Assignment 3: Data Exploration

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OVERVIEW

This exercise accompanies the lessons in Environmental Data Analytics on Data Exploration.

Directions

1. Change "Student Name, Section #" on line 3 (above) with your name and section number.
2. Work through the steps, **creating code and output** that fulfill each instruction.
3. Be sure to **answer the questions** in this assignment document.
4. When you have completed the assignment, **Knit** the text and code into a single PDF file.
5. After Knitting, submit the completed exercise (PDF file) to the dropbox in Sakai. Add your last name into the file name (e.g., "FirstLast_A03_DataExploration.Rmd") prior to submission.

The completed exercise is due on <>.

Set up your R session

1. Check your working directory, load necessary packages (tidyverse), and upload two datasets: the ECOTOX neonicotinoid dataset (ECOTOX_Neonicotinoids_Insects_raw.csv) and the Niwot Ridge NEON dataset for litter and woody debris (NEON_NIWO_Litter_massdata_2018-08_raw.csv). Name these datasets "Neonics" and "Litter", respectively. **Be sure to add the `stringsAsFactors = TRUE` parameter to the function when reading in the CSV files.**

```
getwd()
```

```
## [1] "C:/Users/Jackie/Box/Classes Spring 2022/Environmental Data Analytics/Environmental_Data_Analyti
```

```
library(tidyverse)
Neonics <- read.csv("/Users/Jackie/Box/Classes Spring 2022/Environmental Data Analytics/Environmental_Da
#stringAsFactors changes characters to factor for analysis
Litter <- read.csv("/Users/Jackie/Box/Classes Spring 2022/Environmental Data Analytics/Environmental_Da
```

Learn about your system

2. The neonicotinoid dataset was collected from the Environmental Protection Agency's ECOTOX Knowledgebase, a database for ecotoxicology research. Neonicotinoids are a class of insecticides used widely in agriculture. The dataset that has been pulled includes all studies published on insects. Why might we be interested in the ecotoxicologoy of neonicotinoids on insects? Feel free to do a brief internet search if you feel you need more background information.

Answer:

3. The Niwot Ridge litter and woody debris dataset was collected from the National Ecological Observatory Network, which collectively includes 81 aquatic and terrestrial sites across 20 ecoclimatic domains. 32 of these sites sample forest litter and woody debris, and we will focus on the Niwot Ridge long-term ecological research (LTER) station in Colorado. Why might we be interested in studying litter and woody debris that falls to the ground in forests? Feel free to do a brief internet search if you feel you need more background information.

   Answer:

4. How is litter and woody debris sampled as part of the NEON network? Read the NEON_Litterfall_UserGuide.pdf document to learn more. List three pieces of salient information about the sampling methods here:

   Answer: *

Obtain basic summaries of your data (Neonics)

5. What are the dimensions of the dataset? A: 4623 x 30

```
dim(Neonics)
```

```
## [1] 4623   30
```

6. Using the `summary` function on the "Effect" column, determine the most common effects that are studied. Why might these effects specifically be of interest?

```
NeonicsEffects <- summary(Neonics$Effect)
sort(NeonicsEffects)
```

```
##       Hormone(s)        Histology       Physiology          Cell(s)
##                1                5                7                9
##     Biochemistry     Accumulation     Intoxication    Immunological
##               11               12               12               16
##       Morphology           Growth        Enzyme(s)         Genetics
##               22               38               62               82
##        Avoidance      Development     Reproduction Feeding behavior
##              102              136              197              255
##         Behavior        Mortality       Population
##              360             1493             1803
```

   Answer: The most common effects studied are Population, Mortality, Behavior, Feeding behavior, Reproduction, Avoidance and Development. The effects of this insecticide on insects in these categories could be of interest to researches because they provide insight into the physiological effects of the insecticide on the basic life cycle functions of insects.

7. Using the `summary` function, determine the six most commonly studied species in the dataset (common name). What do these species have in common, and why might they be of interest over other insects? Feel free to do a brief internet search for more information if needed.

```
NeonicsSpecies <- summary(Neonics$Species.Common.Name)
sort(NeonicsSpecies, decreasing = TRUE)
```

```
##                          (Other)                       Honey Bee
##                              670                             667
##                   Parasitic Wasp             Buff Tailed Bumblebee
##                              285                             183
##               Carniolan Honey Bee                      Bumble Bee
##                              152                             140
##                  Italian Honeybee                  Japanese Beetle
##                              113                              94
##                 Asian Lady Beetle                  Euonymus Scale
##                               76                              75
##                         Wireworm                European Dark Bee
##                               69                              66
##                 Minute Pirate Bug              Asian Citrus Psyllid
##                               62                              60
##                    Parastic Wasp            Colorado Potato Beetle
##                               58                              57
##                  Parasitoid Wasp              Erythrina Gall Wasp
##                               51                              49
##                     Beetle Order       Snout Beetle Family, Weevil
##                               47                              47
##           Sevenspotted Lady Beetle                  True Bug Order
##                               46                              45
##              Buff-tailed Bumblebee                    Aphid Family
##                               39                              38
##                   Cabbage Looper              Sweetpotato Whitefly
##                               38                              37
##                   Braconid Wasp                   Cotton Aphid
##                               33                              33
##                   Predatory Mite            Ladybird Beetle Family
##                               33                              30
##                       Parasitoid                    Scarab Beetle
##                               30                              29
##                   Spring Tiphia                     Thrip Order
##                               29                              29
##               Ground Beetle Family               Rove Beetle Family
##                               27                              27
##                   Tobacco Aphid                    Chalcid Wasp
##                               27                              25
##             Convergent Lady Beetle                  Stingless Bee
##                               25                              25
##                Spider/Mite Class              Tobacco Flea Beetle
##                               24                              24
##                 Citrus Leafminer                  Ladybird Beetle
##                               23                              23
##                        Mason Bee                        Mosquito
##                               22                              22
##                     Argentine Ant                         Beetle
##                               21                              21
##         Flatheaded Appletree Borer             Horned Oak Gall Wasp
##                               20                              20
```

```
##                Leaf Beetle Family                   Potato Leafhopper
##                                20                                  20
##         Tooth-necked Fungus Beetle                       Codling Moth
##                                20                                  19
##          Black-spotted Lady Beetle                       Calico Scale
##                                18                                  18
##                Fairyfly Parasitoid                        Lady Beetle
##                                18                                  18
##             Minute Parasitic Wasps                          Mirid Bug
##                                18                                  18
##                  Mulberry Pyralid                           Silkworm
##                                18                                  18
##                     Vedalia Beetle                Araneoid Spider Order
##                                18                                  17
##                         Bee Order                     Egg Parasitoid
##                                17                                  17
##                       Insect Class             Moth And Butterfly Order
##                                17                                  17
##       Oystershell Scale Parasitoid Hemlock Woolly Adelgid Lady Beetle
##                                17                                  16
##              Hemlock Wooly Adelgid                               Mite
##                                16                                  16
##                      Onion Thrip                Western Flower Thrips
##                                16                                  15
##                     Corn Earworm                  Green Peach Aphid
##                                14                                  14
##                         House Fly                           Ox Beetle
##                                14                                  14
##                 Red Scale Parasite                  Spined Soldier Bug
##                                14                                  14
##              Armoured Scale Family                   Diamondback Moth
##                                13                                  13
##                     Eulophid Wasp                  Monarch Butterfly
##                                13                                  13
##                     Predatory Bug                Yellow Fever Mosquito
##                                13                                  13
##                Braconid Parasitoid                       Common Thrip
##                                12                                  12
##       Eastern Subterranean Termite                             Jassid
##                                12                                  12
##                         Mite Order                          Pea Aphid
##                                12                                  12
##                   Pond Wolf Spider             Spotless Ladybird Beetle
##                                12                                  11
##              Glasshouse Potato Wasp                           Lacewing
##                                10                                  10
##             Southern House Mosquito             Two Spotted Lady Beetle
##                                10                                  10
##                          Ant Family                       Apple Maggot
##                                 9                                   9
```

```
#you can also do this, which just gives top four:
head(summary(Neonics$Species.Common.Name))
```

```
##             Honey Bee        Parasitic Wasp Buff Tailed Bumblebee
##                   667                       285                   183
##   Carniolan Honey Bee            Bumble Bee      Italian Honeybee
##                   152                       140                   113
```

Answer: The top six species are Honey Bee, Parasitic Wasp Buff, Tailed Bumblebee, Carniolan Honey Bee, The "other" category which is the largest

8. Concentrations are always a numeric value. What is the class of Conc.1..Author. in the dataset, and why is it not numeric?

```
class(Neonics$Conc.1..Author.)
```

```
## [1] "factor"
```

```
head(Neonics$Conc.1..Author.)
```

```
## [1] 27.2 19.7 47   25   13   268
## 1006 Levels: ~10 ~30/ ~40/ ~41 <0.0004 <0.025 <0.088 <0.5 <1.5 <10/ ... NR/
```

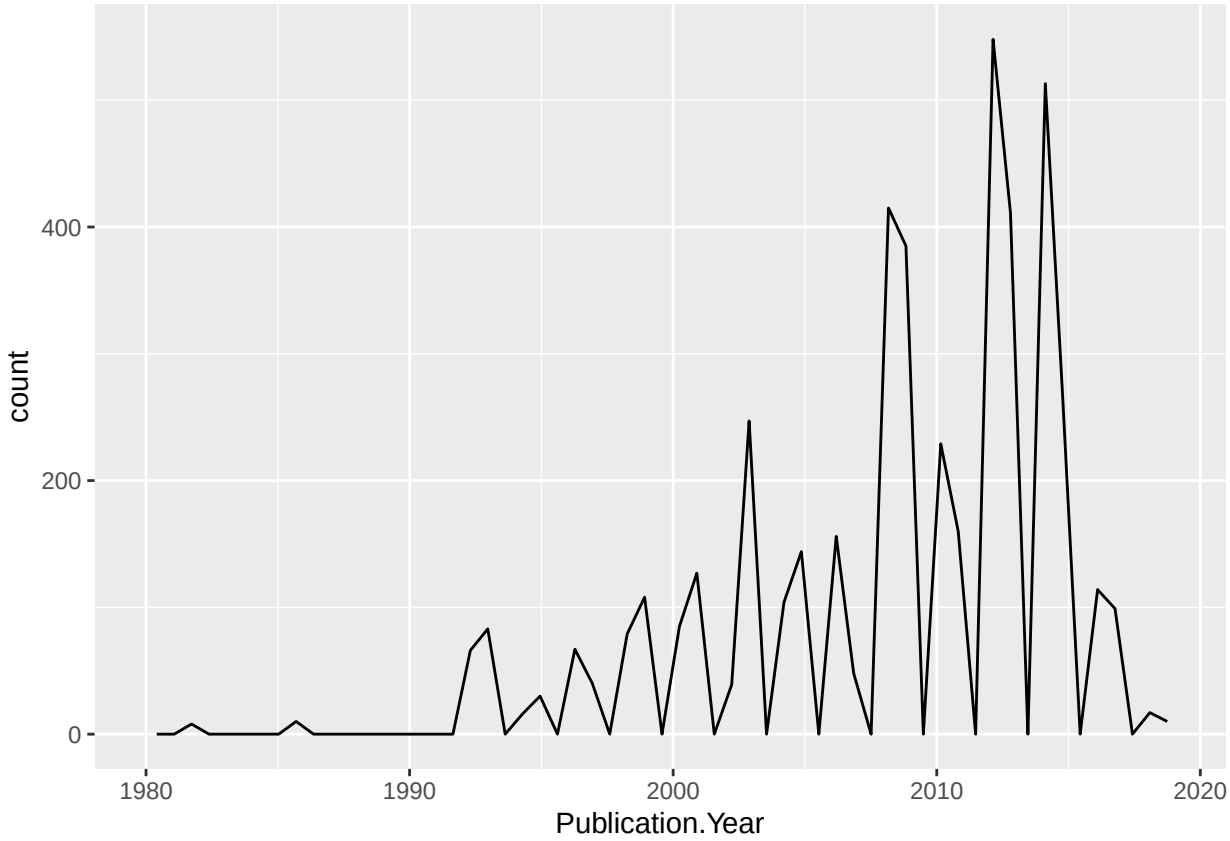
Answer: The class of this variable is "factor". The reason it is a factor instead of a number is because the numbers have sympols in them such as > and ~

Explore your data graphically (Neonics)

9. Using `geom_freqpoly`, generate a plot of the number of studies conducted by publication year.

```
ggplot(Neonics)+
  geom_freqpoly(aes(x = Publication.Year), bins = 60)+ #what should I set my bins to??
  scale_x_continuous(limits = c(1980, 2019))
```

```
## Warning: Removed 3 row(s) containing missing values (geom_path).
```

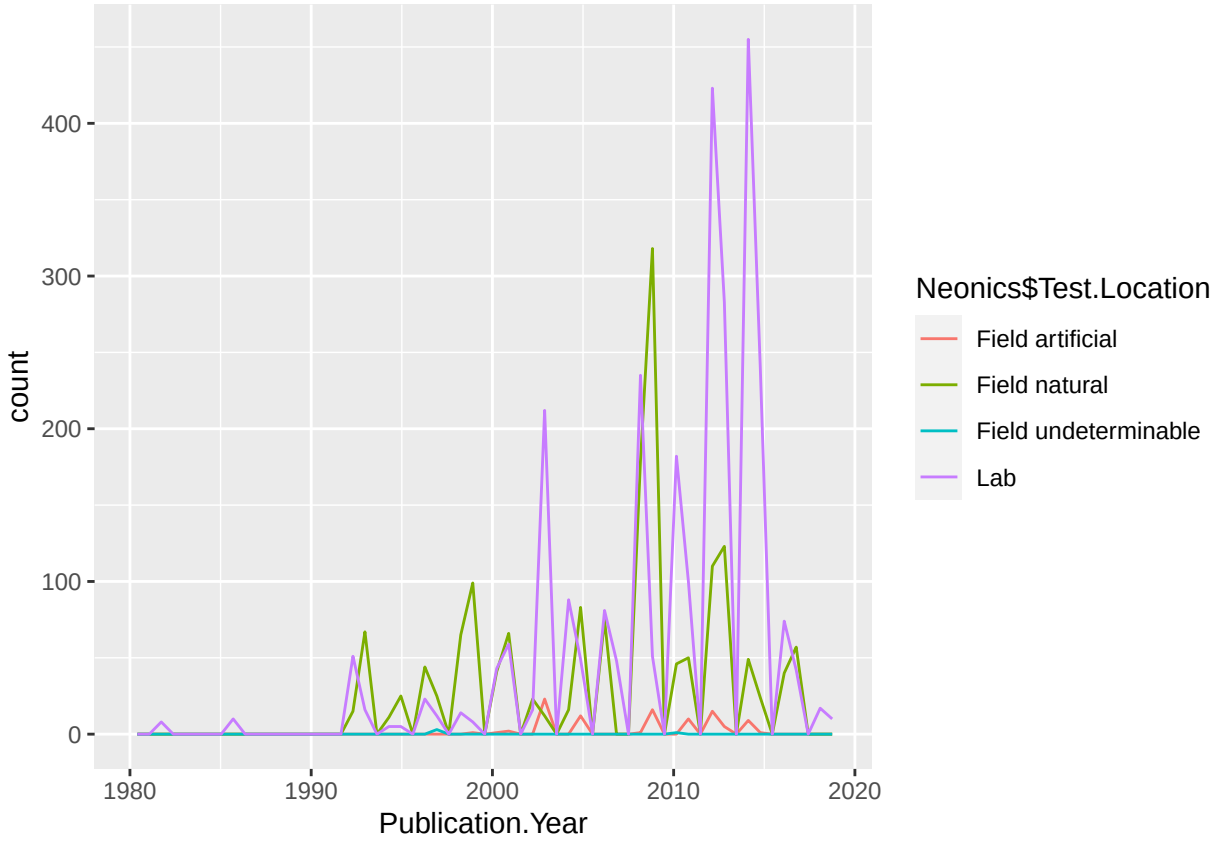


10. Reproduce the same graph but now add a color aesthetic so that different Test.Location are displayed as different colors.

```
ggplot(Neonics)+
  geom_freqpoly(aes(x = Publication.Year, color = Neonics$Test.Location), bins = 60)+ #what should I se
  scale_x_continuous(limits = c(1980, 2019))
```

```
## Warning: Use of `Neonics$Test.Location` is discouraged. Use `Test.Location`
## instead.
```

```
## Warning: Removed 12 row(s) containing missing values (geom_path).
```



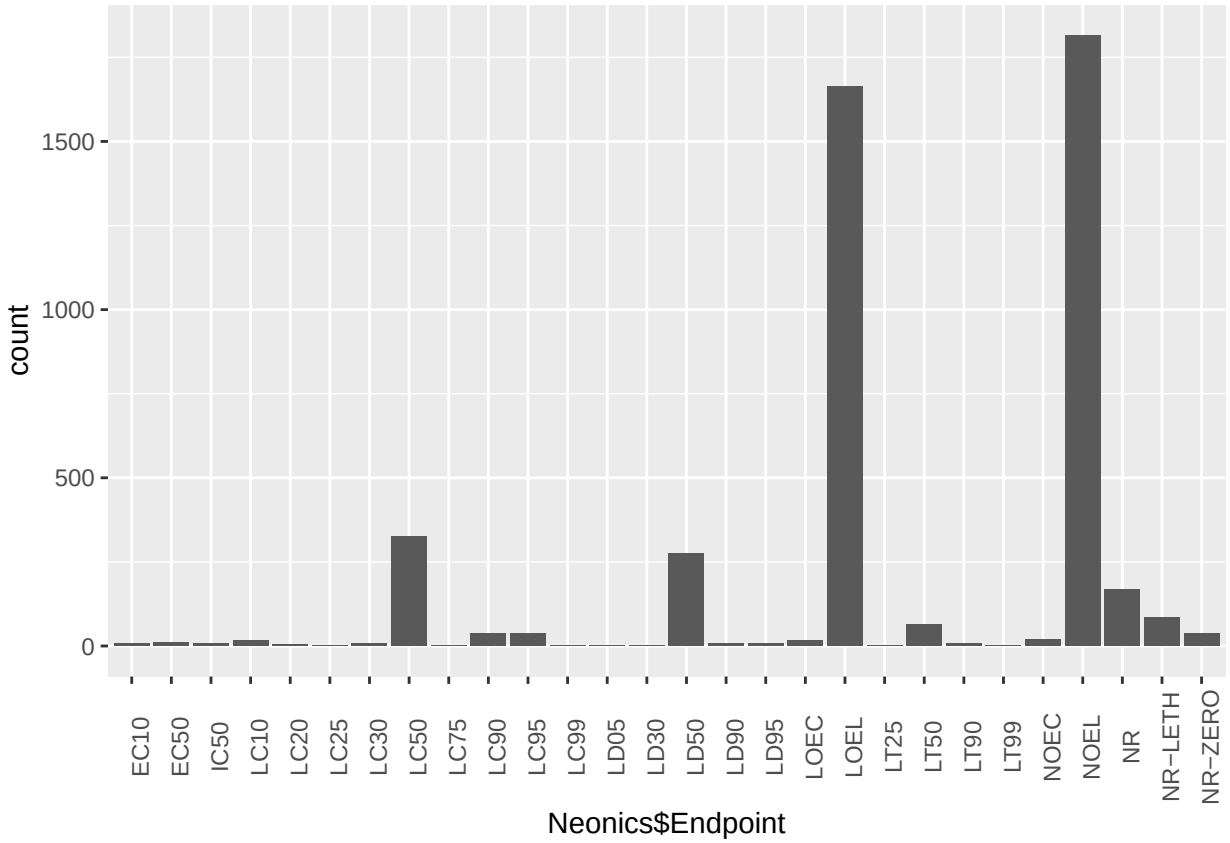
Interpret this graph. What are the most common test locations, and do they differ over time?

> Answer: From the 1980s until the early 2000s, the most common testing locations were "field natural". From the early 2000s until the present the lab studies have become the dominant study type and location.

11. Create a bar graph of Endpoint counts. What are the two most common end points, and how are they defined? Consult the ECOTOX_CodeAppendix for more information.

```
ggplot(Neonics)+
  geom_bar(aes(Neonics$Endpoint))+
  theme(axis.text.x = element_text(angle = 90)) #rotates text element of X axis
```

```
## Warning: Use of `Neonics$Endpoint` is discouraged. Use `Endpoint` instead.
```



Answer: The two most common endpoints by far are LOEL and NOEL. LOEL stands for "lowest observable effect level" which is the lowest concentration that produces effects that are significantly different than the controls, in a terrestrial environment. NOEL is also a terrestrial measurement and stands for "No Observable Effect Level" and is inversely the highest concentration which does not produce significantly different responses from those of the controls.

Explore your data (Litter)

12. Determine the class of collectDate. Is it a date? If not, change to a date and confirm the new class of the variable. Using the `unique` function, determine which dates litter was sampled in August 2018.

```
class(Litter$collectDate) #currently factor
```

```
## [1] "factor"
```

```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

```
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
Litter$collectDate <- ymd(Litter$collectDate) #overwritting litter column
class(Litter$collectDate)
```

```
## [1] "Date"
```

```
unique(Litter$collectDate)#collected on "2018-08-02" and "2018-08-30"
```

```
## [1] "2018-08-02" "2018-08-30"
```

13. Using the `unique` function, determine how many plots were sampled at Niwot Ridge. How is the information obtained from `unique` different from that obtained from `summary`?

```
?unique
```

```
## starting httpd help server ... done
```

```
unique(Litter$namedLocation)
```

```
##  [1] NIWO_061.basePlot.ltr NIWO_064.basePlot.ltr NIWO_067.basePlot.ltr
##  [4] NIWO_040.basePlot.ltr NIWO_041.basePlot.ltr NIWO_063.basePlot.ltr
##  [7] NIWO_047.basePlot.ltr NIWO_051.basePlot.ltr NIWO_058.basePlot.ltr
## [10] NIWO_046.basePlot.ltr NIWO_062.basePlot.ltr NIWO_057.basePlot.ltr
## 12 Levels: NIWO_040.basePlot.ltr ... NIWO_067.basePlot.ltr
```

```
summary(Litter$namedLocation)
```

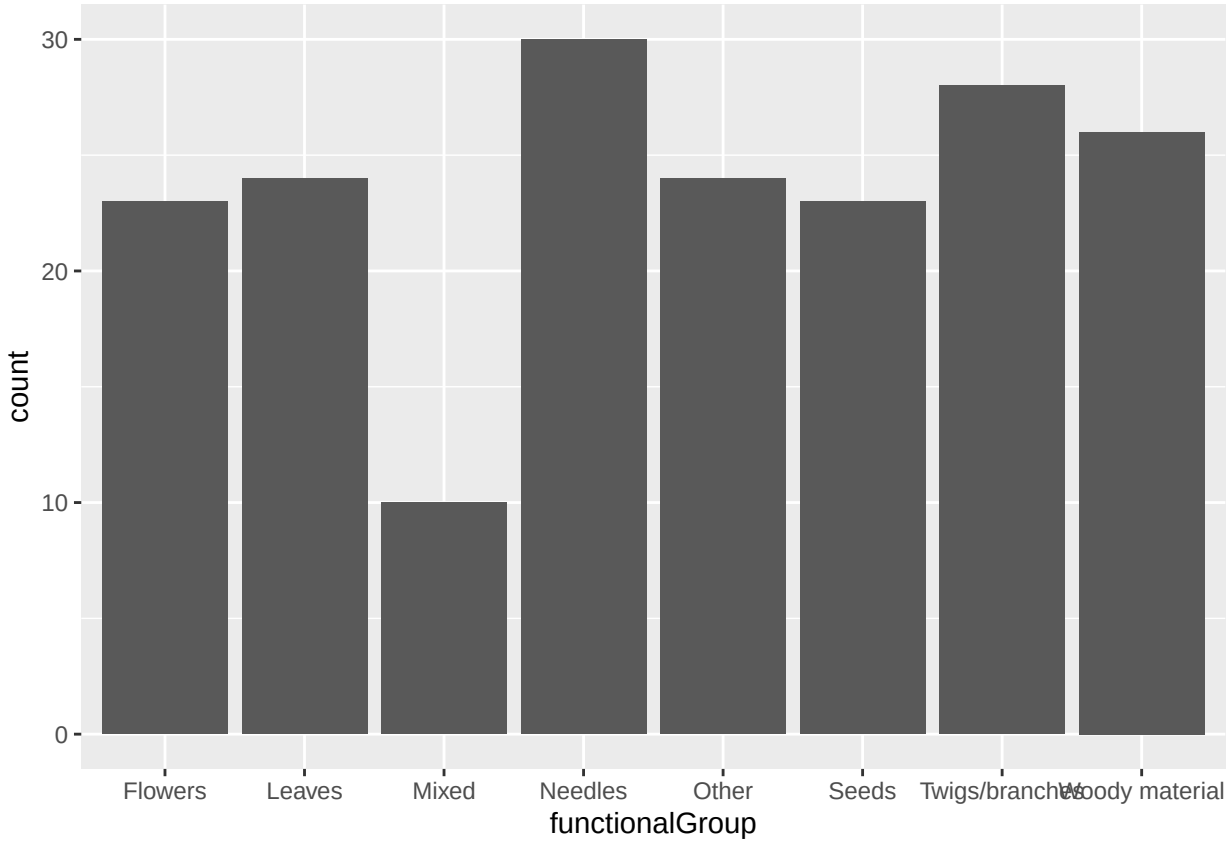
```
## NIWO_040.basePlot.ltr NIWO_041.basePlot.ltr NIWO_046.basePlot.ltr
##                    20                    19                    18
## NIWO_047.basePlot.ltr NIWO_051.basePlot.ltr NIWO_057.basePlot.ltr
##                    15                    14                     8
## NIWO_058.basePlot.ltr NIWO_061.basePlot.ltr NIWO_062.basePlot.ltr
##                    16                    17                    14
## NIWO_063.basePlot.ltr NIWO_064.basePlot.ltr NIWO_067.basePlot.ltr
##                    14                    16                    17
```

```
###come back to this one
```

Answer:

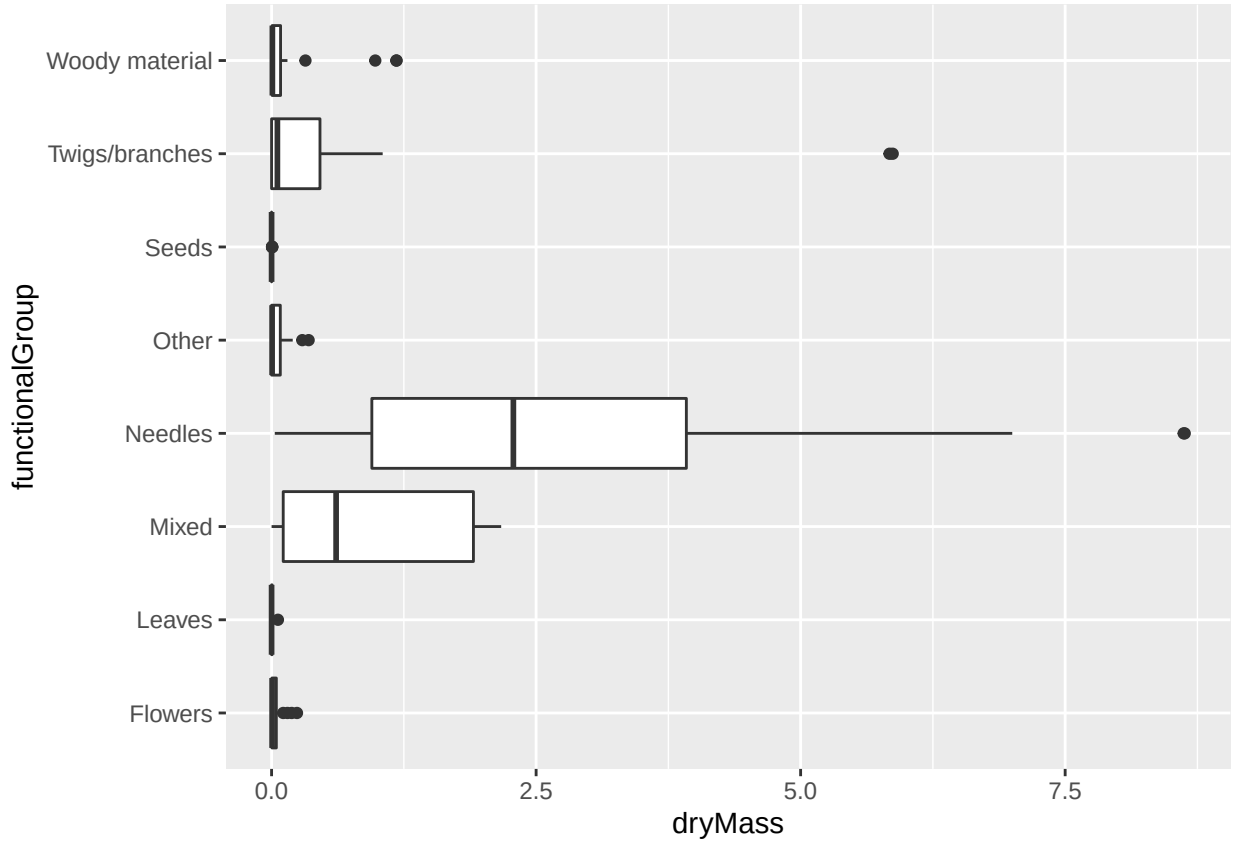
14. Create a bar graph of functionalGroup counts. This shows you what type of litter is collected at the Niwot Ridge sites. Notice that litter types are fairly equally distributed across the Niwot Ridge sites.

```
ggplot(Litter, aes(x = functionalGroup))+
  geom_bar()
```



15. Using `geom_boxplot` and `geom_violin`, create a boxplot and a violin plot of dryMass by functionalGroup.

```
ggplot(Litter) +
  geom_boxplot(aes(x = dryMass, y = functionalGroup))
```

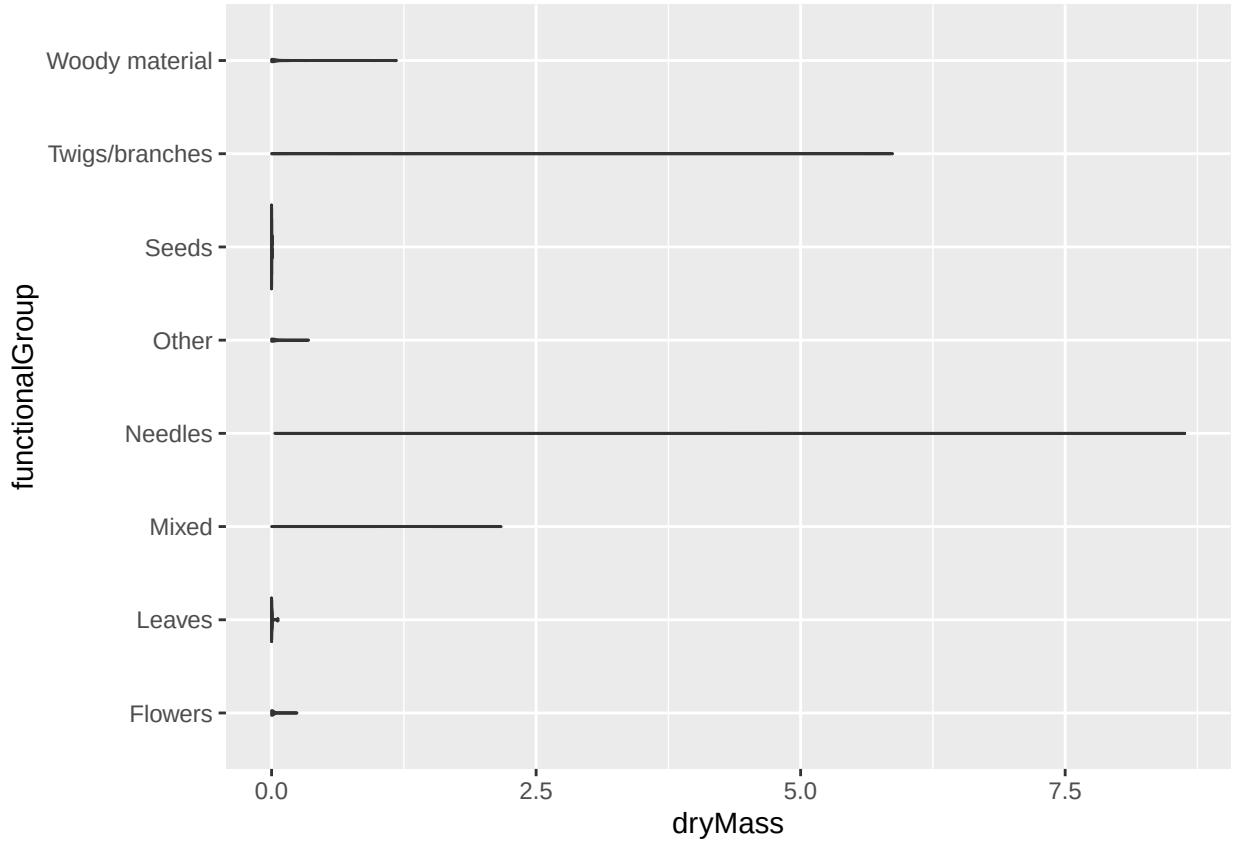



```
ggplot(Litter) +
  geom_violin(aes(x = dryMass, y = functionalGroup),
              draw_quantiles = c(0.25, 0.5, 0.75))
```

```
## Warning in regularize.values(x, y, ties, missing(ties), na.rm = na.rm):
## collapsing to unique 'x' values

## Warning in regularize.values(x, y, ties, missing(ties), na.rm = na.rm):
## collapsing to unique 'x' values

## Warning in regularize.values(x, y, ties, missing(ties), na.rm = na.rm):
## collapsing to unique 'x' values
```




```
###need help with this error message
```

Why is the boxplot a more effective visualization option than the violin plot in this case?

Answer:

What type(s) of litter tend to have the highest biomass at these sites?

Answer: