**Brain-Storm: How could you find the population of beans in the jar quickly?**

**There are Four Ways to Determine Population Size**

**1. Direct Observation-Count the number of organisms in natural setting ecosystem.**

*Examples*: Counting the number of starfish or counting students sitting in class

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| Pros | Cons |
| -Accurate-Precise-Reliable, because it isn’t an estimate | -Not practical: -Cannot do this in large areas-Best if organisms don’t move-Gives a limited view (only as many as you can count/see) |

**2. Indirect Observation-Observe signs of the organism and count the signs instead of the organisms themselves.**

*Examples*: Counting the number of nests in a tree and multiplying by the number of birds usually found in the nests. Counting tracks in the snow.

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| Pros | Cons |
| -Sometimes easier/safer to count signs not mobile organisms-Easy to calculate-Can add to research | -An estimate-You need to know some info (like kind of tracks, # of birds in a nest)-Still hard to do in large areas-Signs can be hard to interpret: (Did one bear walk in circles or are there 2 bears?) |

**3. Sampling- (Random Sampling) Make an estimate by counting the number of organisms in a small area and then multiplying it to find the number of organisms in the larger area.**

*Examples*: Counting houses on one street in Beachwood, and multiplying by the number of streets in Beachwood to find the total number of houses.

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| Pros | Cons |
| -Estimate, but can be reasonable-Concentrates on a small area and multiply to find a big area.-Actually counting organisms | -Estimate, can be thrown off by lack of data or too much data in another area-Small area needs to represent total area-Needs to be random |

**4. Mark-and Recapture Studies- Collect a group of organisms and label the organisms. Release them. Then later collect another group. Count the ones with marks, do calculations to estimate total number.**

*Examples*: Banding of birds, marking of turtles/cattle/deer.

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| Pros | Cons |
| -Gather data over time: YEARLY TRENDSEstimate but can be reasonable-Can make other observations like health of organisms-Can gather other data at the same time | -Estimate-lengthy calculations-Time consuming-Dependent on capturing organisms-Assume all organisms have the same ability to get captured |

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**Populations can Change in Size**

1. Populations can increase in size through \_\_\_**birth­­**\_\_\_ and \_\_\_**immigration**\_\_.
2. Populations can decrease in size through \_\_**death**\_\_\_ and \_\_**emigration**\_\_\_.
3. What is the easiest method to depict population size changes**? Mark-and-Recapture is the easiest because you can collect data over months of years by recapturing again.**
4. If the birth rate is > than the death rate the population \_\_**increases**\_\_\_.
5. If the birth rate is < than the death rate the population \_\_**decreases**\_\_\_.
6. What is the difference between immigration and emigration? **Immigration- means that organisms are moving IN “I”=IN**; **Emigration- means that organisms are moving out or EXITING “E” = EXIT**

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**Three more Important Factors in Population Size are:**

**1. Population Density- the amount of individuals in an area**

*Examples*: 20 butterflies in 10 square feet, # of people in room

**2. Limiting Factors- an environmental condition that does not all the population to increase, or forces a decrease.**

 *Examples*: Food, Water, Weather Conditions, Space, Air, Sunlight

**3. Carrying Capacity- the largest population that the environment can support** *Examples*: (Bucket holds only 2 liters of water any more it over flows….Ecosystem can only have some many of a plant or animal or they leave/die.) Ex 2: An elevator can hold 1000lbs….any more the elevator does not work.