USING THE BREEDER'S EQUATION
ANGELL*BIO 150

Write out the Breeders Equation here_____**$R=h^2S$**_____

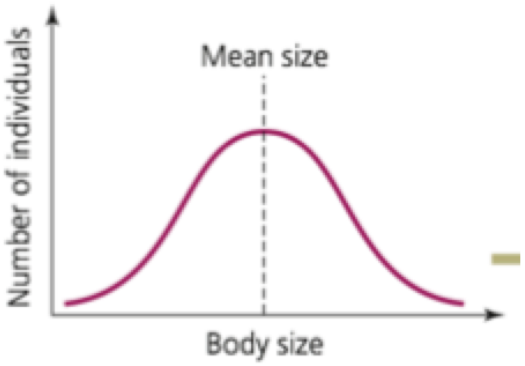
Hibernation is a critical time for brown or grizzly bears (*Ursus arctos)* since, like other bears such as the black bear, they are unable to eat. Individuals that enter hibernation with a high weight are likely to make it to the spring. Those that do not add enough weight may die before spring comes. Search for links to "Fat Bear Week" to learn more. https://www.npr.org/2019/10/06/767384374/its-fat-bear-week-in-alaska-s-katmai-national-park-time-to-fill-out-your-bracket

1. Imagine the graph to the right shows a population of bears and the distribution of body weight in this population as bears are getting ready to hibernate.

Show **strong directional selection** for body size by shading in the part of the curve that is likely to include survivors. For example, perhaps the mean body weight or body size is 300 lbs. Imagine that only bears greater than 400 lbs survive to produce offspring.

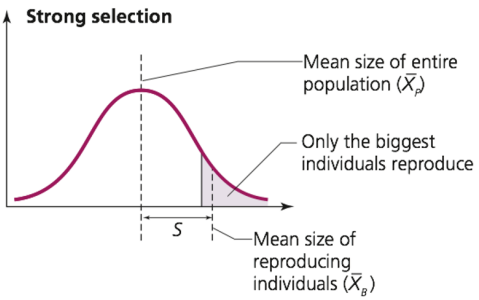
Sketch a vertical line where you predict the **mean** would be for the survivors or selected individuals (those over 400lbs).

The selection differential (S) is the mean of the selected or surviving population minus the mean of the original (or parental population). Label the selection differential on the graph.



300lbs

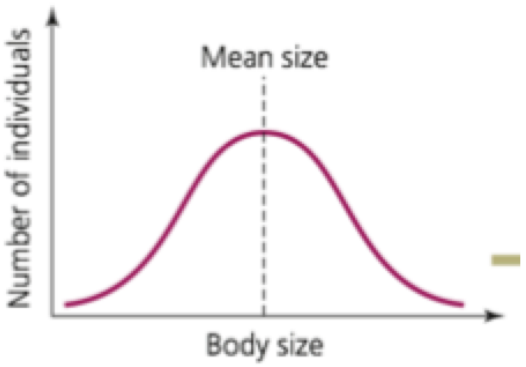
Maybe something that looks like this??



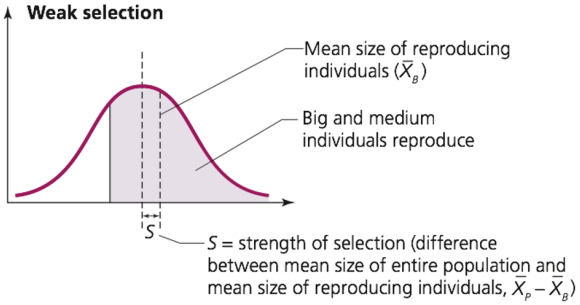
2. Now show **weak directional selection** for body size. Once again shade the survivors but this time allow more individuals of moderate body weights to survive.

Add a vertical line where you predict the mean would be for the survivors or selected individuals.

Label the selection differential (S).



Maybe something that looks like this...?



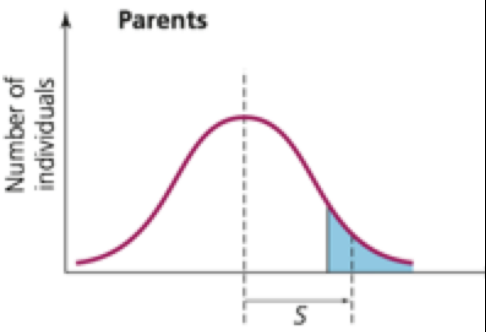
3. Now lets think about the **response** (R) to selection. All else being equal, which of the two populations above will have a greater response to selection and why?

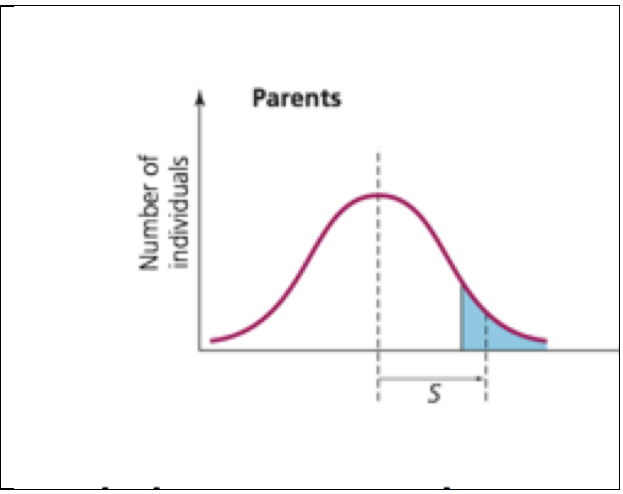
You should expect the stronger directional selection for body size to result in a greater response to selection.

4. How will the population shown to the right respond in the next generation if the heritability is 0?

Sketch a curve representing the distribution of body size in the next generation.

If you select a subset of the population and there is no heritability you will simply get the same shaped curve (maybe fewer individuals).



5. What if heritability is 1? What will happen? Again sketch a curve showing how it will shift in the next generation. ***If you select a subset of the population and the heritability is 1 then the mean in the next generation will be the same as those in the selected.***	

6. Lets go back to our bears. Assume the narrow sense heritability is .5. If you have a population of grizzly bears where the mean weight upon entering hibernation is 300 lbs and no bears survive the winter unless they are at least 400 lbs, then in the next generation you would expect the bears to be how much heavier?

So in this one I gave you a cutoff so you just might want to imagine what the mean for those survivors would be. Here I assumed the mean was 420 (since the cutoff was 400). You might have chosen something else.

$R=h^2S$
R=.5 (420-300)
R=60lbs
This means you would expect the next generation to be 60lbs heavier than the previous generation.

Of course we are assuming that the total parental bear population passes away etc…(unreasonable expectations for bears but anyway).

7. A sunflower population has a mean of 100 days to flowering. Two parents were selected that had a mean of 90 days to flowering. The quantitative trait days to flowering has a narrow sense heritability of 0.2. What would be the mean of a population derived from crossing these two parents? (This is a bit tricky because we are selecting for more rapid flowering-or fewer days to flowering- rather than greater body weight.)

$R=h^2S$
R=.2(90-100)

R=.2(-10)
R=-2

This means that the population would respond by flowering two days earlier than the original 100 days. So would flower at 98 days. Here days to flowering was reduced.

8. Imagine that a plant breeder is involved in a selective breeding project with the aim of increasing the number of kernels per ear of corn. Lets assume that the average ear of corn in the parent generation has 100 kernels. Let us also assume that the selected parents produce corn with an average of 120 kernels per ear. If the narrow sense heritability is .5 for this trait, how much would you expect the number of kernals to increase in the next generation?

$R=h^2S$

R=.5(120-100)
R=10
Here the response to selection would be 10, so we add that to the 100 kernals of the parental population and get 110!