

Guidelines for Sizing Experimental Mouse Colonies

Technical Information Services

October 5, 2017



The Jackson Laboratory's Mission

“To discover precise genomic solutions for disease
and empower the global biomedical community
in the shared quest to improve human health.”

Performing Research

Investigating genetics and
biology of human disease

Providing Resources

JAX[®] Mice, Clinical & Research
Services, online data resources,
technical publications, and more

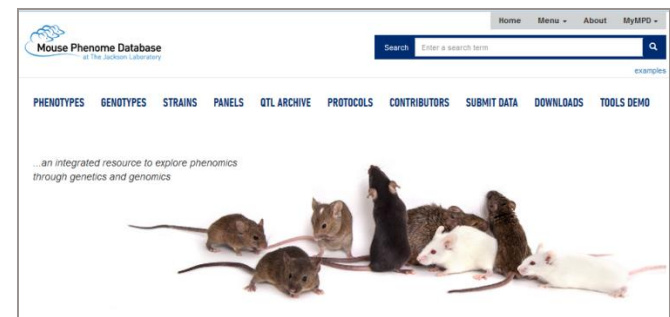
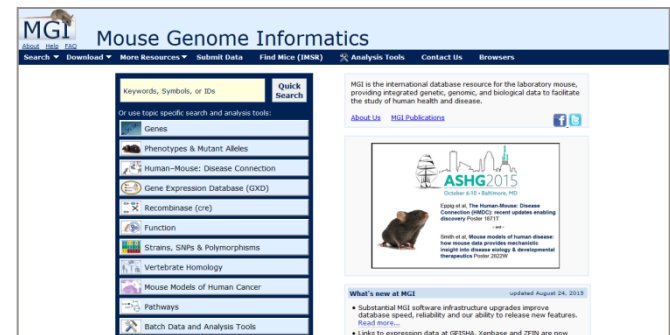
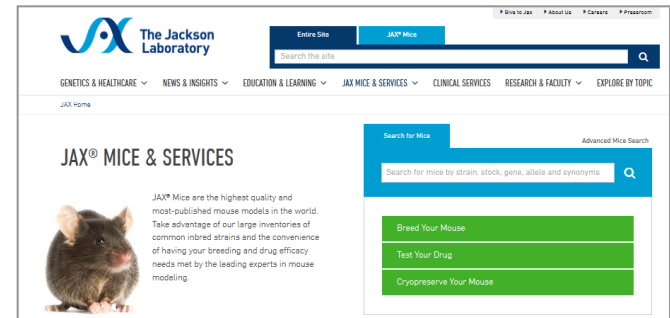
Educating Scientists

World-class courses,
internships, and other programs



Online Resources to Expedite Research

- JAX[®] Mice Database
www.jax.org/mouse-search
- Mouse Genome Informatics
www.informatics.jax.org
- Mouse Phenome Database
www.jax.org/phenome
- Others, including:
[JAX-Clinical Knowledgebase](#)
[Mouse Tumor Biology Database](#)



JAX[®] Mice

The *Gold Standard* for Biomedical Research

- NIH-funded resource
- >9,500 strains and growing
 - >3 million mice shipped annually
- Unsurpassed genetic quality & animal health
- Best characterized & referenced ~100 new pubs/week
- Common inbred strains ([C57BL/6J](#), [BALB/cJ](#), [B6.SJL-Ptprc^aPepc^b/BoyJ](#)) support development/collection of specialty strains and other valuable community research resources



Learning Goals

- Breeding performance data collection
- Define research needs
- Calculate # of breeders (females) needed
 - Steady state
 - How decisions impact colony size
- Adjusting research needs to existing resources



Reproductive Characteristics

- Gestation: 18.5 to 21 days
- Litter size: 2 to 12+ pups
- Weaning age: 21 to 28 days
- Sexual maturity: 5 to 8 weeks
- Productive breeding life: ~ 7-8 months



8 day old NOD/ShiLtJ pups ([001976](#))

Silver LM. (1995) *Mouse Genetics: Concepts and Applications*, Oxford University Press.
Available online at www.informatics.jax.org/silver



Data Collection & Record Keeping

Critical for successful colony management

- Improve efficiency
- Detect problems/mutations early



Record Keeping: Pedigree Book / Cage Cards

- Weaned pups per female per week
 - Average number of pups weaned per litter
 - Total pups weaned / # of litters
 - Average number of litters per female
 - Total # of litters / Total # of females
 - Including non-productive
 - Breeding rotation
 - Look for when litter sizes and/or frequency declines
- Genotype ratio (if segregating)
- Sex ratio
- Evaluate every ~6 months!!!!



Breeding Productivity Ranges for Common Backgrounds (WPF)

Strain	Wean/Female/Week
C57BL/6	0.54 - 0.83
BALB/c	0.52 - 0.60
C3H	0.69 - 1.21
B6;129 mixed	0.62 - 1.76
FVB/N	1.47 - 1.71
129	0.35 - 0.74
NOD	0.53 - 1.50

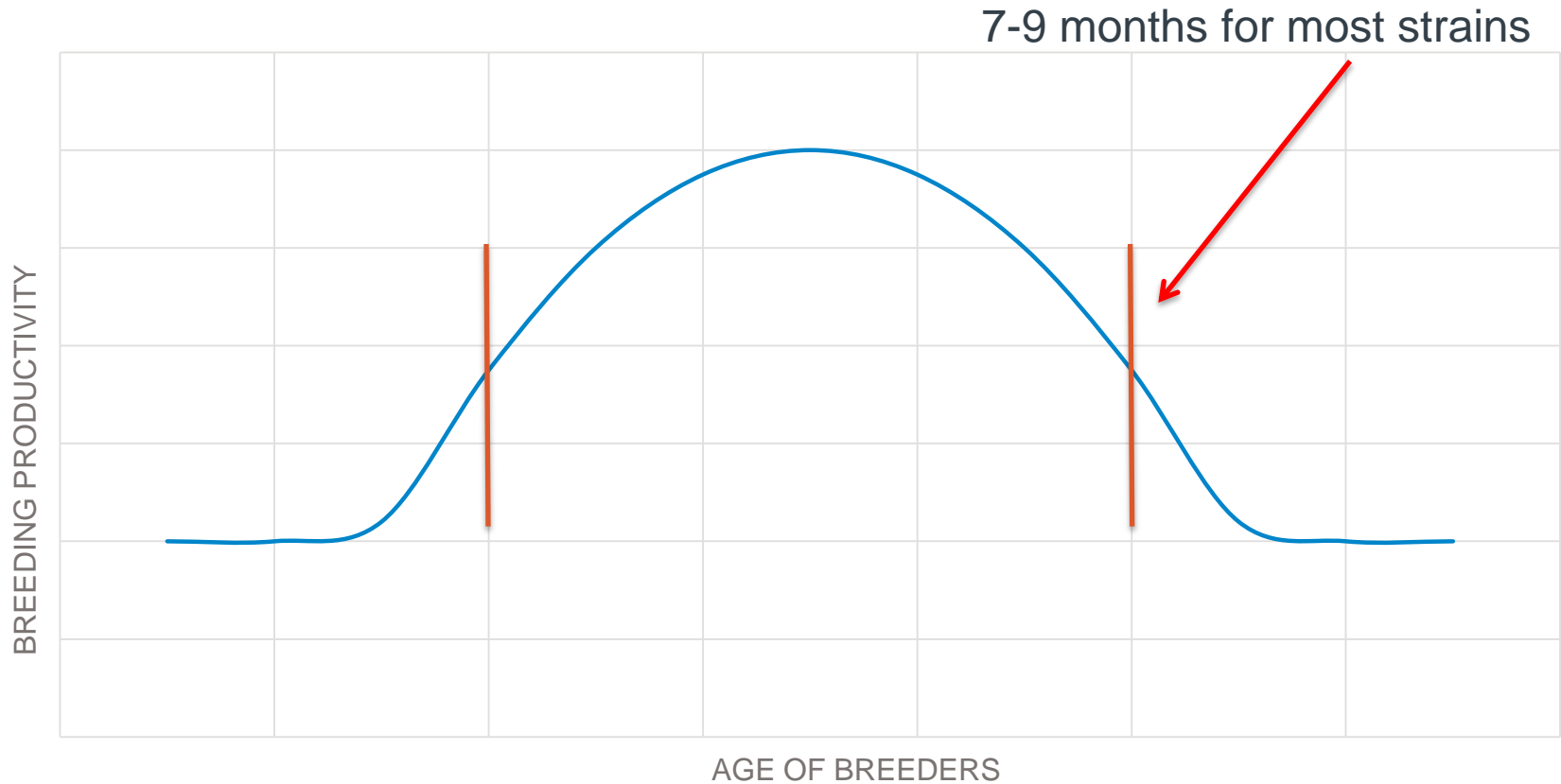


Assumptions

- Existing Colonies
 - Not covering building new colonies
- Mixed age breeders
- Breeding with pairs or trios
 - We very rarely use harem matings (1 male + more than 2 females)
- Close to even sex ratio
 - Very few strains show significant skewing
- Estimates based on averages
 - Breeding is biological!



Breeding Productivity vs. Age



Consistent Breeding Performance



Research Needs – Steady State Colony

- Number of mice
 - Can you take less?
- Genotypes
 - Homozygotes
 - Heterozygotes
 - Hemizygotes
- Sex(es)
- Age range
- Frequency
- Breeding Scheme
 - Hom x Hom
 - Het x Het
 - Het x Wild Type
- Controls
 - From colony
 - Another strain/colony



Standard KO: Congenic C57BL/6

- Experimental Mice: Homozygous for *GeneX* KO allele

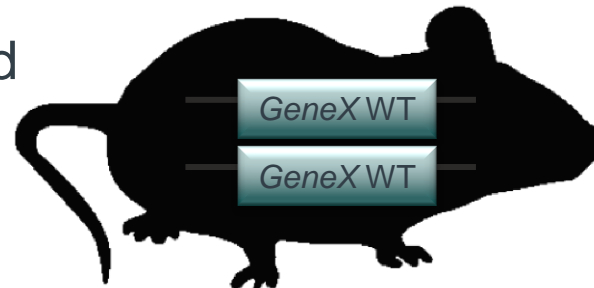
- Viable & fertile
- Breed Hom x Hom



Homozygous *GeneX* knockout

- Control Mice: C57BL/6, wild type for *GeneX*

- From vendor as needed
- Own colony

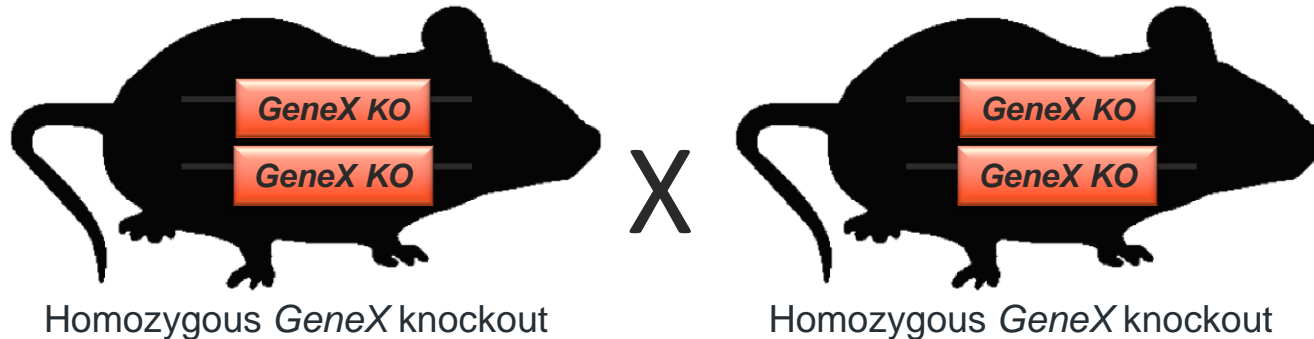


Homozygous *GeneX* wild type



Standard KO: Congenic C57BL/6

- Homozygote X Homozygote

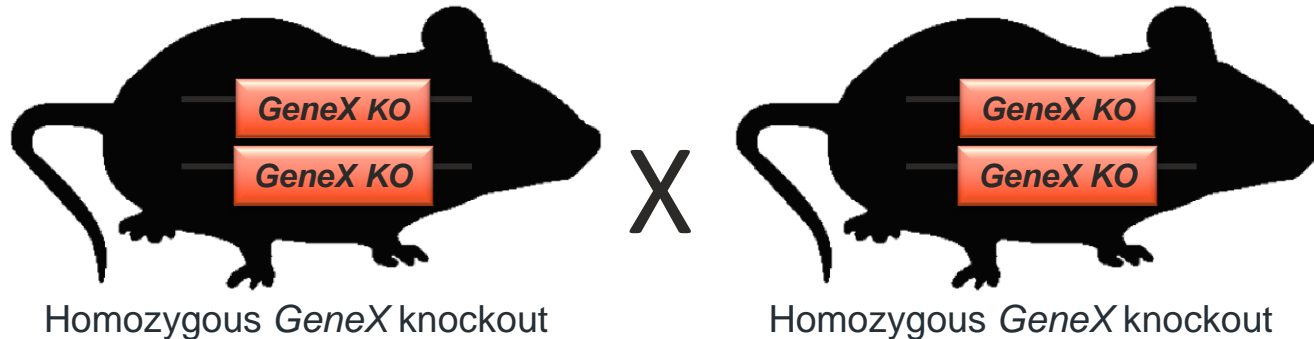


- 20 mixed sex homozygotes
- 5-8 weeks of age (4 week age range)
- Monthly (every 4 weeks)



Standard KO: Congenic C57BL/6

- Homozygote X Homozygote



- Average # of pups weaned per litter = 5
- Average number of litters per female = 2.8
- Breeding rotation = 26 weeks



General Steps

- Calculate number of mice needed weekly
- Calculate wean/female/week
- Calculate number of female breeders needed
- Replacement breeders
 - Frequency
 - Factor in?



Calculate # of Mice Needed Weekly

Hom x Hom
20 Mixed Sex
4 week range
Monthly

Line 1: How many mice do you need?

20

Line 2: What age range?

4

Enter 1 if all need to be born in same week

Enter 2 if 2 week range, 3 if three week range, *etc.*

Line 3: How frequently do you need mice?

4

Enter 1 for weekly, 2 for every other week, 4 for monthly

Line 4: Divide Line 1 by smaller of Lines 2 or 3

5



Calculate # of Mice Needed Weekly

Hom x Hom
20 Mixed Sex
4 week range
Monthly

Line 5: What sex of mice?

1

Enter 1 if using both, enter 2 if using one sex

Line 6: What Breeding Scheme?

1

If Hom x Hom, enter 1

If Het x Hom (or recip), enter 2

If Het/Hemi x WT (or recip.), enter 2

If Het x Het, enter 4

Line 7: Can you use fewer mice?

1

If yes, enter 1

If no, enter “fudge factor” (1.1 for 10% over, 1.2 for 20%, *etc.*)



Calculate # of Mice Needed Weekly

Hom x Hom
20 Mixed Sex
4 week range
Monthly

Line 8: Calculate # mice you need weekly

5

Multiply Line 4 X Line 5 X Line 6 X Line 7

Round *up* to nearest whole number

$(5 * 1 * 1 * 1)$

5 mice per week x 4 weeks = 20 mice/month!

Calculate wean/female/week (breeding performance)



Calculate Wean per Female per Week

Hom x Hom
20 Mixed Sex
4 week range
Monthly

Line 9: Average number of pups/litter?

5

Line 10: Average number of litters/female?

2.8

Including non-productive

Line 11: Breeding Rotation (in weeks)

26

Line 12: Calculate wean per female per week

0.54

Divide Line 10 by Line 11, then multiply by Line 9

Round to nearest hundredth



Breeding Productivity Ranges for Common Backgrounds (WPF)

Strain	Wean/Female/Week
C57BL/6	0.54 - 0.83
BALB/c	0.52 - 0.60
C3H	0.69 - 1.21
B6;129 mixed	0.62 - 1.76
FVB/N	1.47 - 1.71
129	0.35 - 0.74
NOD	0.53 - 1.50



Calculate # of Females Needed

Hom x Hom
20 Mixed Sex
4 week range
Monthly

Line 13: Calculate number of breeding females

10

Divide Line 8 by Line 12

Round *up* to nearest whole number

(5 / 0.54)

10 females x 0.54 (wean/female/week) = 5.4 pups/week

What happens when breeders get old?



Replacement Breeders

Hom x Hom
20 Mixed Sex
4 week range
Monthly

Line 14: Replacement females needed weekly

0.5

Divide Line 13 by Line 11 (10 / 26)

Round *up* to nearest half

Do we have to factor in additional breeders?



Replacement Breeders

Hom x Hom
20 Mixed Sex
4 week range
Monthly

May not need to factor in:

- When experimental mice and breeders have ***different*** genotypes
 - Heterozygote x heterozygote, using homs
 - Heterozygote x homozygote, using one sex
 - Heterozygote/hemizygote x WT, using one sex
- OR age range (weeks) < cohort frequency (weeks)
 - EX: 1 week age range needed every 4 weeks



Replacement Breeders

Hom x Hom
20 Mixed Sex
4 week range
Monthly

Need to factor in when: **Yes**

- Experimental mice and breeders have same genotype
 - Homozygote x homozygote
 - Heterozygote x homozygote, using both sexes
 - Heterozygote/hemizygote x WT, using both sexes
- AND age range (weeks) \geq cohort frequency (weeks)
 - EX: 4 week range needed every 4 weeks



Replacement Breeders

Hom x Hom
20 Mixed Sex
4 week range
Monthly

Line 14: Replacement females needed weekly

0.5

Divide Line 13 by Line 11 ($10 / 26$)

Round *up* to nearest half

Line 15: Additional females needed

2

Multiply Line 14 by 2 then divide by Line 12

Round *up* to nearest whole number

$(0.5 * 2 / 0.54)$

Line 16: **Final number of females needed**

12

Add Line 13 and Line 15



Final Colony

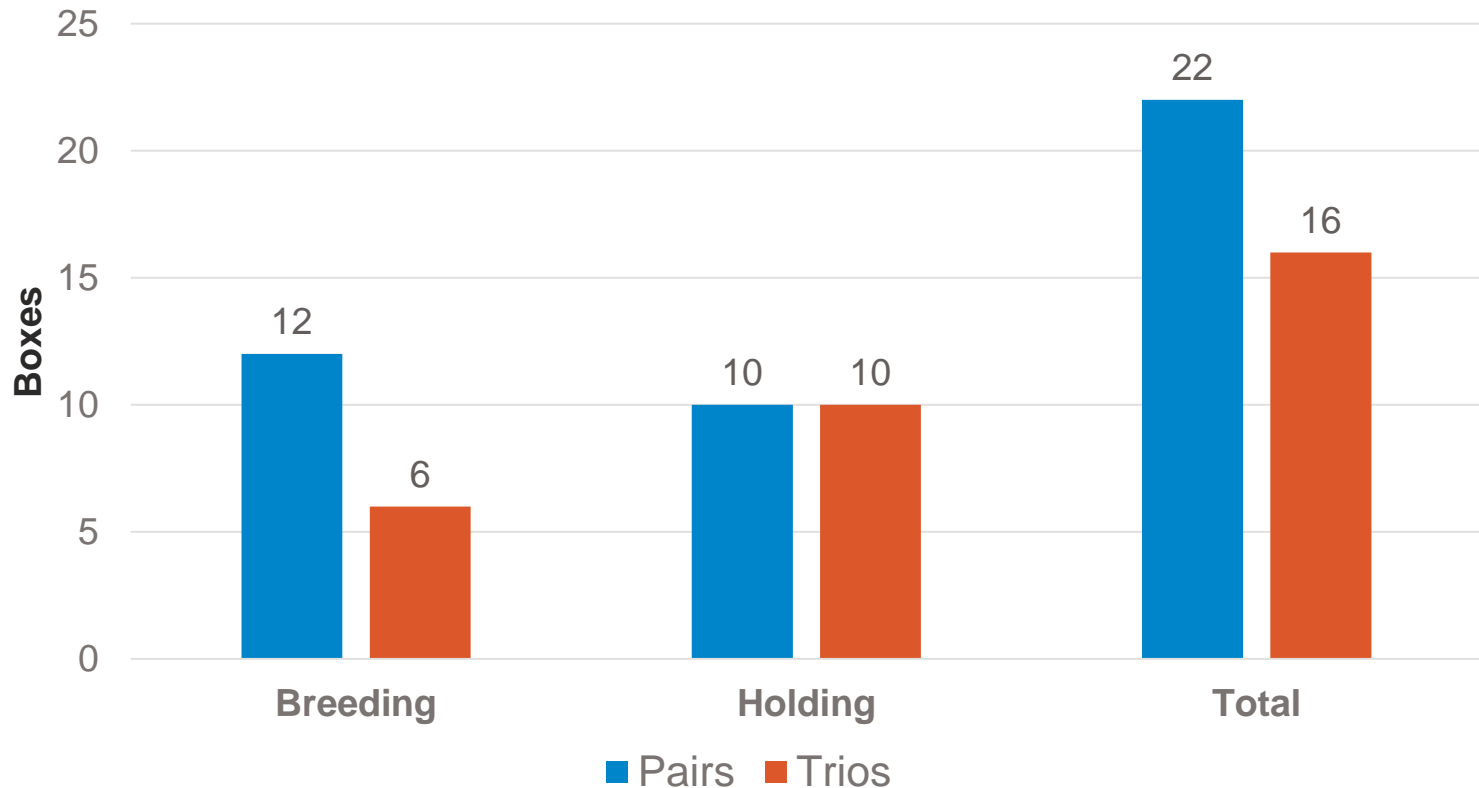
Hom x Hom
20 Mixed Sex
4 week range
Monthly

12 females x 0.54 = 6.48 pups/week



How Much Box Space Is Needed?

Hom x Hom
20 Mixed Sex
4 week range
Monthly

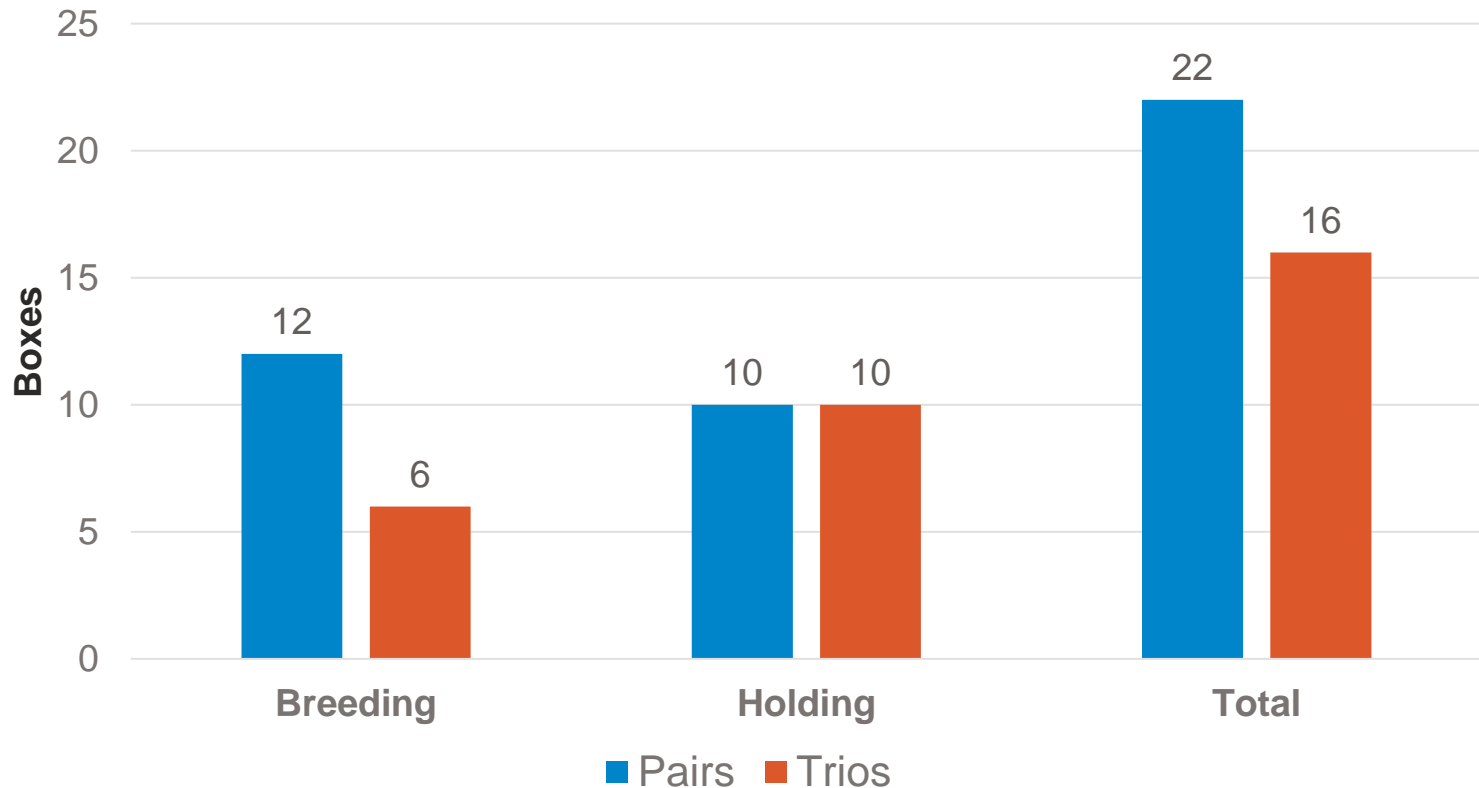


Will need additional space for experiments and controls!



How Much Box Space Is Needed?

Hom x Hom
20 Mixed Sex
4 week range
Monthly



Do you have that much space?



Costs Per Mouse

Hom x Hom
20 Mixed Sex
4 week range
Monthly

Pairs

- 76 box/pen weeks
 - 12 Breeding boxes x 4 weeks/cohort = 48 weeks
 - Holding for experiments/replacement = 28 weeks
 - 2 boxes held for 5 weeks each (3-8 weeks) = 10
 - 2 boxes held for 4 weeks each (3-7 weeks) = 8
 - 2 boxes held for 3 weeks each (3-6 weeks) = 6
 - 2 boxes held for 2 weeks each (3-5 weeks) = 4
- \$400/cohort*
- \$20/mouse*



**Example per diem of \$0.75 (\$5.25/week)*

THE JACKSON LABORATORY

Costs Per Mouse

Hom x Hom
20 Mixed Sex
4 week range
Monthly

Trios

- 52 weeks
 - 6 Breeding boxes x 4 weeks/cohort = 24 weeks
 - Holding for experiments/replacement = 28 weeks
 - 2 boxes held for 5 weeks each (3-8 weeks) = 10
 - 2 boxes held for 4 weeks each (3-7 weeks) = 8
 - 2 boxes held for 3 weeks each (3-6 weeks) = 6
 - 2 boxes held for 2 weeks each (3-5 weeks) = 4
- \$275/cohort*
- \$13.75/mouse*



**Example per diem of \$0.75 (\$5.25/week)*

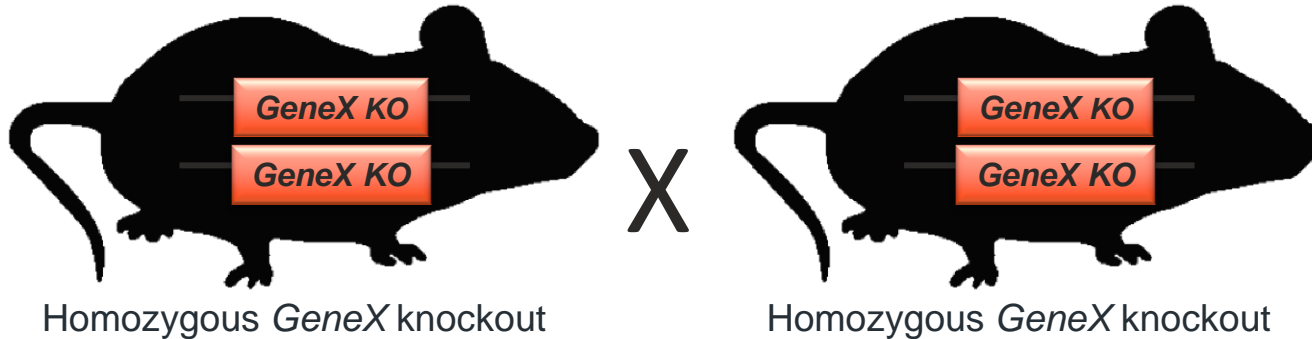
Altering Research Needs

- Age Range
- Sex
- Number of mice
- Breeding Scheme



Changing Age Range

- Homozygote X Homozygote

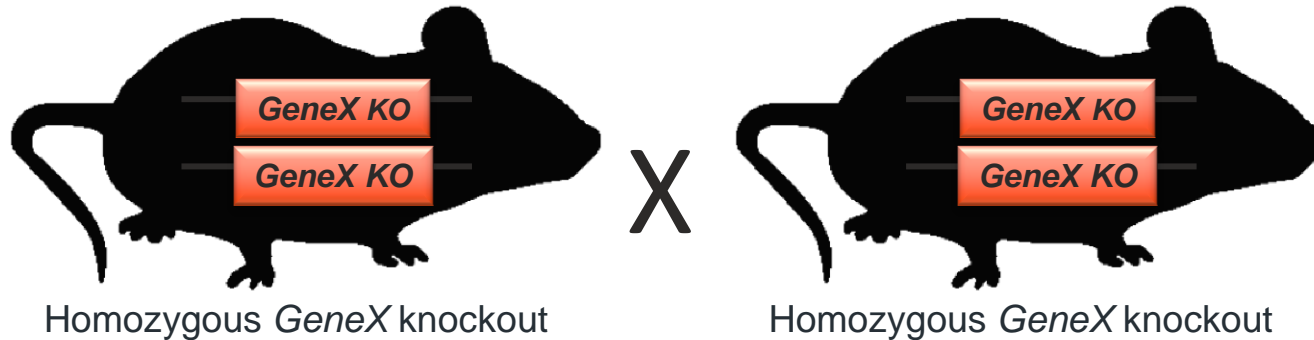


- 20 mixed sex homozygotes
- 5-8 weeks of age (4 week age range)
- Monthly (every 4 weeks)



Changing Age Range

- Homozygote X Homozygote



- 20 mixed sex homozygotes
- 8 weeks of age (1 week age range)
- Monthly (every 4 weeks)



Changing Age Range

Hom x Hom
20 Mixed Sex
1 week range
Monthly

Line 1: How many mice do you need?

20	20
----	----

Line 2: What age range?

4	1
---	---

Enter 1 if all need to be born in same week

Enter 2 if 2 week range, 3 if three week range, *etc.*

Line 3: How frequently do you need mice?

4	4
---	---

Enter 1 for weekly, 2 for every other week, 4 for monthly

Line 4: Divide Line 1 by smaller of Lines 2 or 3

5	20
---	----



Changing Age Range

Hom x Hom
20 Mixed Sex
1 week range
Monthly

Line 5: What sex of mice?

Enter 1 if using both, enter 2 if using one sex

1	1
---	---

Line 6: What Breeding Scheme?

If Hom x Hom, enter 1

If Het x Hom (or recip), enter 2

If Het/Hemi x WT (or recip.), enter 2

If Het x Het, enter 4

1	1
---	---

Line 7: Can you use fewer mice?

If yes, enter 1

If no, enter “fudge factor” (1.1 for 10% over, 1.2 for 20%, *etc.*)

1	1
---	---



Changing Age Range

Hom x Hom
20 Mixed Sex
1 week range
Monthly

Line 8: Calculate # mice you need weekly

5

20

Multiply Line 4 X Line 5 X Line 6 X Line 7

Round ***up*** to nearest whole number

$(20 * 1 * 1 * 1)$



Changing Age Range

Hom x Hom
20 Mixed Sex
1 week range
Monthly

Line 9: Average number of pups/litter?

5

Line 10: Average number of litters/female?

2.8

Including non-productive

Line 11: Breeding Rotation (in weeks)

26

Line 12: Calculate wean per female per week

0.54

Divide Line 10 by Line 11, then multiply by Line 9

Round to nearest hundredth



Changing Age Range

Hom x Hom
20 Mixed Sex
1 week range
Monthly

Line 13: Calculate number of breeding females

10

38

Divide Line 8 by Line 12

Round ***up*** to nearest whole number

(20 / 0.54)

38 females x 0.54 (wean/female/week) = 20.5 pups/week



Changing Age Range

Hom x Hom
20 Mixed Sex
1 week range
Monthly

Line 14: Replacement females needed weekly

0.5

1.5

Divide Line 13 by Line 11

Round **up** to nearest half

(38 / 26)

Do we need to factor in replacement breeders?



Replacement Breeders

Hom x Hom
20 Mixed Sex
1 week range
Monthly

May not need to factor: **NO**

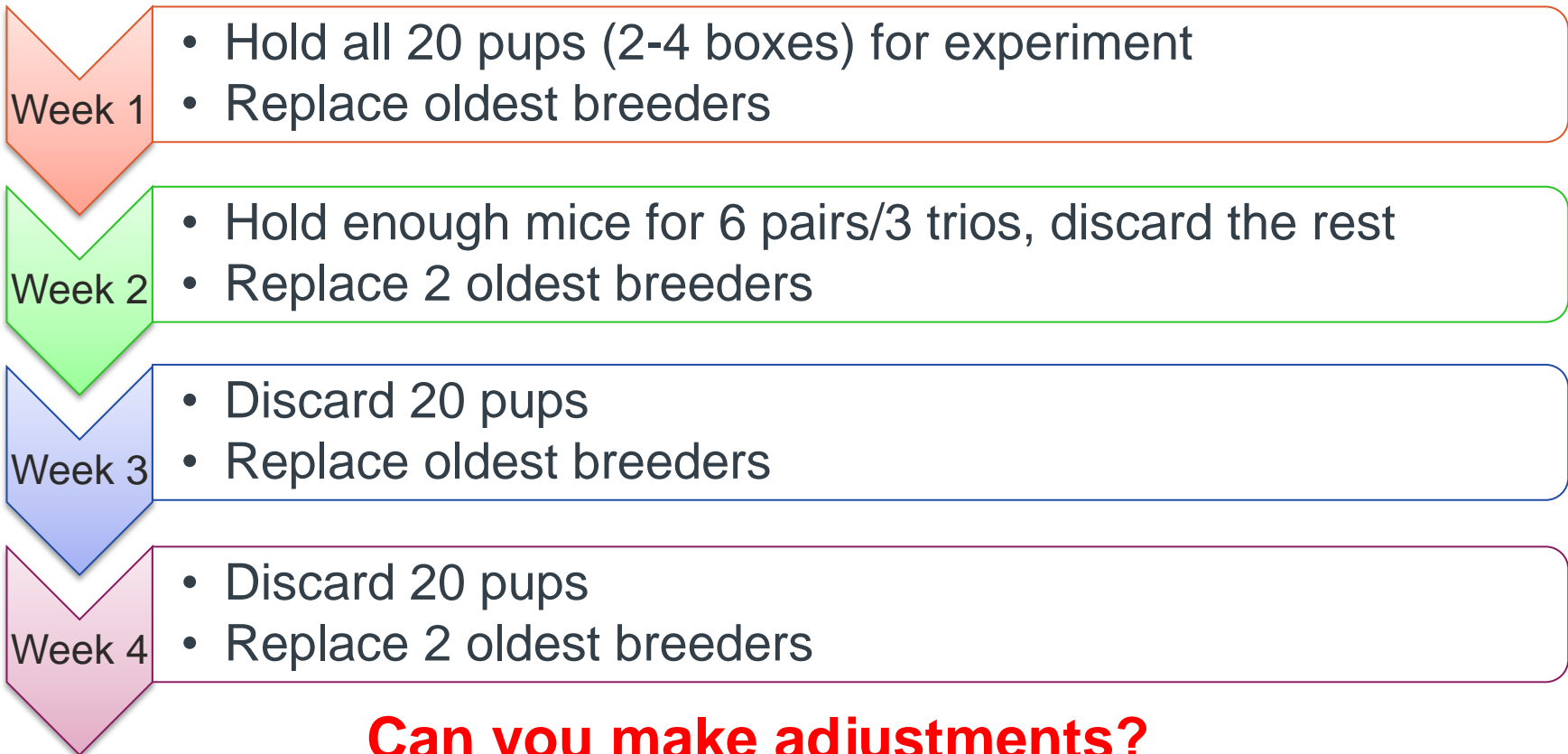
- When experimental mice and breeders have *different* genotypes
 - Heterozygote x heterozygote
 - Heterozygote x homozygote, using one sexes
 - Heterozygote/hemizygote x WT, using one sexes
- OR age range (weeks) < cohort frequency (weeks)
 - EX: 1 week age range needed every 4 weeks



Final Colony

Hom x Hom
20 Mixed Sex
1 week range
Monthly

38 females x 0.54 = 20.5 pups/week

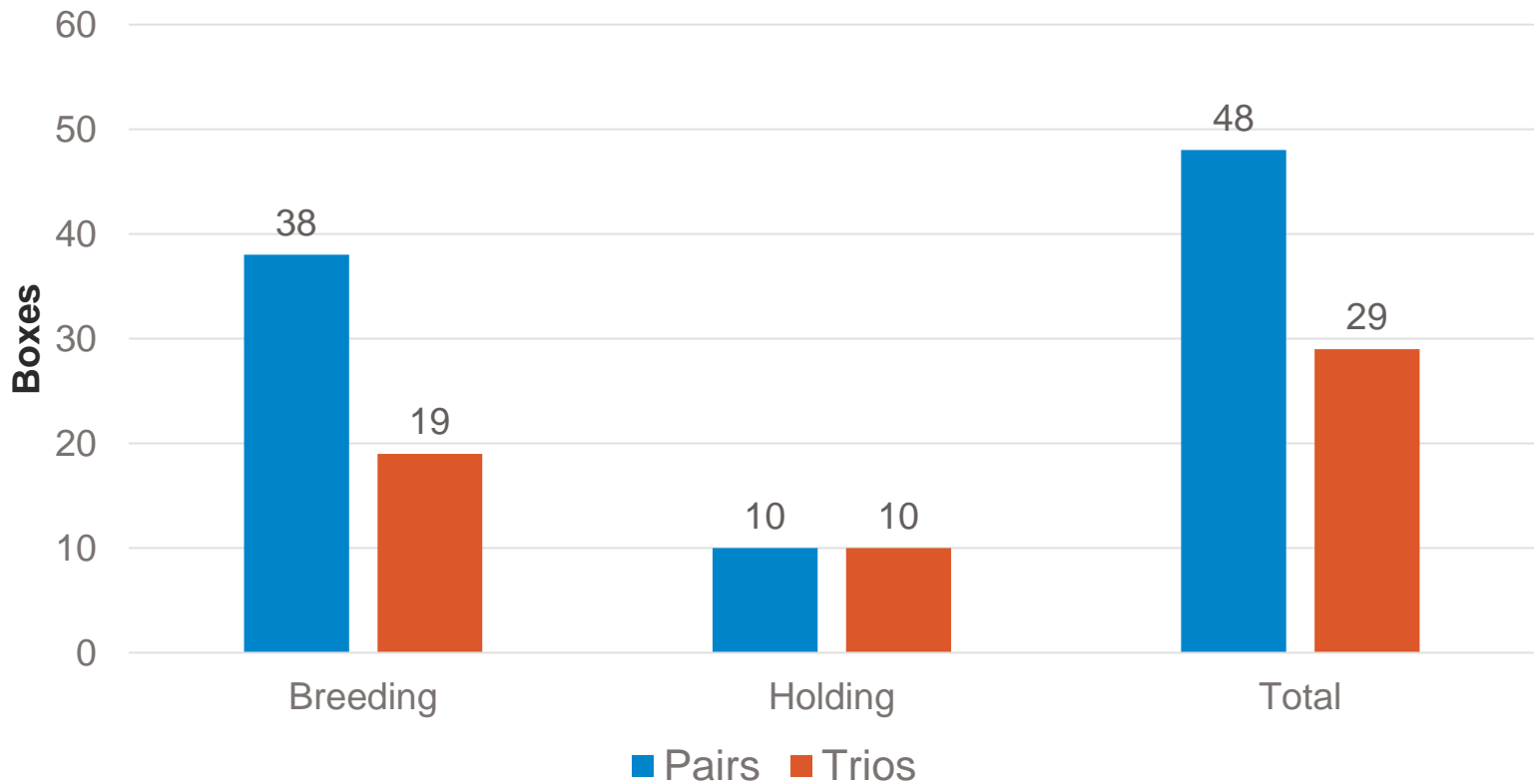


Can you make adjustments?



How Much Box Space Is Needed?

Hom x Hom
20 Mixed Sex
1 week range
Monthly



Do you have that much space?



Costs Per Mouse

Hom x Hom
20 Mixed Sex
1 week range
Monthly

Pairs

- 178 box/pen weeks
 - 38 Breeding boxes x 4 weeks/cohort = 152 weeks
 - Holding for experiments/replacement = 26 weeks
 - 4 boxes held for 5 weeks each (3-8 weeks) = 20
 - Cohort
 - 2 boxes held for 3 weeks each (3-6 weeks) = 6
 - Replacement breeders
- \$935/cohort*
- \$46.75/mouse*



* *Example per diem of \$0.75 (\$5.25/week)*

Costs Per Mouse

Hom x Hom
20 Mixed Sex
1 week range
Monthly

Trios

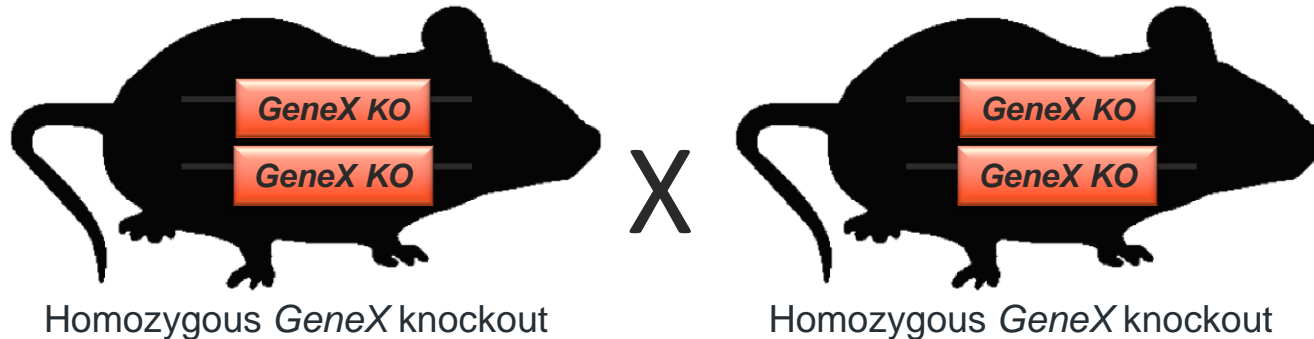
- 102 box/pen weeks
 - 19 Breeding boxes x 4 weeks/cohort = 76 weeks
 - Holding for experiments/replacement = 26 weeks
 - 4 boxes held for 5 weeks each (3-8 weeks) = 20
 - Cohort
 - 2 boxes held for 3 weeks each (3-6 weeks) = 6
 - Replacement breeders
- \$536/cohort*
- \$26.80/mouse*



* Example per diem of \$0.75 (\$5.25/week)

Mixed vs. Single Sex

- Homozygote X Homozygote

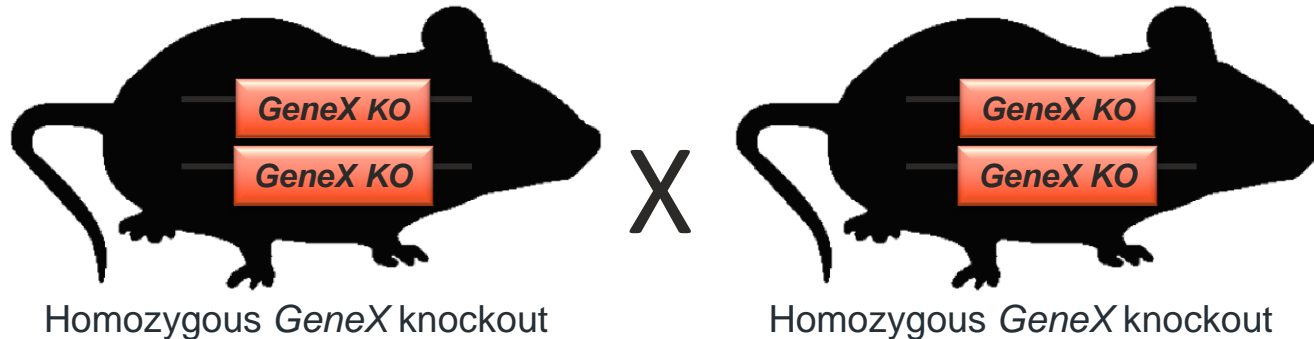


- 20 mixed sex homozygotes
- 5-8 weeks of age (4 week age range)
- Monthly (every 4 weeks)



Mixed vs. Single Sex

- Homozygote X Homozygote



- 20 **female** homozygotes
- 5-8 weeks of age (4 week age range)
- Monthly (every 4 weeks)



Mixed vs. Single Sex

Hom x Hom
20 Female
4 week range
Monthly

Line 5: What sex of mice?

Enter 1 if using both, enter 2 if using one sex

1	2
---	---

Line 6: What Breeding Scheme?

If Hom x Hom, enter 1

If Het x Hom (or recip), enter 2

If Het/Hemi x WT (or recip.), enter 2

If Het x Het, enter 4

1	1
---	---

Line 7: Can you use fewer mice?

If yes, enter 1

If no, enter “fudge factor” (1.1 for 10% over, 1.2 for 20%, *etc.*)

1	1
---	---



Mixed vs. Single Sex

Hom x Hom
20 Female
4 week range
Monthly

Line 8: Calculate # mice you need weekly

5

10

Multiply Line 4 X Line 5 X Line 6 X Line 7

Round *up* to nearest whole number

$(5 * 2 * 1 * 1)$

10 mice per week x 4 weeks = 40 mice/month!

20 females, 20 males

Calculate the number of breeding females needed



Mixed vs. Single Sex

Hom x Hom
20 Female
4 week range
Monthly

Line 13: Calculate number of breeding females

10

19

Divide Line 8 by Line 12

Round *up* to nearest whole number

(10 / 0.54)

19 females x 0.54 (wean/female/week) = 10.3 pups/week



Mixed vs. Single Sex

Hom x Hom
20 Female
4 week range
Monthly

Line 14: Replacement females needed weekly

0.5

1

Divide Line 13 by Line 11 (19 / 26)

Round *up* to nearest half

Do we need to factor in replacement breeders?



Mixed vs. Single Sex

Hom x Hom
20 Female
4 week range
Monthly

Need to factor in when: **YES**

- Experimental mice and breeders have same genotype
 - Homozygote x homozygote
 - Heterozygote x homozygote, using both sexes
 - Heterozygote/hemizygote x WT, using both sexes
- AND age range (weeks) \geq cohort frequency (weeks)
 - EX: 4 week range needed every 4 weeks



Mixed vs. Single Sex

Hom x Hom
20 Female
4 week range
Monthly

Line 14: Replacement females needed weekly

0.5

1

Divide Line 13 by Line 11 (19 / 26)

Round *up* to nearest half

Line 15: Additional females needed

2

4

Multiply Line 14 by 2 then divide by Line 12

Round *up* to nearest whole number

(1 * 2 / 0.54)

Line 16: **Final number of females needed**

12

23

Add Line 13 and Line 15

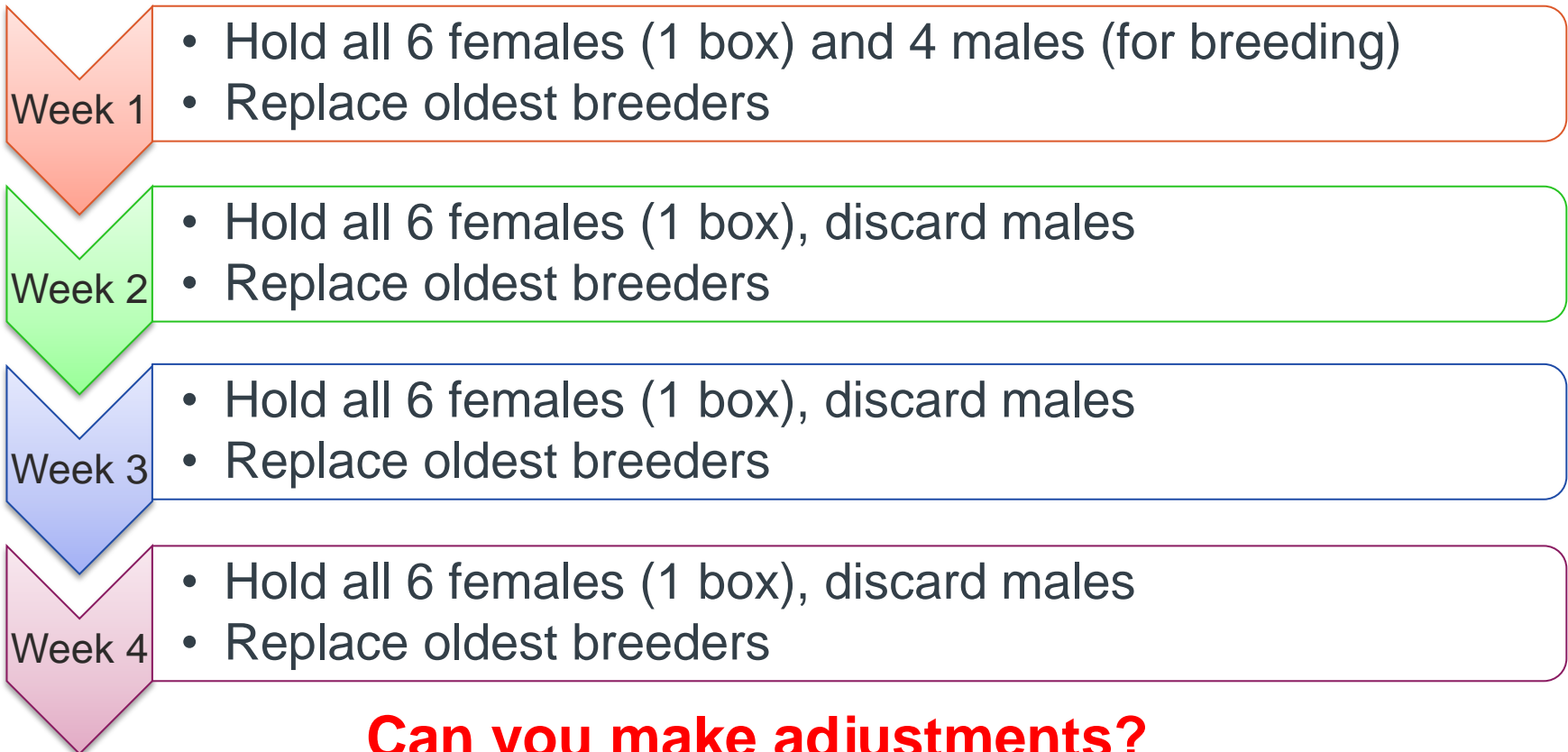
(19 + 4)



Final Colony

Hom x Hom
20 Female
4 week range
Monthly

23 females x 0.54 = 12.4 pups/week
~6 females

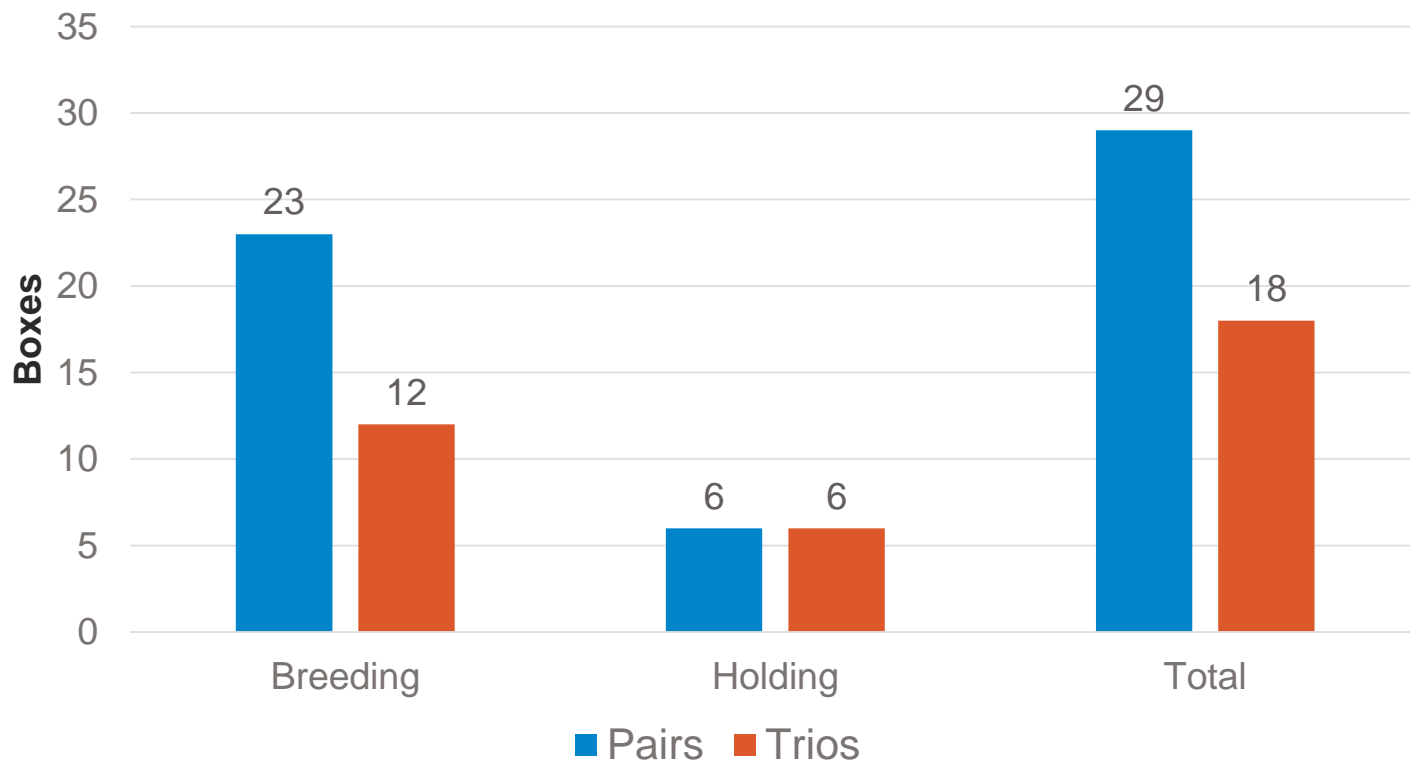


Can you make adjustments?



How Much Box Space Is Needed?

Hom x Hom
20 Female
4 week range
Monthly

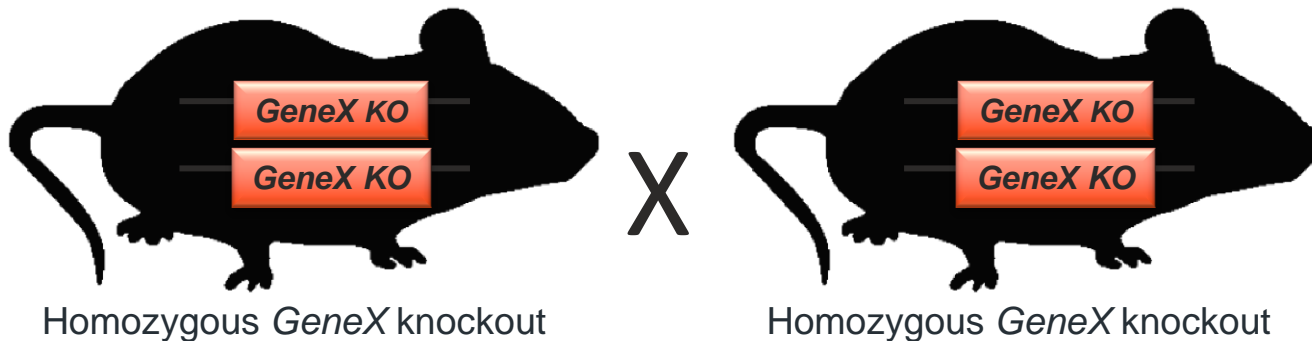


Do you have that much space?



Changing Number

- Homozygote X Homozygote

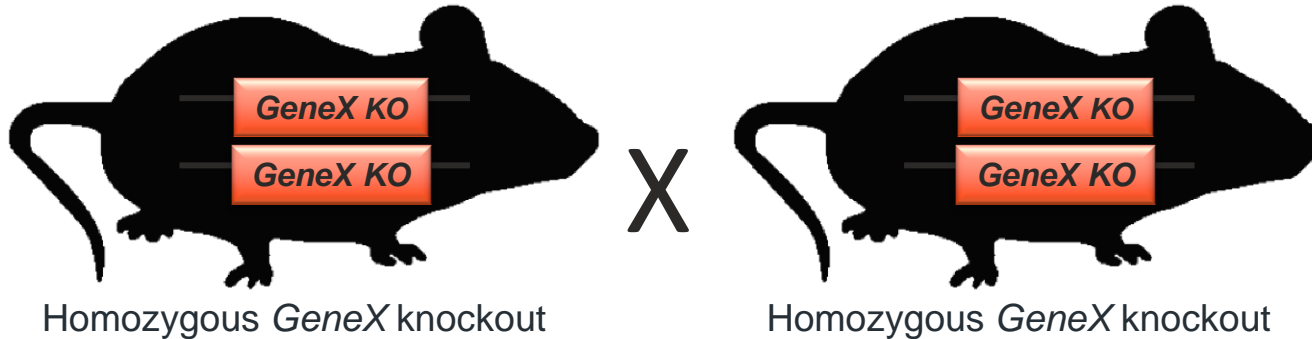


- 20 mixed sex homozygotes
- 5-8 weeks of age (4 week age range)
- Monthly (every 4 weeks)



Changing Number

- Homozygote X Homozygote



- **100** mixed sex homozygotes
- 5-8 weeks of age (4 week age range)
- Monthly (every 4 weeks)



Changing Number

Hom x Hom
100 Mixed Sex
4 week range
Monthly

Line 1: How many mice do you need?

20

100

Line 2: What age range?

4

4

Enter 1 if all need to be born in same week

Enter 2 if 2 week range, 3 if three week range, *etc.*

Line 3: How frequently do you need mice?

4

4

Enter 1 for weekly, 2 for every other week, 4 for monthly

Line 4: Divide Line 1 by smaller of Lines 2 or 3

5

25



Changing Number

Hom x Hom
100 Mixed Sex
4 week range
Monthly

Line 8: Calculate # mice you need weekly

5

25

Multiply Line 4 X Line 5 X Line 6 X Line 7

Round *up* to nearest whole number

(25 * 1 * 1 * 1)

25 mice per week x 4 weeks = 100 mice/month!

Calculate the number of breeding females needed



Changing Number

Hom x Hom
100 Mixed Sex
4 week range
Monthly

Line 13: Calculate number of breeding females

10	47
----	----

Divide Line 8 by Line 12

Round *up* to nearest whole number

(25 / 0.54)

47 females x 0.54 (wean/female/week) = 25.4 pups/week



Changing Number

Hom x Hom
100 Mixed Sex
4 week range
Monthly

Line 14: Replacement females needed weekly

0.5

2

Divide Line 13 by Line 11 (47 / 26)

Round *up* to nearest half

Do we need to factor in replacement breeders?



Changing Number

Hom x Hom
100 Mixed Sex
4 week range
Monthly

Need to factor in when: **YES**

- Experimental mice and breeders have same genotype
 - Homozygote x homozygote
 - Heterozygote x homozygote, using both sexes
 - Heterozygote/hemizygote x WT, using both sexes
- AND age range (weeks) \geq cohort frequency (weeks)
 - EX: 4 week range needed every 4 weeks



Changing Number

Hom x Hom
100 Mixed Sex
4 week range
Monthly

Line 14: Replacement females needed weekly

0.5

2

Divide Line 13 by Line 11 ($47 / 26$)

Round *up* to nearest half

Line 15: Additional females needed

2

8

Multiply Line 14 by 2 then divide by Line 12

Round *up* to nearest whole number

($2 * 2 / 0.54$)

Line 16: **Final number of females needed**

12

55

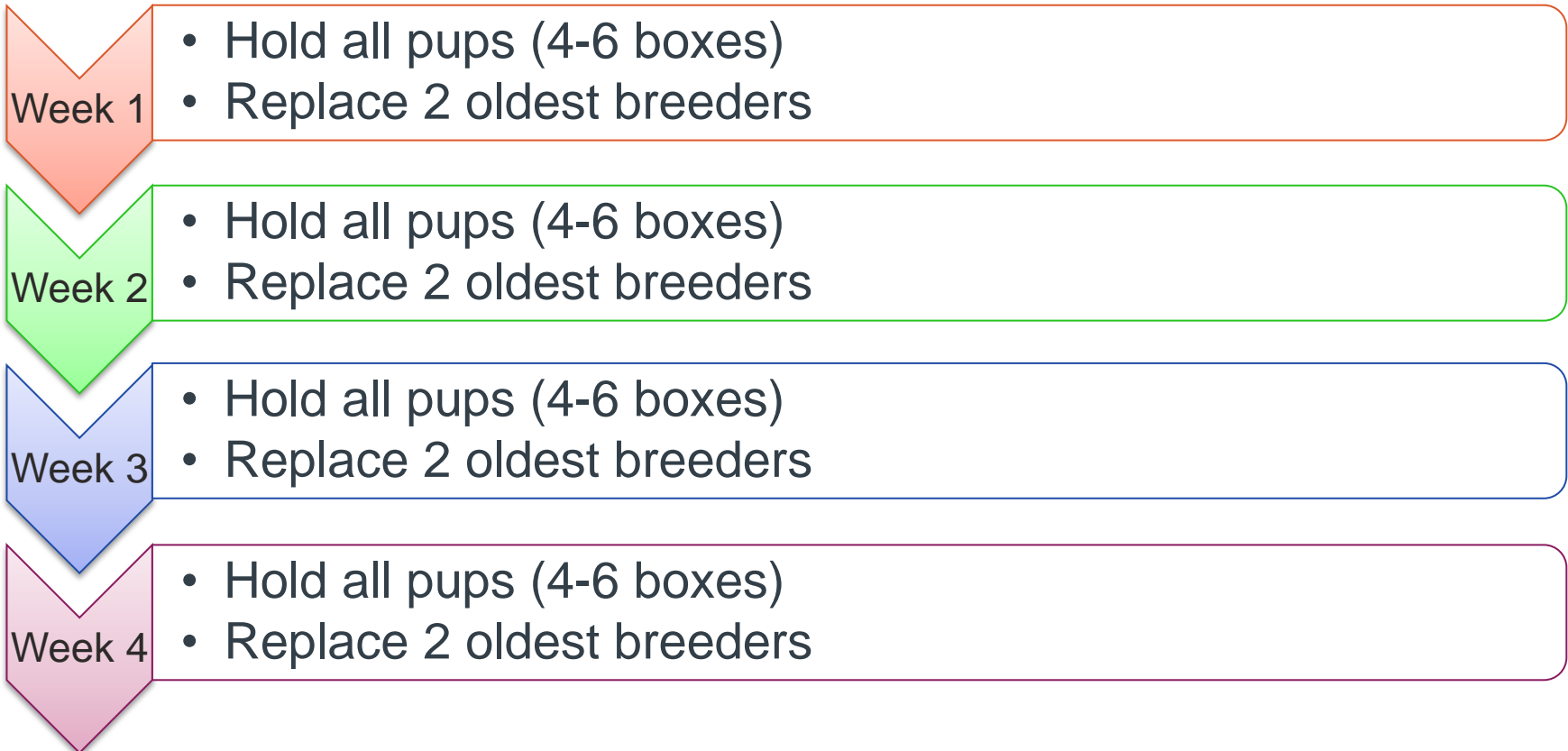
Add Line 13 and Line 15



Final Colony

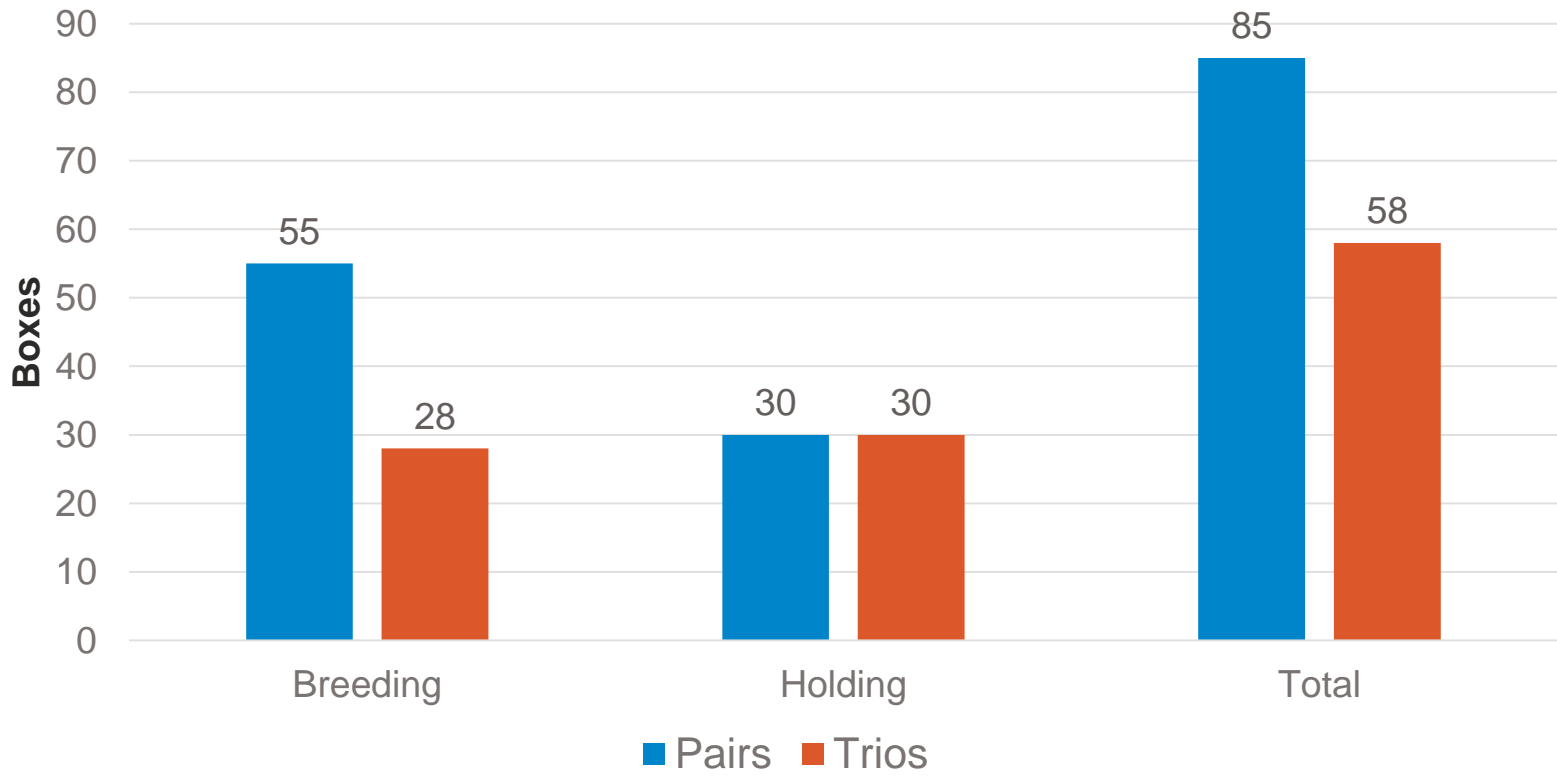
Hom x Hom
100 Mixed Sex
4 week range
Monthly

55 females x 0.54 = 29.7 pups/week



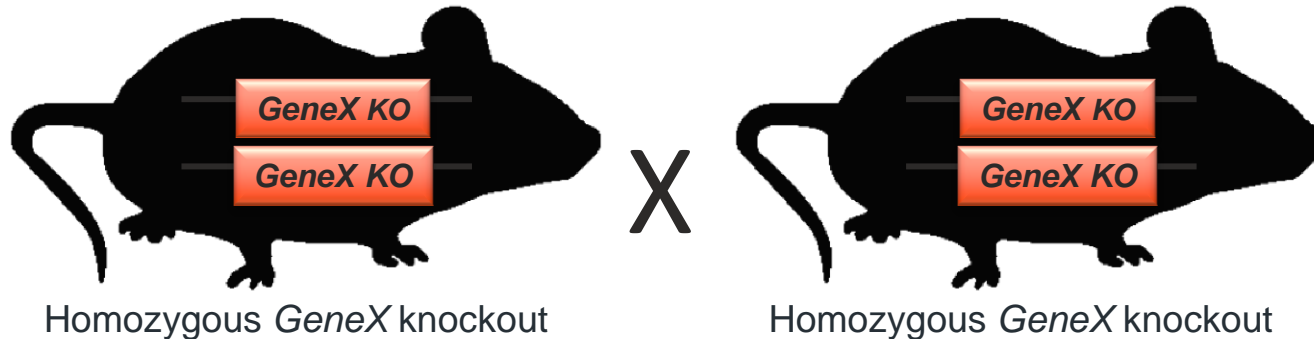
How Much Box Space Is Needed?

Hom x Hom
100 Mixed Sex
4 week range
Monthly



Changing Breeding Scheme

- Homozygote X Homozygote



- 20 mixed sex homozygotes
- 5-8 weeks of age (4 week age range)
- Monthly (every 4 weeks)



Changing Breeding Scheme

- Heterozygote X Heterozygote
 - Mixed genetic background
 - Homozygotes infertile
 - Area of research/journals require colony controls
- 20 mixed sex homozygotes
- 5-8 weeks of age (4 week age range)
- Monthly (every 4 weeks)



Changing Breeding Scheme

Het x Het
20 Mixed Sex
4 week range
Monthly

Line 5: What sex of mice?

Enter 1 if using both, enter 2 if using one sex

1	1
---	---

Line 6: What Breeding Scheme?

If Hom x Hom, enter 1

If Het x Hom (or recip), enter 2

If Het/Hemi x WT (or recip.), enter 2

If Het x Het, enter 4

1	4
---	---

Line 7: Can you use fewer mice?

If yes, enter 1

If no, enter “fudge factor” (1.1 for 10% over, 1.2 for 20%, *etc.*)

1	1
---	---



Changing Breeding Scheme

Het x Het
20 Mixed Sex
4 week range
Monthly

Line 8: Calculate # mice you need weekly

5

20

Multiply Line 4 X Line 5 X Line 6 X Line 7

Round *up* to nearest whole number

$(5 * 1 * 4 * 1)$

20 mice per week x 4 weeks = 80 mice/month!

Calculate the number of breeding females needed



Breeding Scheme

Het x Het
20 Mixed Sex
4 week range
Monthly

Line 13: Calculate number of breeding females

10

38

Divide Line 8 by Line 12

Round *up* to nearest whole number

(20 / 0.54)

38 females x 0.54 (wean/female/week) = 20.5 pups/week



Changing Breeding Scheme

Het x Het
20 Mixed Sex
4 week range
Monthly

Line 14: Replacement females needed weekly

0.5	1.5
-----	-----

Divide Line 13 by Line 11
Round *up* to nearest half
(38 / 26)

Do we need to factor in replacement breeders?



Replacement Breeders

Het x Het
20 Mixed Sex
4 week range
Monthly

May not need to factor: **NO**

- When experimental mice and breeders have *different* genotypes
 - Heterozygote x heterozygote
 - Heterozygote x homozygote, using one sexes
 - Heterozygote/hemizygote x WT, using one sexes
- OR age range (weeks) < cohort frequency (weeks)
 - EX: 2 week age range needed every 4 weeks



Changing Breeding Scheme

Het x Het
20 Mixed Sex
4 week range
Monthly

38 females x 0.54 = 20.5 pups/week

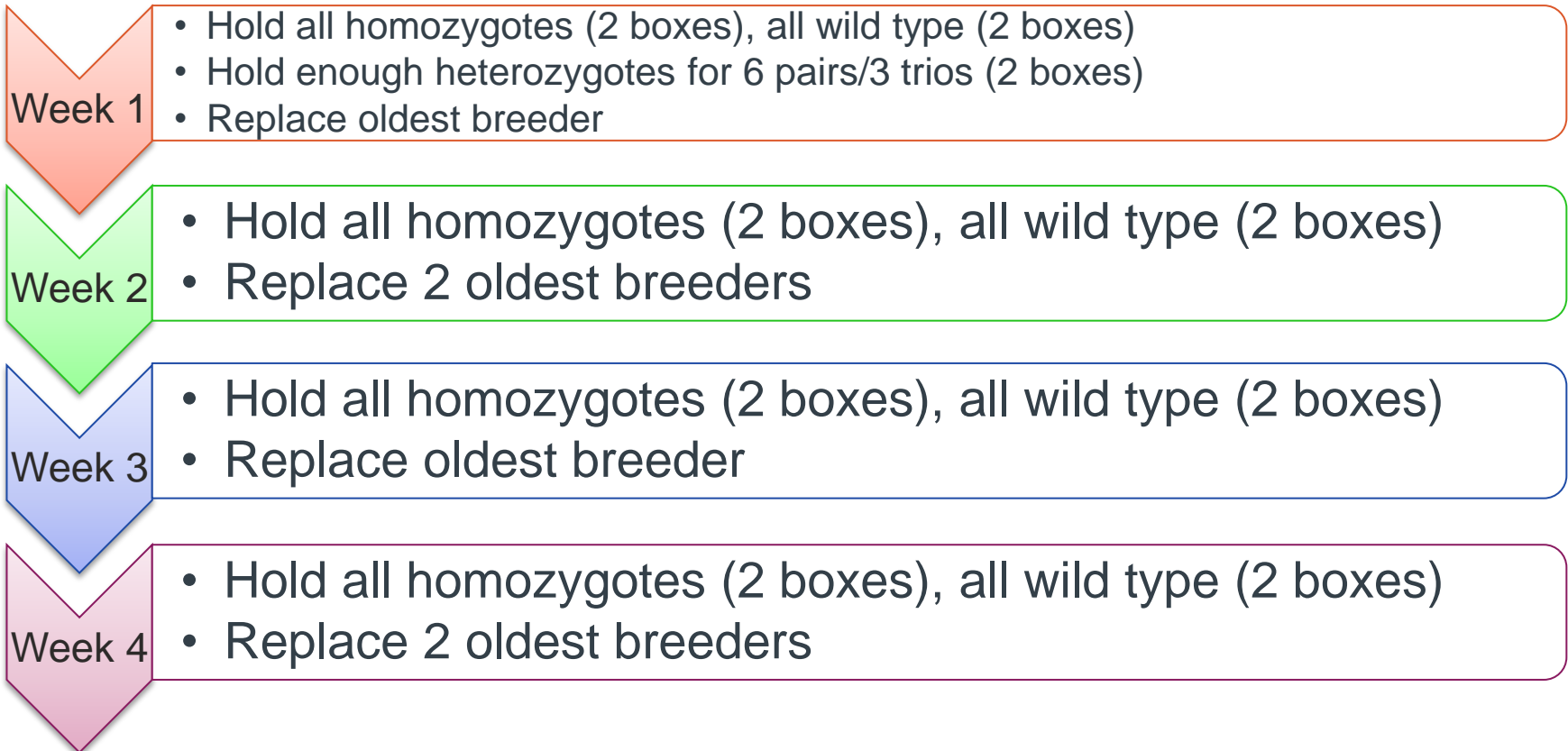
- 5 Homozygotes
 - Hold for experiments
- 10 Heterozygotes
 - Replacement breeders
 - Discard remaining
- 5 Wild type
 - Hold for controls



Final Colony

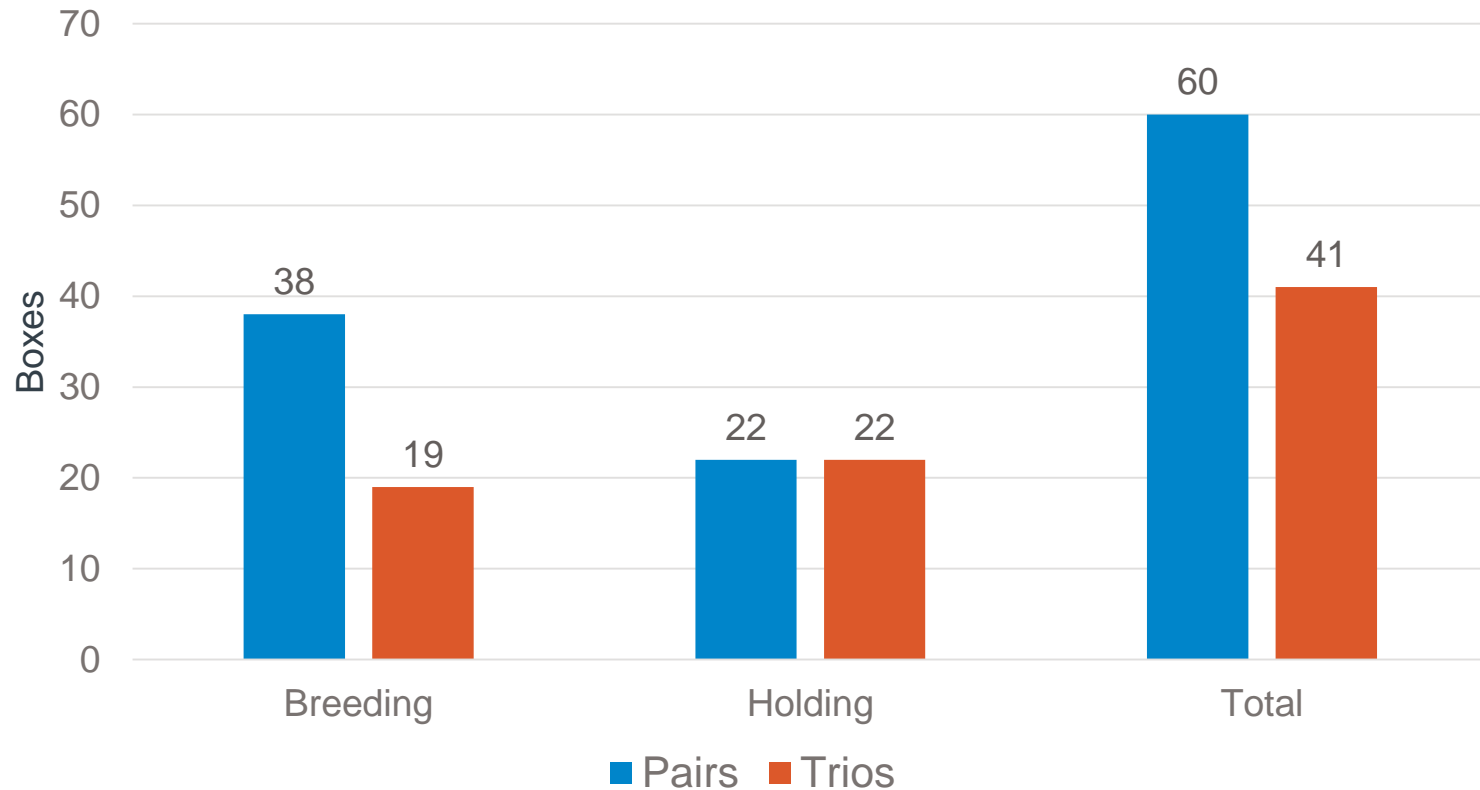
Het x Het
20 Mixed Sex
4 week range
Monthly

38 females x 0.54 = 20.5 pups/week



How Much Box Space Is Needed?

Het x Het
20 Mixed Sex
4 week range
Monthly



Controls included!



Your Total Costs



- Monetary
 - Per Diems
 - If supplemented, overhead from grants may be funding
 - Technician salary
 - Genotyping
- Time used to manage colonies
 - Collecting/analyzing breeding data
 - Planning
- Space for colonies



Colony Management Tips

- Mate early (4-12 weeks)



- Choose breeders carefully
 - Avoid selection pressure
- Replace breeders on a rotation (monthly)
 - Mixed-age colony breeds more consistently
 - Requires having young breeders available
- Replace non-productive breeders ASAP (60-90 days)
- Collect your own breeding statistics
 - Evaluate regularly



Other Factors That Impact Breeding

- Pedigree/lineage tracking
- Health status
- Good quality diet
 - Q/C ensuring consistency
 - Variation can impact breeding and weights
- Technician training and experience
 - Detect problems earlier
- Consistency (SOPs)
 - Following protocols



Review of Learning Goals

- Breeding performance data collection
- Define research needs
- Calculate # of breeders (females) needed
 - Steady state
 - How decisions impact colony size
- Adjusting research needs to existing resources





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Thank you!

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