

A brief introduction to RGD's PhenoMiner

- PhenoMiner is a tool for ontology-based storage and mining of quantitative phenotype data for the laboratory rat
- PhenoMiner includes both data from high-throughput phenotyping projects (standardized) and scientific literature (unstandardized).
- To allow comparisons across studies as well as flexible and intelligent querying, PhenoMiner uses ontologies to express
 - *What was measured* (Clinical Measurement Ontology)
 - *How it was measured* (Measurement Method Ontology)
 - *Under what conditions it was measured* (Experimental Condition Ontology)
 - *In what animals it was measured* (Rat Strain Ontology)
- The Vertebrate Trait Ontology is also used to group related measurements within a study.
- PhenoMiner can be accessed through the Phenotypes and Models tab in the menu at the top of any RGD page or button on RGD's home page.

Limitations of the PhenoMiner 1.0 User Interface

- “The process for selecting records to view is not intuitive.”
- “Once I’ve selected terms it’s hard to change my selections.”
- “I can only view results for one measurement at a time even if I choose terms that use the same units.”
- “I can see the information at the top of the result page but I can’t do anything with it—there’s no way to filter my results on that page.”
- “What? I can sort the results in the table?”
- “Oh, but when I sort the table it doesn’t change anything in the graph. That still appears to be ordered randomly!”
- Coloring the bars in the graph by the experimental conditions is nice but I’d like to choose what they are colored by.”

PhenoMiner 2.0: More intuitive selection and modification

The screenshot displays the PhenoMiner 2.0 interface. At the top, the 'PhenoMiner Database' header is visible. Below it, the 'Rat Strains Selection' section is highlighted with a green bar, containing the instruction: 'Select 1 or more Rat Strains from the list below.' The main interface area is titled 'PhenoMiner Database' and includes the instruction: 'Select values from categories of interest and select "Generate Report" to build report'. On the right, a 'Matching Records' box shows the year '2012'. The 'Rat Strains' section on the left allows users to 'Search for data related to one or more rat strains.' It provides examples: 'congenic strain, ACI, BN' and an 'Edit Strains' button. Below this, a list of selected strains is shown: 'SR/Jr (71)', 'SR/JrHsd (48)', and 'SS/JrHsdMcwi (1893)'. To the right of the search area, the 'Additional Options...' section contains three buttons: 'Limit By Clinical Measurements', 'Limit By Experimental Conditions', and 'Limit By Measurement Methods'. Below these is an 'I'm Done..' button and a 'Generate Report' button. At the bottom of the interface, there are 'Select Rat Strains' and 'Cancel' buttons. A red arrow on the left side of the interface points to the 'Rat Strains' section.

PhenoMiner Database

Rat Strains Selection

- Select 1 or more Rat Strains from the list below.

PhenoMiner Database

Select values from categories of interest and select "Generate Report" to build report

Matching Records 2012

Rat Strains

Search for data related to one or more rat strains.

Examples: congenic strain, ACI, BN

Edit Strains

- SR/Jr (71)
- SR/JrHsd (48)
- SS/JrHsdMcwi (1893)

Additional Options...

Limit By Clinical Measurements

Limit By Experimental Conditions

Limit By Measurement Methods

I'm Done..

Generate Report

Select Rat Strains Cancel

- The landing page of the original PhenoMiner was designed to be flexible

Select any ontology

Navigate through the tree?

Go to another page with further options

Back and forth between ontology tree selection pages and "where do you want to go next?" pages

PhenoMiner 2.0: More intuitive selection and modification

PhenoMiner Database Clear

Select values from categories of interest and select **"Generate Report"** to build report

Rat Strains
Search for data related to one or more rat strains.

Clinical Measurements
Query by clinical measurement.

Measurement Methods
Filter results by Measurement method.

Experimental Conditions
Filter based condition.

Generate Report

Rat Strain Selection

Ex: congenic strain, ACI, WKY

select

ACI(517)

select

ACI-Lystbg-Kyo/Kyo(66)

select

ACI.COP-(D10Mgh8-D10Rat4)/Shul(2)

select

ACI.COP-(D3Mgh16-D3Rat119)/Shul(2)

select

ACI.COP-(D3Rat130-D3Rat114)/Shul(2)

select

ACI.COP-(D6Rat80-D6Rat146)/Shul(3)

select

ACI.FHH-(D17Rat117-D17Arb5)(D17Rat180-D17Rat51)/Eur(20)

select

ACI.FHH-(D1Mit18-D1Mit8)(D14Mit11-D14Hmgc14b)(D14Rat65-D14Rat90)/Eur(8)

select

ACI.FHH-(D1Mit18-D1Rat90)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/Eur(3)

select

ACI.FHH-(D1Mit18-D1Rat90)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/Eur(9)

select

ACI.FHH-(D1Mit18-D1Rat90)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/EurMcwi(6)

select

ACI.FHH-(D1Mit18-D1Rat90)(D3Got102-D3Got149)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/Mcwi(3)

select

ACI.FHH-(D1Mit18-D1Rat90)(D3Rat6-D3Got149)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/Mcwi(3)

select

ACI.FHH-(D1Mit18-D1Rat90)(D3Rat84-D3Rat59)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/Eur(6)

Strains

Clinical Measurements

Measurement Methods

Experimental Conditions

chromosome altered(23471)

coisogenic strain(640)

congenic strain(6140)

consomic strain(19370)

inbred strain(23376)

mutant strain(11061)

outbred strain(4573)

recombinant inbred strain(2695)

segregating inbred strain(460)

transgenic strain(1208)

- In PhenoMiner 2.0 all of the components are on a single page.
- The Strain Ontology loads automatically but you can still start with any of the ontologies by using the tabs in the lower right panel.
- As selections are made in the bottom panels, they appear in the boxes at the top.

PhenoMiner 2.0: More intuitive selection and modification

PhenoMiner 2.0: More intuitive selection and modification

Rat Strain Selection

Ex: congenic strain, ACI, WKY

Prominent Search box

Alphabetical list of terms

Rat Strain Selection Interface:

- Search Box:** Ex: congenic strain, ACI, WKY
- Alphabetical List of Terms:**
 - select ACI(517)
 - select ACI-Lystbg-Kyo/Kyo(66)
 - select ACI.COP-(D10Mgh8-D10Rat4)/Shul(2)
 - select ACI.COP-(D3Mgh16-D3Rat119)/Shul(2)
 - select ACI.COP-(D3Rat130-D3Rat114)/Shul(2)
 - select ACI.COP-(D6Rat80-D6Rat146)/Shul(3)
 - select ACI.FHH-(D17Rat117-D17Arb5)(D17Rat180-D17Rat51)/Eur(20)
 - select ACI.FHH-(D1Mit18-D1Mit8)(D14Mit11-D14Hmgc14b)(D14Rat65-D14Rat90)/Eur(8)
 - select ACI.FHH-(D1Mit18-D1Rat90)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/Eur(3)
 - select ACI.FHH-(D1Mit18-D1Rat90)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/Eur(9)
 - select ACI.FHH-(D1Mit18-D1Rat90)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/EurMcwi(6)
 - select ACI.FHH-(D1Mit18-D1Rat90)(D3Got102-D3Got149)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/Mcwi(3)
 - select ACI.FHH-(D1Mit18-D1Rat90)(D3Rat6-D3Got149)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/Mcwi(3)
 - select ACI.FHH-(D1Mit18-D1Rat90)(D3Rat84-D3Rat59)(D14Mit11-D14Rat33)(D14Rat65-D14Rat90)/Eur(6)

Footer:

- Rat Genome Project
- <http://rgd.mcw.edu>
- DEPARTMENT OF BIOMEDICAL ENGINEERING
- MEDICAL COLLEGE OF WISCONSIN
- MARQUETTE UNIVERSITY

PhenoMiner 2.0: More intuitive selection and modification

PhenoMiner Database
Select values from categories of interest and select **"Generate Report"** to build report

Rat Strains
Search for data related to one or more rat strains.

Clinical Measurements
Query by clinical measurement.

Measurement Methods
Filter results by Measurement method.

Exp
Filter b

Rat Strain Selection

SS/Jr

select SS/Jr(3110)

select **SS/Jr(520)**

select SS/Jr.SR/Jr(149)

select SS/Jr.SR/Jr (chr 7)(75)

select SS/Jr.SR/Jr (chr 13)(17)

select SS/Jr.SR/Jr (chr 3)(83)

select SS/Jr.SR/Jr (chr 9)(4)

select SS.SR-(D13N1-D13Mit1)/Jr(2)

select SS.SR-(Sy12-D13Mit1)/Jr(2)

Strains

- SPRD(6)
- SR(332)
- SS(3448)
 - SS(78)
 - SS/Hsd(32)
 - SS/Jr(3110)
 - SS/Jr(520)**
 - SS/JrHsd(2081)
 - SS/JrHsd(55)
 - SS/JrHsdMcwi(2026)
 - SS/JrHsdMcwi(1893)
 - SS/HsdMcwiCr1(133)
 - SS/JrIpcv(8)
 - SS/JrRkb(6)
 - SS/JrSeac(454)
 - SS/JrTol(41)
 - SS/N(228)

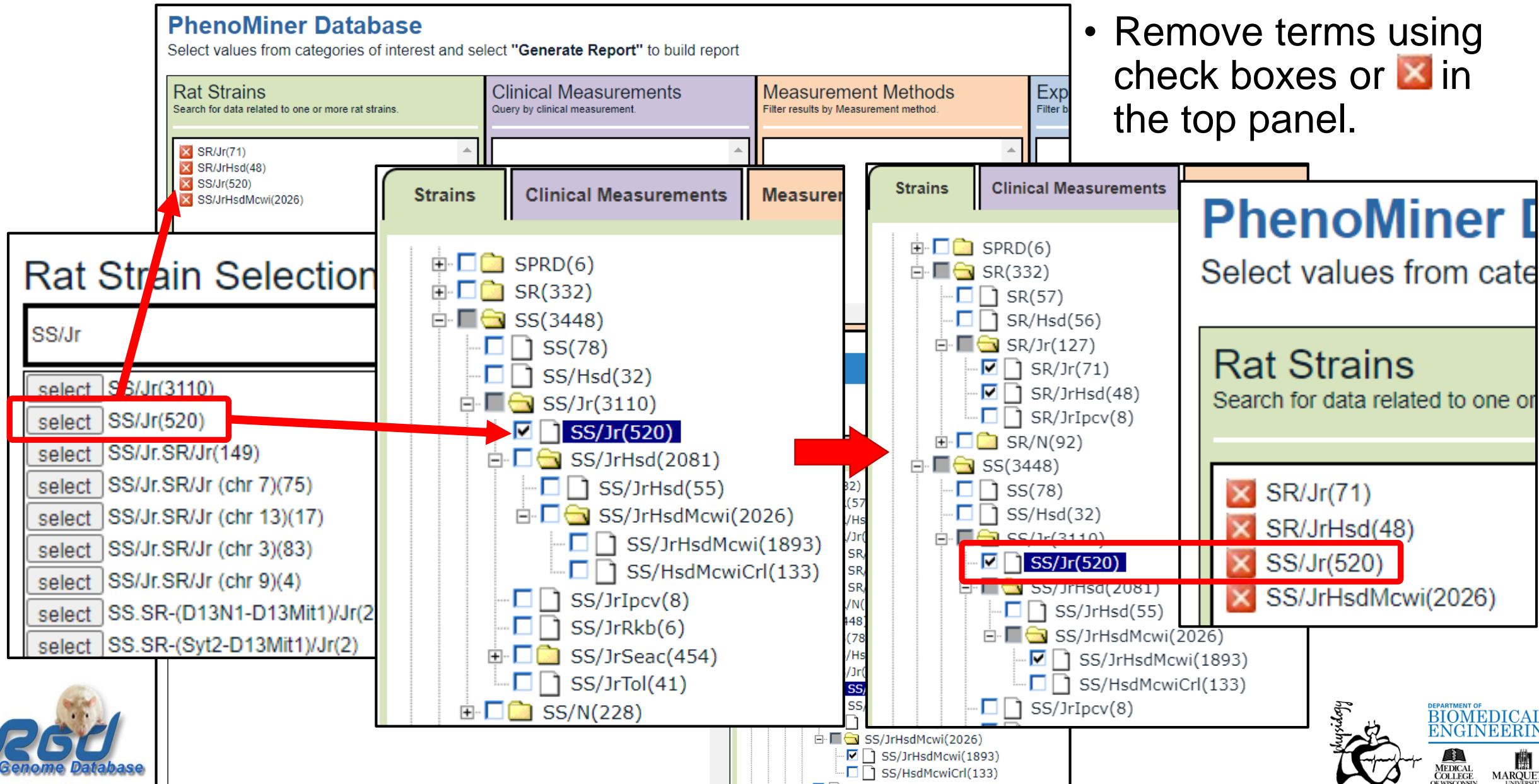
Clinical Measurements

Measurement Methods

- Entering a term in the search box narrows the list below it.
- “Select” puts the term into the box at the top and opens that region in the ontology tree in the bottom right panel making it easy to refine the selection, add terms, etc.

PhenoMiner 2.0: More intuitive selection and modification

- Remove terms using check boxes or  in the top panel.



The screenshot illustrates the PhenoMiner 2.0 interface, showing the workflow for selecting rat strains and clinical measurements. The interface is divided into several panels:

- PhenoMiner Database**: The top panel, which includes tabs for **Rat Strains**, **Clinical Measurements**, **Measurement Methods**, and **Experimental Conditions**. It instructs users to "Select values from categories of interest and select 'Generate Report' to build report".
- Rat Strain Selection**: A panel on the left showing a list of rat strains. The **SS/Jr** category is selected, and the **SS/Jr(520)** strain is highlighted with a red box. A red arrow points from this selection to the **SS/Jr(520)** entry in the **Strains** panel.
- Strains**: A panel in the center showing a hierarchical tree of rat strains. The **SS/Jr(520)** strain is selected, and a red arrow points from this selection to the **SS/Jr(520)** entry in the **Strains** panel.
- Strains**: A panel on the right showing a hierarchical tree of rat strains. The **SS/Jr(520)** strain is selected, and a red arrow points from this selection to the **SS/Jr(520)** entry in the **Strains** panel.
- PhenoMiner Database**: A panel on the right showing the final report, which includes a list of rat strains and their associated clinical measurements. The **SS/Jr(520)** strain is highlighted with a red box.

Red arrows indicate the flow of selection from the **Rat Strain Selection** panel to the **Strains** panel, and from the **Strains** panel to the final report.

PhenoMiner 2.0: More intuitive selection and modification

- All selections are made within the

Rat Strains
Search for data related to one or more rat strains.

☒ SR/Jr(42)
☒ SR/Jr(32)
☒ SR/JrHsd(7)
☒ SS/JrHsdMcwi(252)
☒ SS/JrHsdMcwi(229)

Clinical Measurements
Query by clinical measurement.

Measurement Methods
Filter results by Measurement method.

Experimental Conditions
Filter based condition.

Rat Strains
Search for data related to one or more rat strains.

☒ SR/Jr(32)
☒ SR/Jr(22)
☒ SR/JrHsd(7)
☒ SS/JrHsdMcwi(163)
☒ SS/JrHsdMcwi(141)

Clinical Measurements
Query by clinical measurement.

☒ mean arterial blood pressure(127)
☒ mean arterial blood pressure(77)
☒ diastolic blood pressure(19)
☒ systolic blood pressure(29)
☒ systolic blood pressure(28)
☒ heart rate(90)
☒ heart rate(46)

Measurement Methods
Filter results by Measurement method.

☒ tail cuff plethysmography(9)
☒ radiotelemetry(44)
☒ radiotelemetry(8)
☒ intra-aortic abdominal radiotelemetry(18)
☒ intra-aortic abdominal radiotelemetry(14)
☒ intra-aortic abdominal radiotelemetry via femoral cannulation(4)
☒ intra-aortic thoracic radiotelemetry via carotid cannulation(18)
☒ vascular indwelling catheter method(117)
☒ vascular indwelling catheter method(41)
☒ vascular fluid filled catheter(70)

Experimental Conditions
Filter based condition.

☒ furosemide(25)
☒ control condition(35)
☒ vehicle control condition(3)
☒ controlled sodium content diet(136)
☒ controlled sodium chloride content diet(14)

Clinical Measurement
Ex: heart rate, blood cell count

select

FAPGG metabolism-surface area p

select

absolute change in blood pH(18)

select

absolute change in body temperatu

select

absolute change in heart rate(56)

select

absolute change in mean arterial b

select

absolute change in partial pressure

select

absolute change in partial pressure

select

absolute change in plasma renin a

select

acetylcholine response/sensitivity r

select

acetylcholine-induced blood vesse
in a pre-constricted blood vessel(1

select

adrenal angiotensin II type 1 recep

select

adrenal gland molecular compositi

select

adrenal gland morphological meas

select

adrenal protein/peptide compositi

Experimental Condition Selection
Ex: diet, atmosphere composition

select

17 beta-estradiol(1)

select

NG-nitroarginine methyl ester(3)

select

acetylcholine(4)

select

activity(36)

select

air carbon dioxide content(12)

select

air oxygen content(12)

select

amino acid(3)

select

anesthetic/analgesic(4)

select

angiotensin II(5)

select

angiotensin(5)

select

antibacterial agent(10)

select

anticonvulsant(25)

select

antimicrobial agent(10)

select

bilateral ovariectomy(2)

select

chemical with specified function(43)

select

chemical with specified structure(30)

select

chemical(45)

select

control condition(31)

Generate Report


Strains



Clinical Measurements

Measurement Methods

Experimental Conditions

chemical with specified structure(30)
amino acid(3)
oil(2)
peptide/protein(5)
steroid(1)
sulfonamide(25)
furosemide(25)
control condition(35)
control condition(31)
sham surgical control condition(1)
vehicle control condition(3)
controlled atmosphere composition(24)
controlled visible light condition(18)
diet(146)
drink(10)
forced feeding(10)
solid diet(136)
controlled content diet(136)
radiation exposure(9)


Rat Genome Database
<http://rgd.mcw.edu>

 MEDICAL COLLEGE OF WISCONSIN
 MARQUETTE UNIVERSITY

The PhenoMiner 2.0 results display consists of three parts

Phenominer Database Results (170 hits)

How to display a graph ?

Strain	Phenotype	Conditions	Study	Experiment Name	Sex
SS/JrHsdMcwi	heart rate	control condition	PhysGen Respiratory data	heart pumping trait	female
SS/JrHsdMcwi	systolic blood pressure	controlled sodium content diet (0.4 %) (for 16 hours) and furosemide (10 mg/kg)	Moreno C, et al., Physiol Genomics 2003 Nov 11;15(3):243-57.	arterial blood pressure trait	female
SS/JrHsdMcwi	mean arterial blood pressure	controlled sodium content diet (4 %) (between 17 and 36 days)	PhysGen Renal A data	arterial blood pressure trait	male
SR/Jr	systolic blood pressure	controlled sodium content diet (8 %) (between 48 and 55 days) then controlled exposure to ambient light	St. Lezin EM, et al., J Clin Invest 1996 Jan 15;97(2):522-7	arterial blood pressure trait	male
SS/JrHsdMcwi	systolic blood pressure	controlled sodium content diet (0.1 %) (for 28 days) then controlled sodium content diet (8	Cowley AW Jr, et al., Physiol Genomics 2000 Apr 27;2(3):107-15.	arterial blood pressure trait	male

Measurements

HEART PUMPING TRAIT (beats/min)

☒ heart rate (46)

ARTERIAL BLOOD PRESSURE TRAIT (mmHg)

☐ mean arterial blood pressure (77)

☐ systolic blood pressure (28)

☐ diastolic blood pressure (19)

Strains

SR

☐ SR/Jr (29)

☐ SR/JrHsd (29)

SS

☒ SS/JrHsdMcwi (141)

Methods

☐ intra-aortic abdominal radiotelemetry (14)

☐ intra-aortic abdominal radiotelemetry via femoral cannulation (4)

☐ intra-aortic thoracic radiotelemetry via carotid cannulation (18)

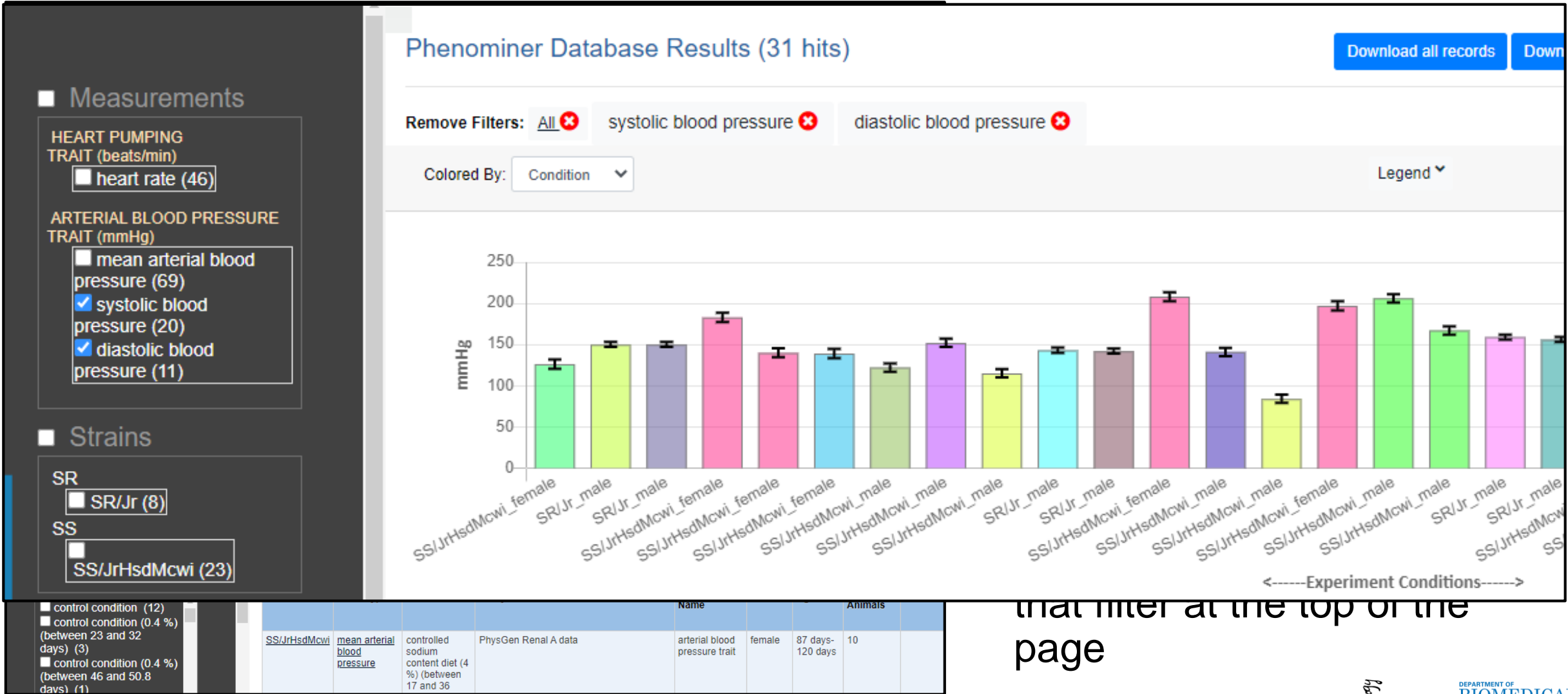
☐ radiotelemetry (8)

☐ tail cuff

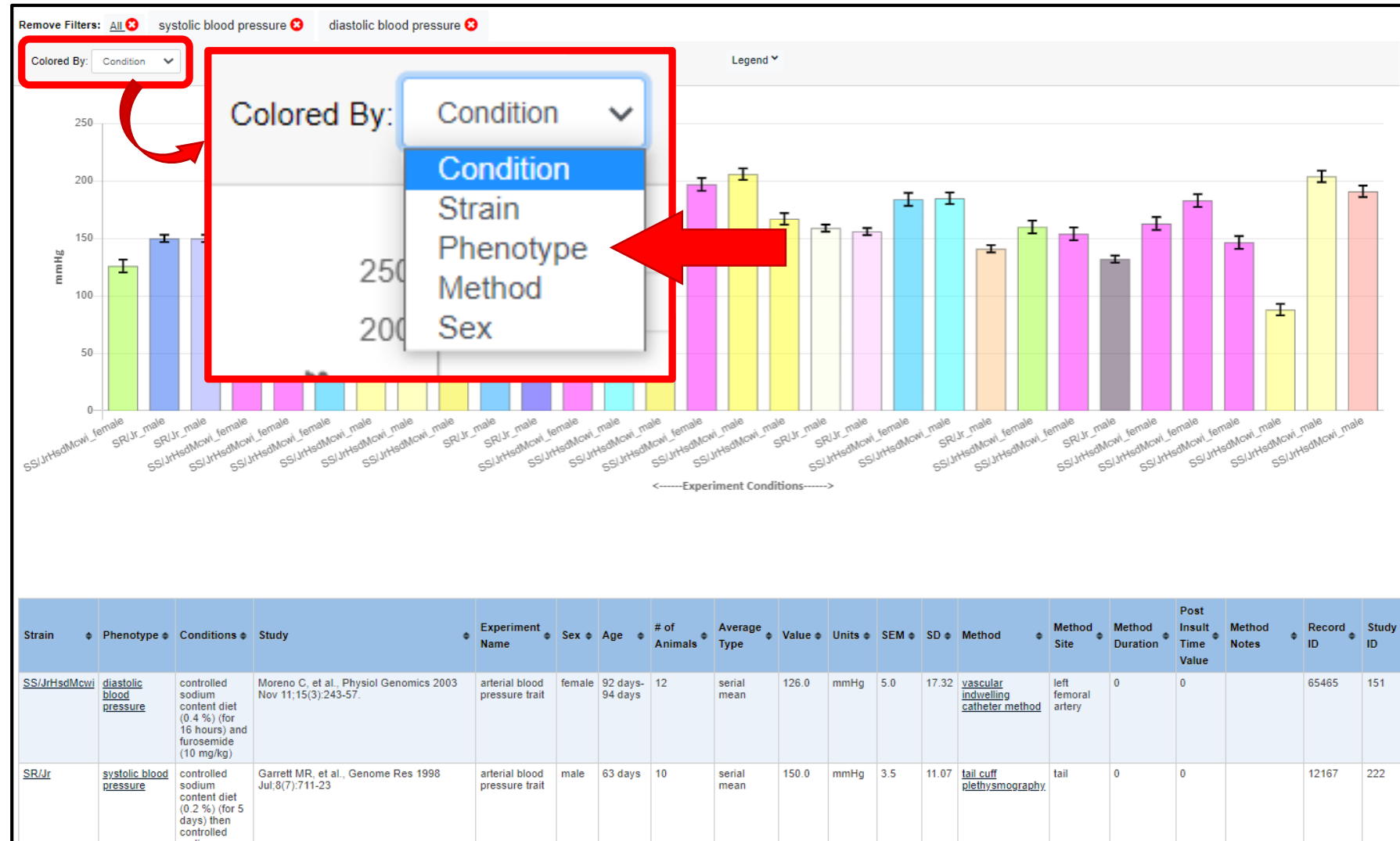
☐ plethysmography (9)

- The PhenoMiner 2.0 results display consists of three parts:
 - A graph
 - A list of filters
 - A table of results
- If measurements that use more than one unit have been selected, the graph is hidden until the user filters the measurement selection

The PhenoMiner 2.0 results display consists of three parts



The PhenoMiner 2.0 graph is more interactive: “Colored by” function

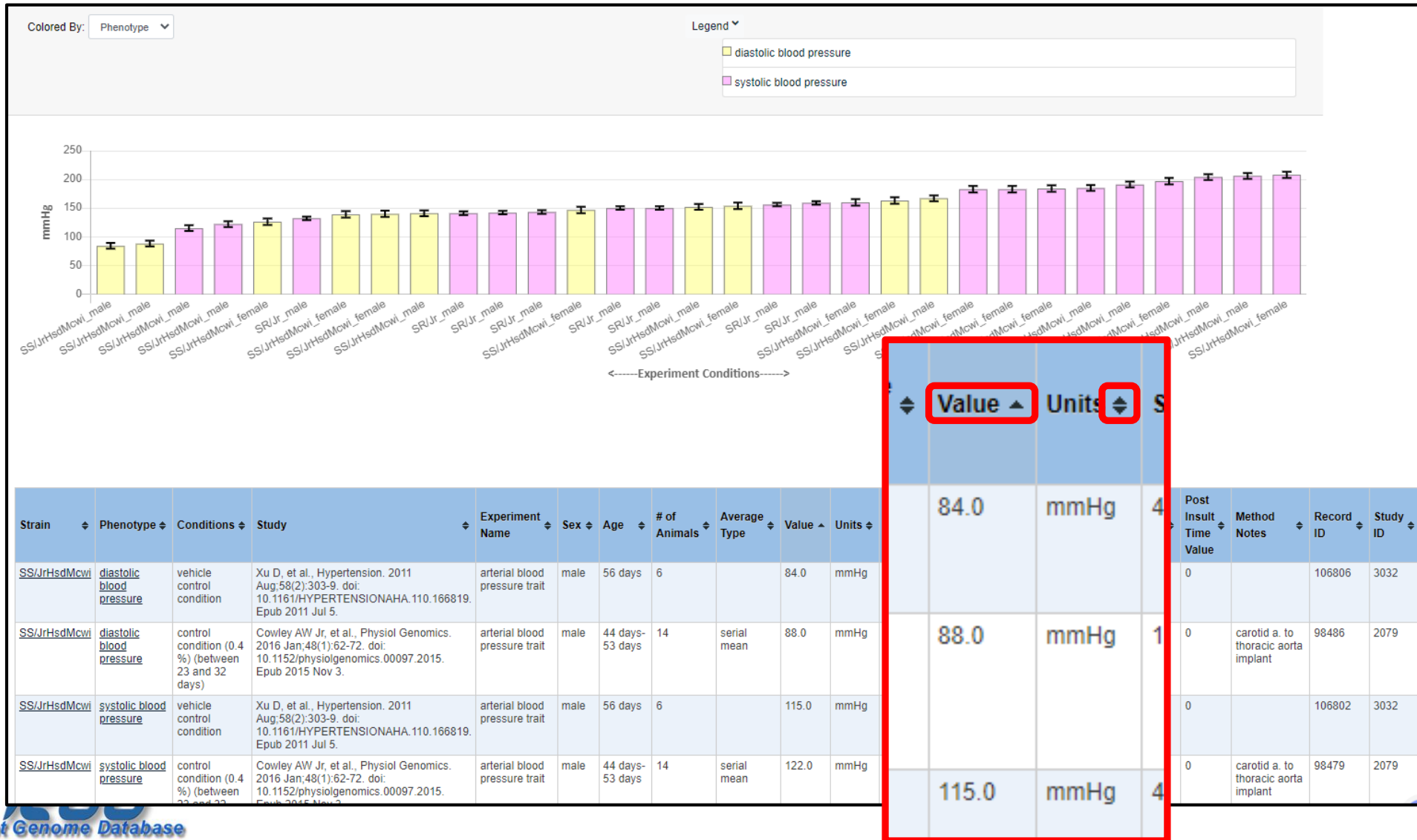


The PhenoMiner 2.0 graph is more interactive: “Colored by” function



The PhenoMiner 2.0 graph is more interactive:

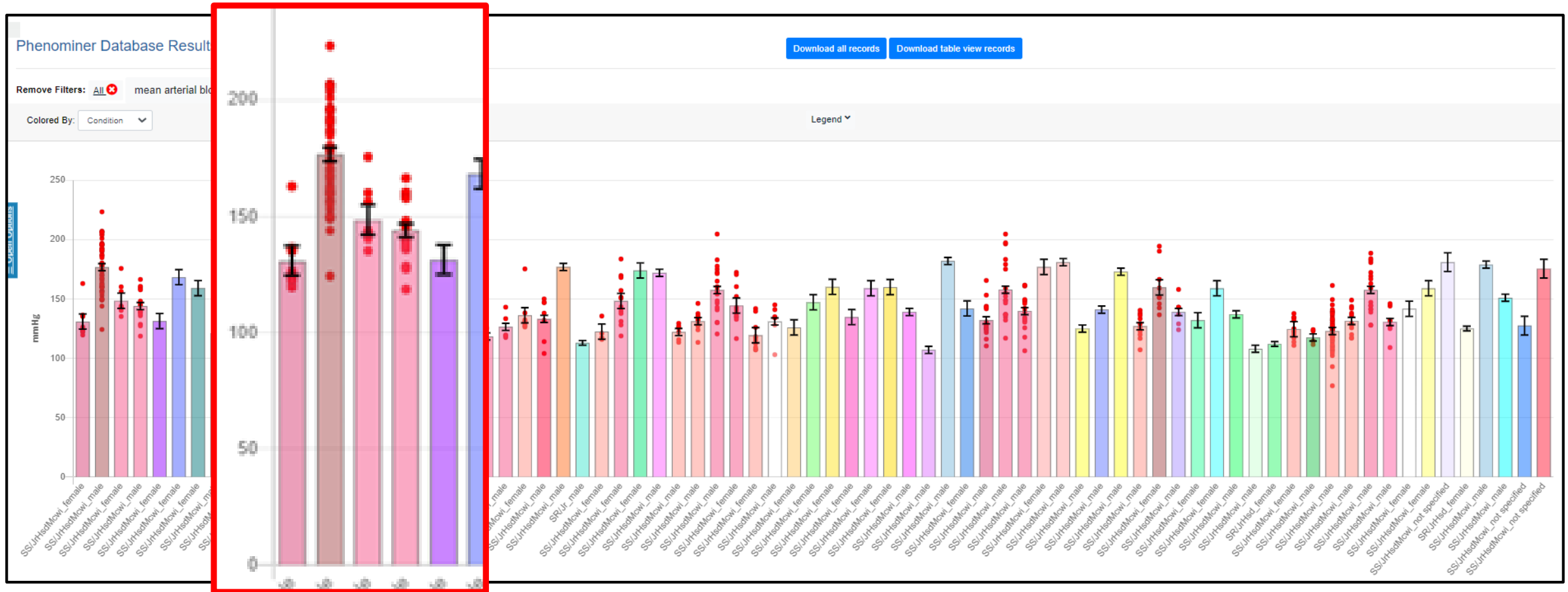
Sorting the table reorders the bars in the graph



- Using colored by phenotype and sort by value it is easy to see at a glance the mix of diastolic and systolic blood pressure values.

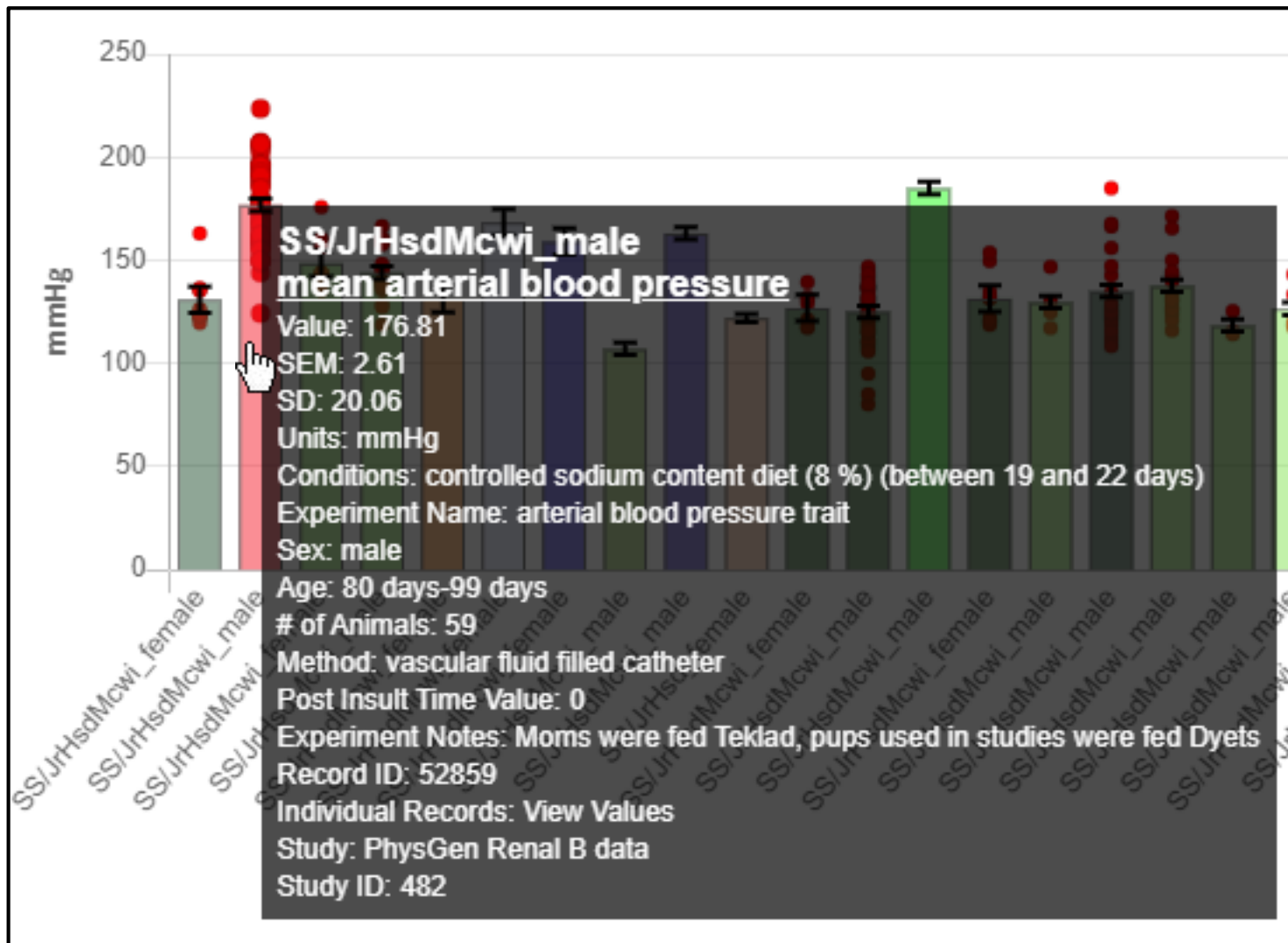


Where data for individual rats has been submitted, the graph shows the average plus the individual values



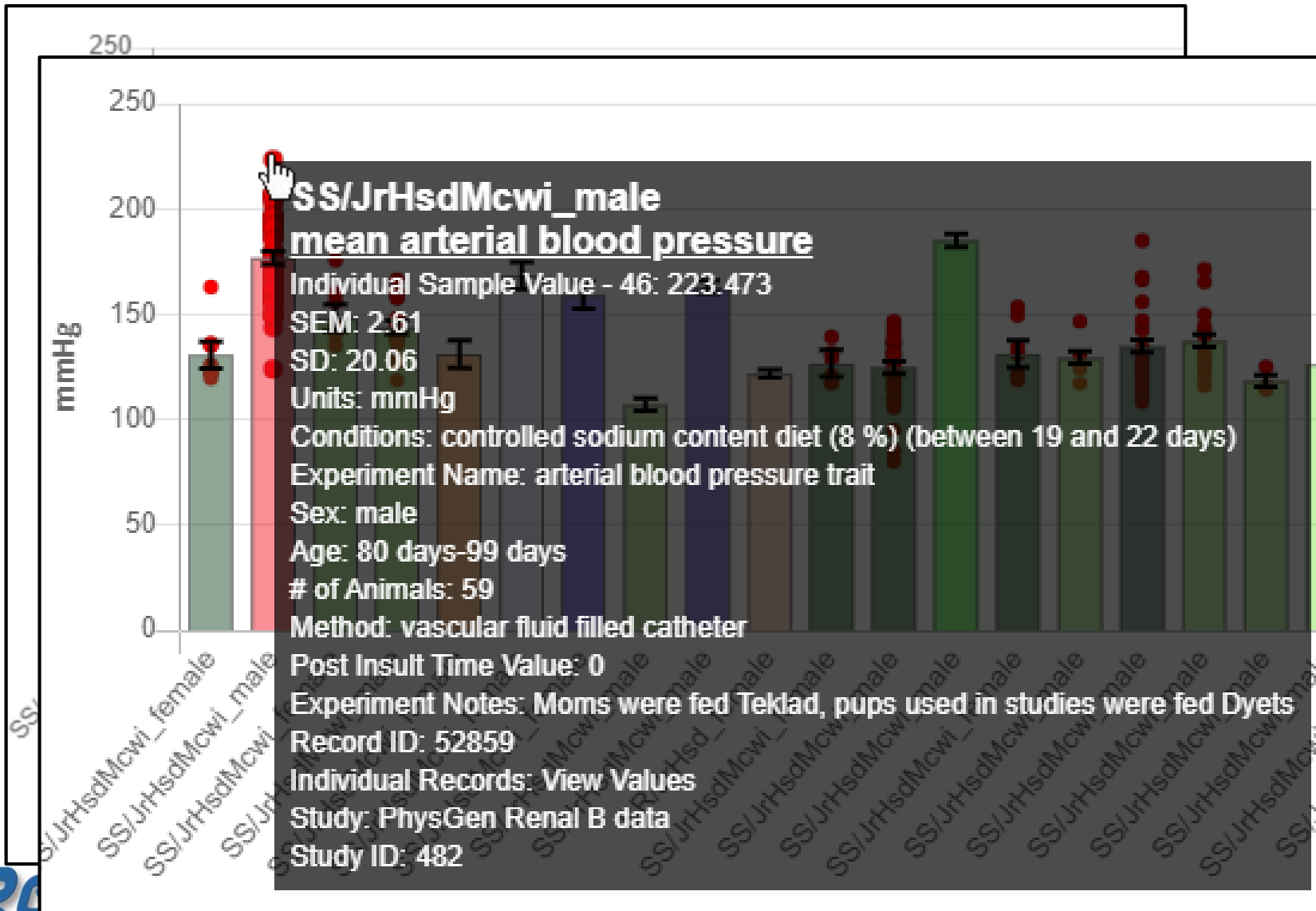
Looking at the graph for mean arterial blood pressure, you can see that some of the bars include red dots indicating the values for individual animals.

Where data for individual rats has been submitted, the graph shows the average plus the individual values



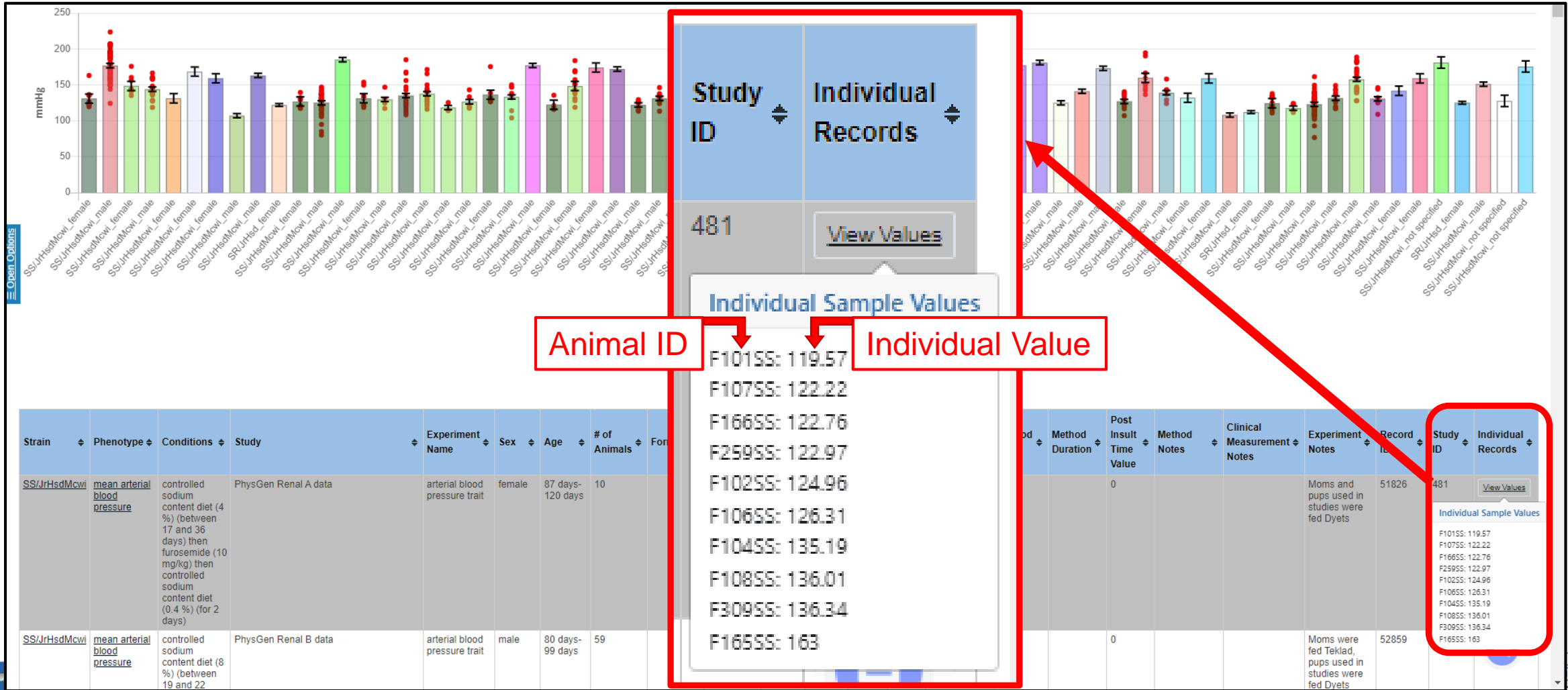
- Mouse over the bar to see a popup with details about the average value for that sample of rats under those conditions.

Where data for individual rats has been submitted, the graph shows the average plus the individual values

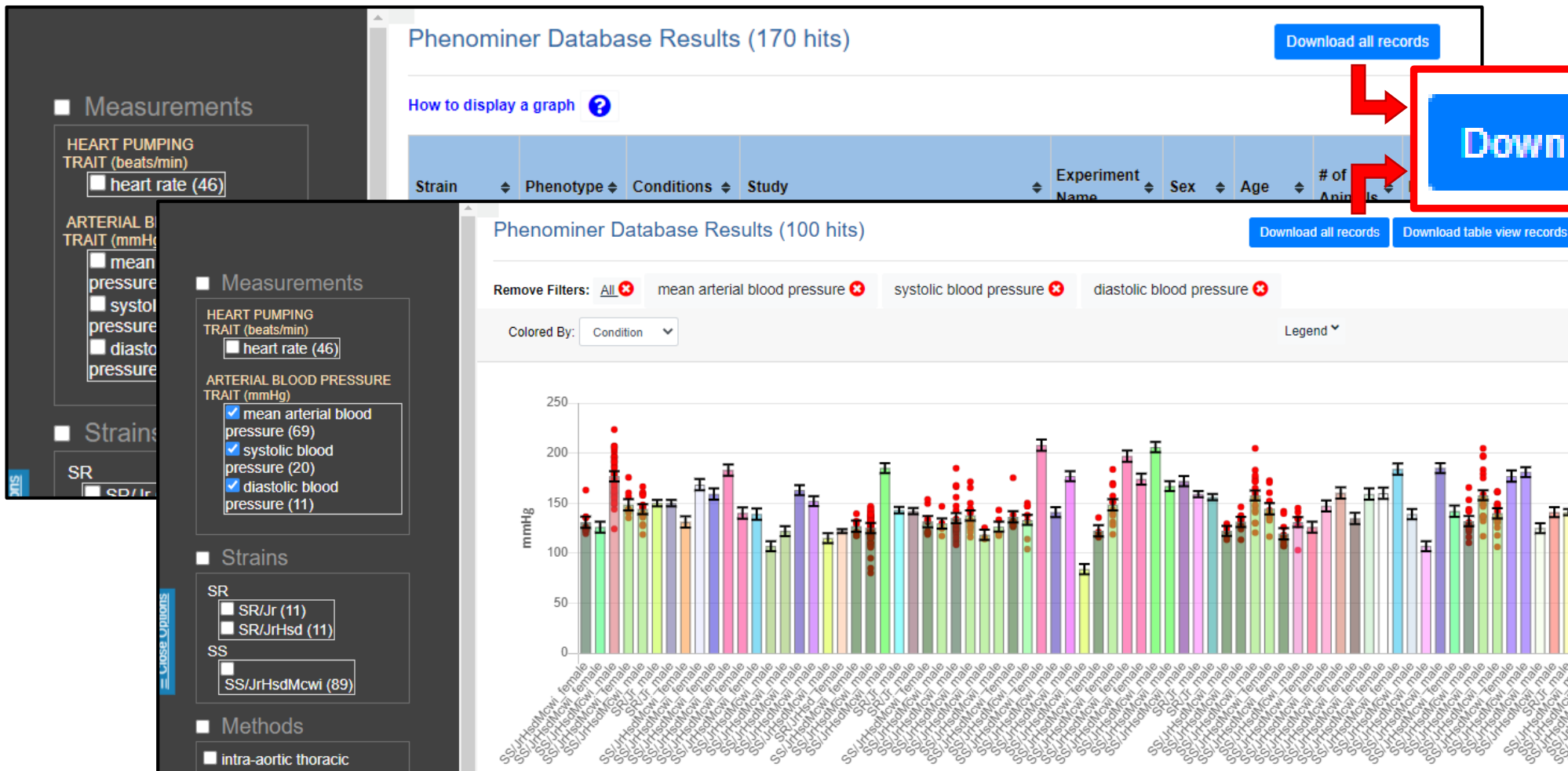


- Mouse over the bar to see a popup with details about the average value for that sample of rats under those conditions.
- Mouse over a dot to see the details for that individual rat measurement.

Where data for individual rats has been submitted, the table shows the average with the option to view individual values



Data from the query can be downloaded



A button for “Download all records” is displayed on the pages for both unfiltered and filtered queries.

Filtered queries also have an option to download just the table view records.

PhenoMiner 2.0: More intuitive selection and modification

