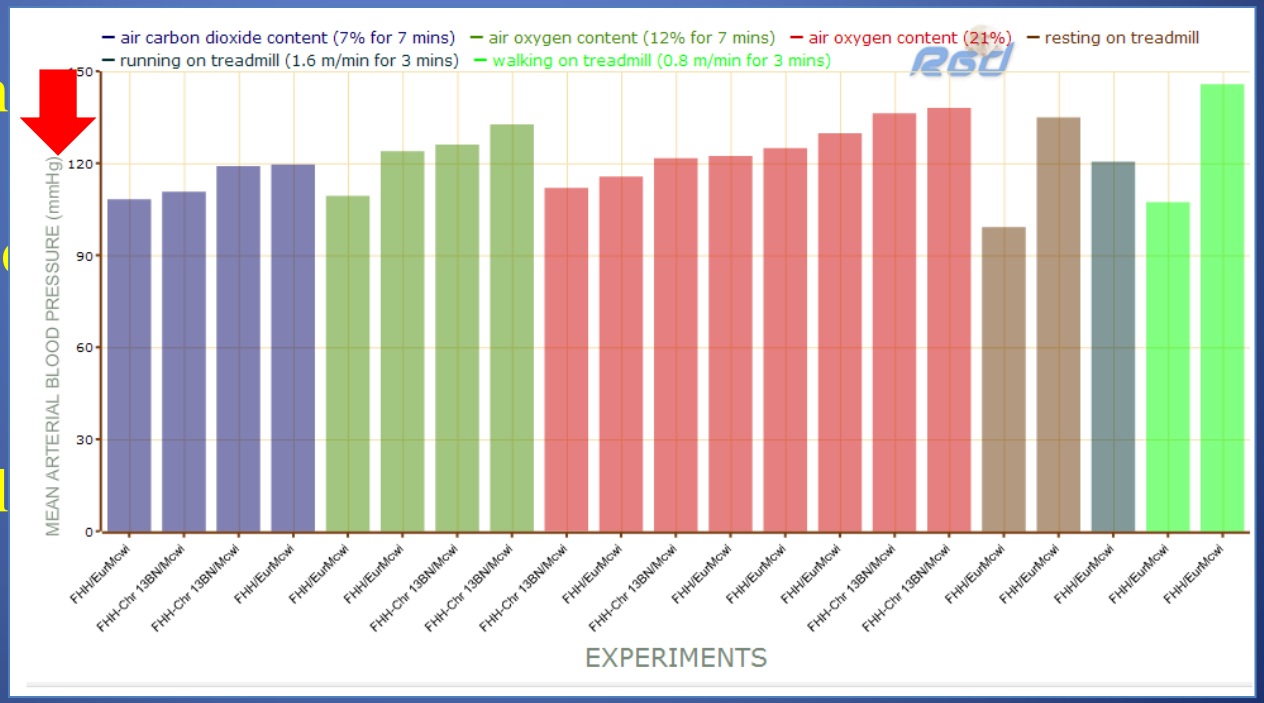


Uses

- Compare phenotypes across experiments for one or more strains
- Compare a phenotype across ages for one or more strains
- Compare phenotype values for a set of substrains
- Comprehensive phenotype values for a single or multiple strains
- Compare results from multiple methods

Uses

- Compare phenotypes across experiments for one or more strains
- Compare a phenotype across ages for one or more strains
- Compare phen
- Comprehensiv strains
- Compare resul

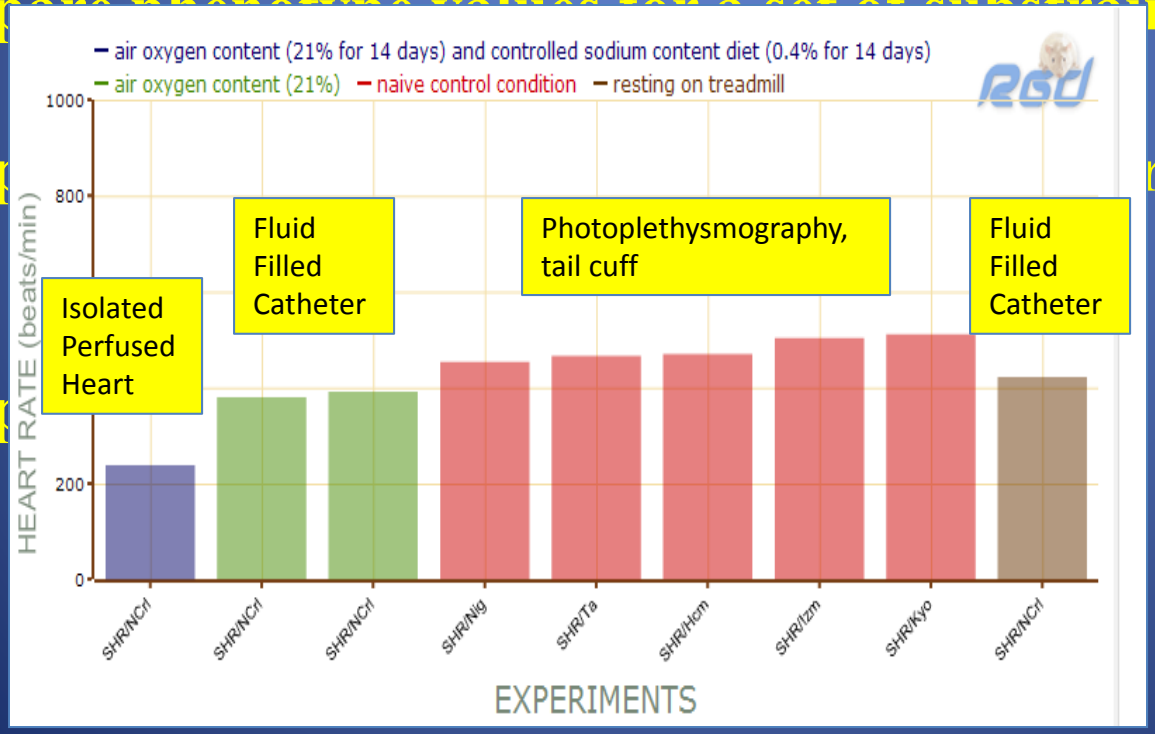


Uses

- Compare phenotypes across experiments for one or more strains
- Compare a phenotype across ages for one or more strains
- Compare phenotype values for a set of substrains
- Comprehensive phenotype values for a single or multiple strains
- Compare results from multiple methods

Uses

- Compare phenotypes across experiments for one or more strains
- Compare a phenotype across ages for one or more strains
- Compare phenotype values for a set of substrains
- Compare multiple strains
- Comp



Future Developments

Data

- Physgen data – complete integration
- NBRP data – complete integration of existing data, continued updates
- Literature
  - integration of data from all QTL papers
  - integration of data from papers characterizing inbred, mutant, congenic and knockout strains
- Researcher submissions – completion of online software for data submission

Future Developments

Data Mining and Visualization

- Improved searching and query building
- Customization of bar charts
- Side by side chart viewing
- Dot plots for multiple phenotypes
- Statistical analysis tools
- Uploading and visualization of own data

Links with Other Tools

- Direct links from strain reports, strain medical records
- Direct links from QTL reports for parental, congenic strains
- Links from strain variation tracks on Gbrowse
- Links from SNPlotyper

Future Developments

Strain: ACI/SegHsd
Value: 7.0 tumors
SD: 5.3
Sex: female
Conditions: 17 beta-estradiol (27.5 mg)
Age: 259 days
M.Method: visual assessment, ex vivo

Strain: SPRD/HanZtm
Value: 11.2 tumors
SD: 0.5
Sex: female
Conditions: 7,12-dimethyltetraphene (DMBA) (65 mg/kg body mass)
Age: 186-191 days
M.Method: visual assessment, ex vivo

Strain: COP/CrCrl
Value: 0.1 tumors
SD: 0.4
Sex: female
Conditions: 17 beta-estradiol (27.5 mg)
Age: 259 days
M.Method: visual assessment, ex vivo

Strain: BN/SsNHsd
Value: 0.0 tumors
Sex: female
Conditions: 17 beta-estradiol (27.5 mg)
Age: 196 days
M.Method: visual assessment, ex vivo

Position	Allele	Sequence	Polymorphic	ACI/Seg…	WKY/NCrl	SPRD/Ha…	…OP/Crl	B… …isd	SS/JrHsdMcwi
Chr 5:12990423	G/A	TCAGCACAAAATCAAACAACCCCACTGCGATATCAAAA… [G/A] TTCTGGGAGATTCAGTATTTGTGTAGTCCTCTCTGCTTCT		AA	GG	AA	AA	GG	AA
Chr 5:13271842	G/A	TTCATGAAATCCCATTTATTGATTGTTTGTAGTACCTGTG [G/A] TAACAATGTTCTATTTAGGCAATCTCTTTTGGTTCCAAAG		GG	GG	AA	NN	NN	AA
Chr 5:13327089	T/C	AGAAAGGGAAGGGAGAAACACTGTAATTAAAATATAATCT [T/C] AAACACAAAATTATTAACACATATTAAAGCTTACACCAGA		CC	CC	CC	CC	TT	CC
Chr 5:13437823	T/C	TCAAAAGCTTTTGTCAAAGCAGCAAGACAAGTAACTAACA [T/C] ATTCAGTGGCATCTCCTTTAGTGAAATCACACCAATCTCT		CC	CC	TT	CC	TT	TT
Chr 5:13500275	A/G	ACTGTATTTTTATTC… [A/G] GAAAGAGTGTTATGA…		GG	GG	GG	GG	AA	GG
Chr 5:13739291	G/A	TATATACAAGAACTC… [G/A] TAACCATATTAAAAA…		AA	AA	GG	AA	GG	GG
Chr 5:13917908	C/A	ATCTCTCAACCTCTT… [C/A] CTCATCAACCAATGA…		CC	AA	AA	CC	CC	AA
Chr 5:14088518	T/C	GCTGAGCCATCTTTCCAACCTCCTTTCTTCAGTCTCTTAA [T/C] GACTCATTTCTGCCCTGCCCTTGAATCCCTCAGGAGAGAG		TT	CC	TT	TT	TT	CC
Chr 5:14090305	G/T	TTAATTTTACTCATACAACAACCCAATTTTTCATTTAAAG [G/T] AAACATTTCATGCAACAGACAGCTTACAGACTCATGGAAT		GG	TT	GG	GG	GG	TT
Chr 5:14181884	C/T	TACTTTAAGTATATACATTGTAGTGATATTTGCTATGTAT [C/T] CAATTTATTTAAAAATGATTGCTCTTCGATGACGAATTAA		TT	TT	TT	NN	NN	CC
Chr		ATATGTTCTGGCCCCTTTTCATGGTTTGTCTCATAGTGAG							

Mamtr1 region

- **Links from SNPlotyper**

Acknowledgments

RGD

Howard Jacob
Melinda Dwinell
Diane Munzenmaier
Elizabeth Worthey
Shirng-Wern Tsaih
Rajni Nigam
Rene Lopez
Stan Laulederkind
Tom Hayman
Tim Lowry
Shur-jen Wang
Jeff DePons
Weisong Liu
Pushkala Jayaraman

NBRP

Tadao Serikawa
Takashi Kuramoto
Tomoji Mashimo
Birger Voight

Physgen

Allen Cowley
Howard Jacob
Andrew Greene
Julian Lombard
David Mattson
Anne Kwitek
Melinda Dwinell

Special Thanks to Rat Researchers worldwide!

RGD is funded by grant HL64541 from the National Heart, Lung, and Blood Institute on behalf of the NIH
Phenominer is funded by grant HL094271