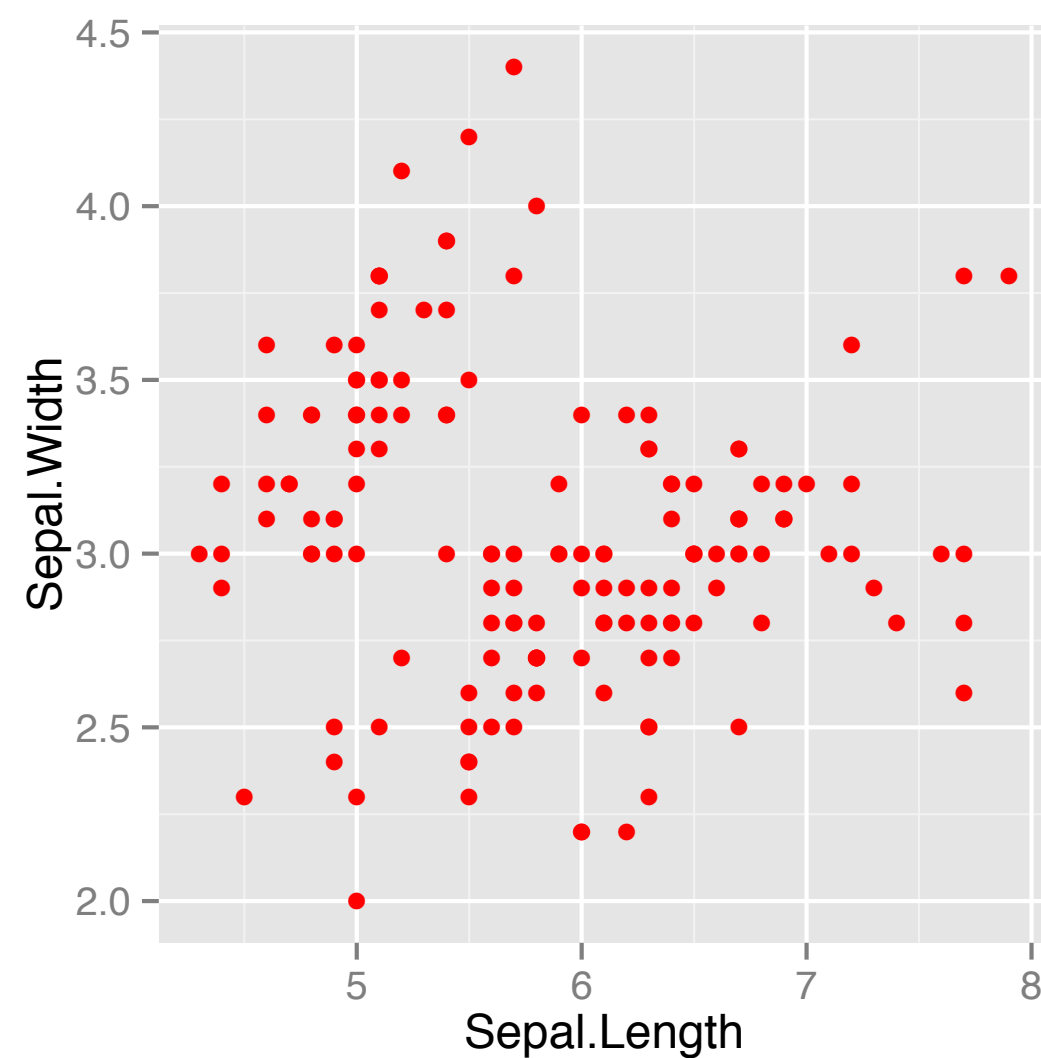




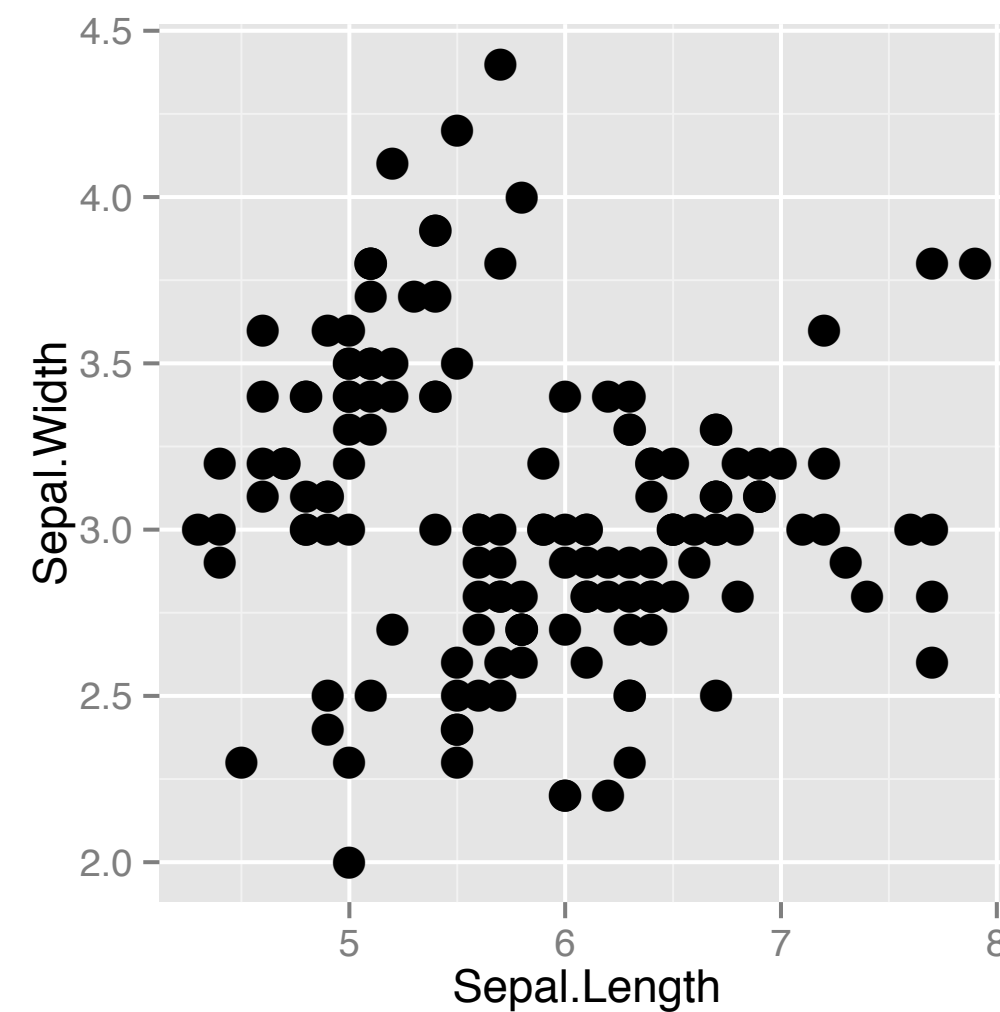
DATA VISUALIZATION WITH GGPLOT2

Visible Aesthetics

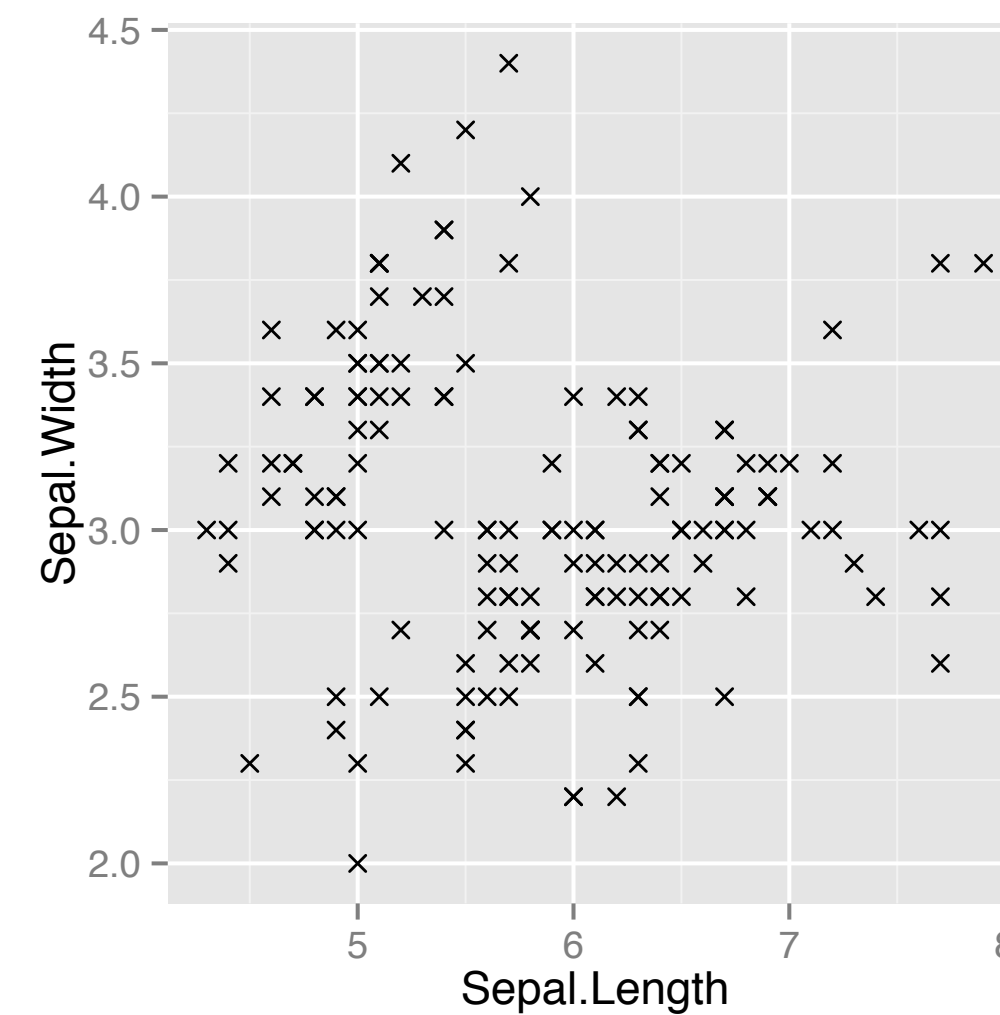
Aesthetics? Attributes!



Type	Property
Colour	Red



Type	Property
Size	10



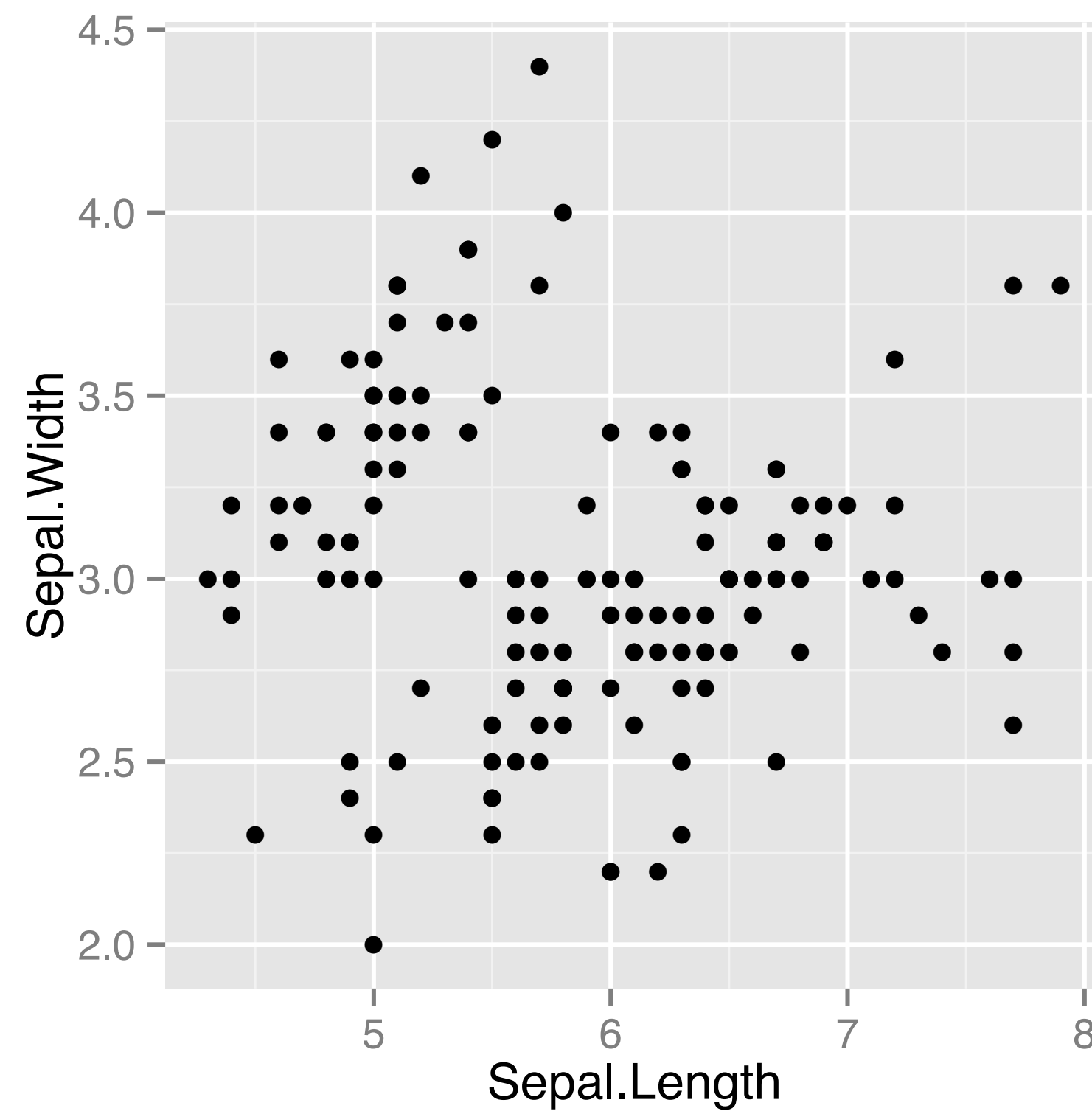
Type	Property
Shape	4

Type	Variable
Colour	Species

mapping Species on colour

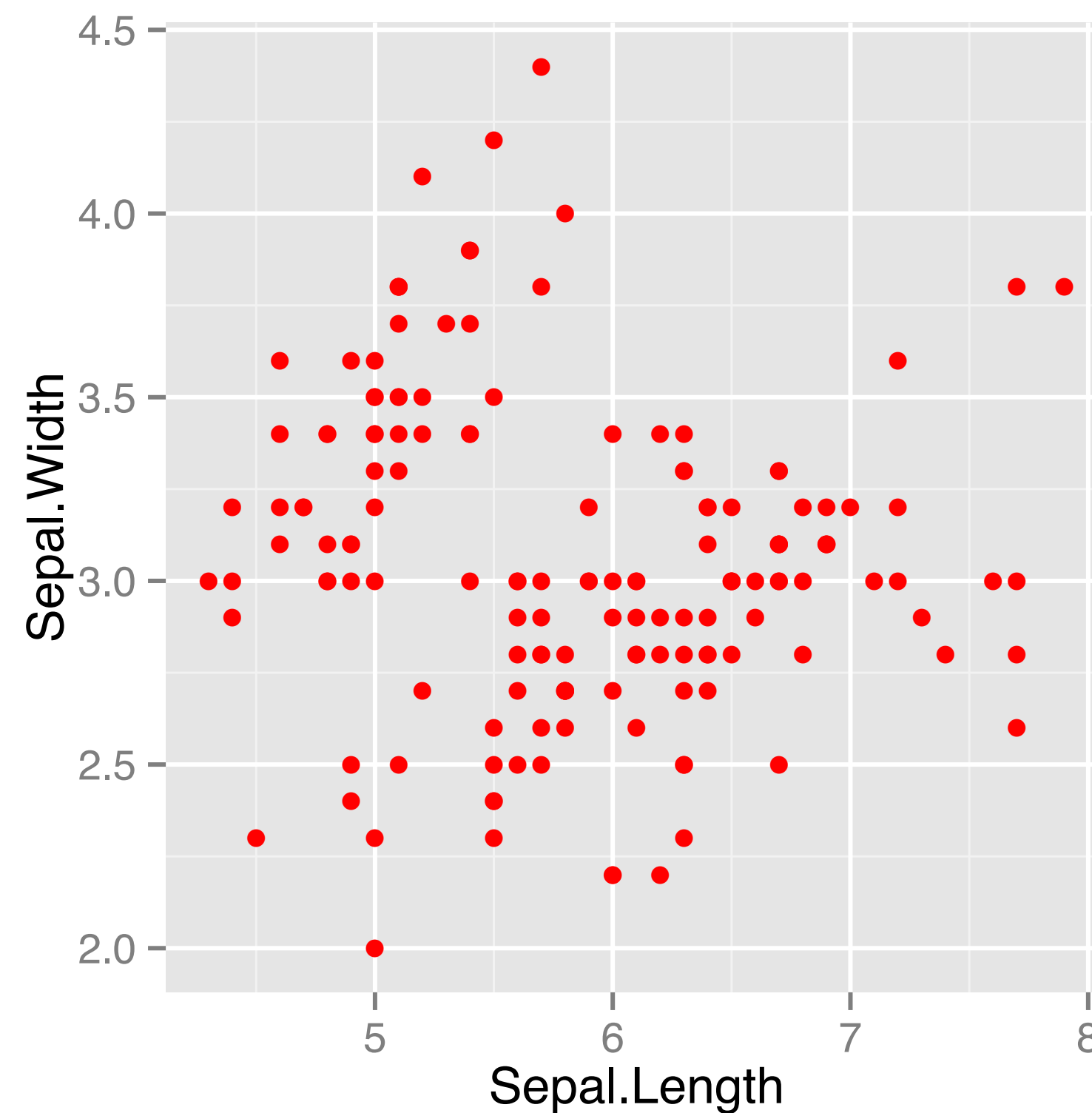
Mapping

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) +  
  geom_point()
```



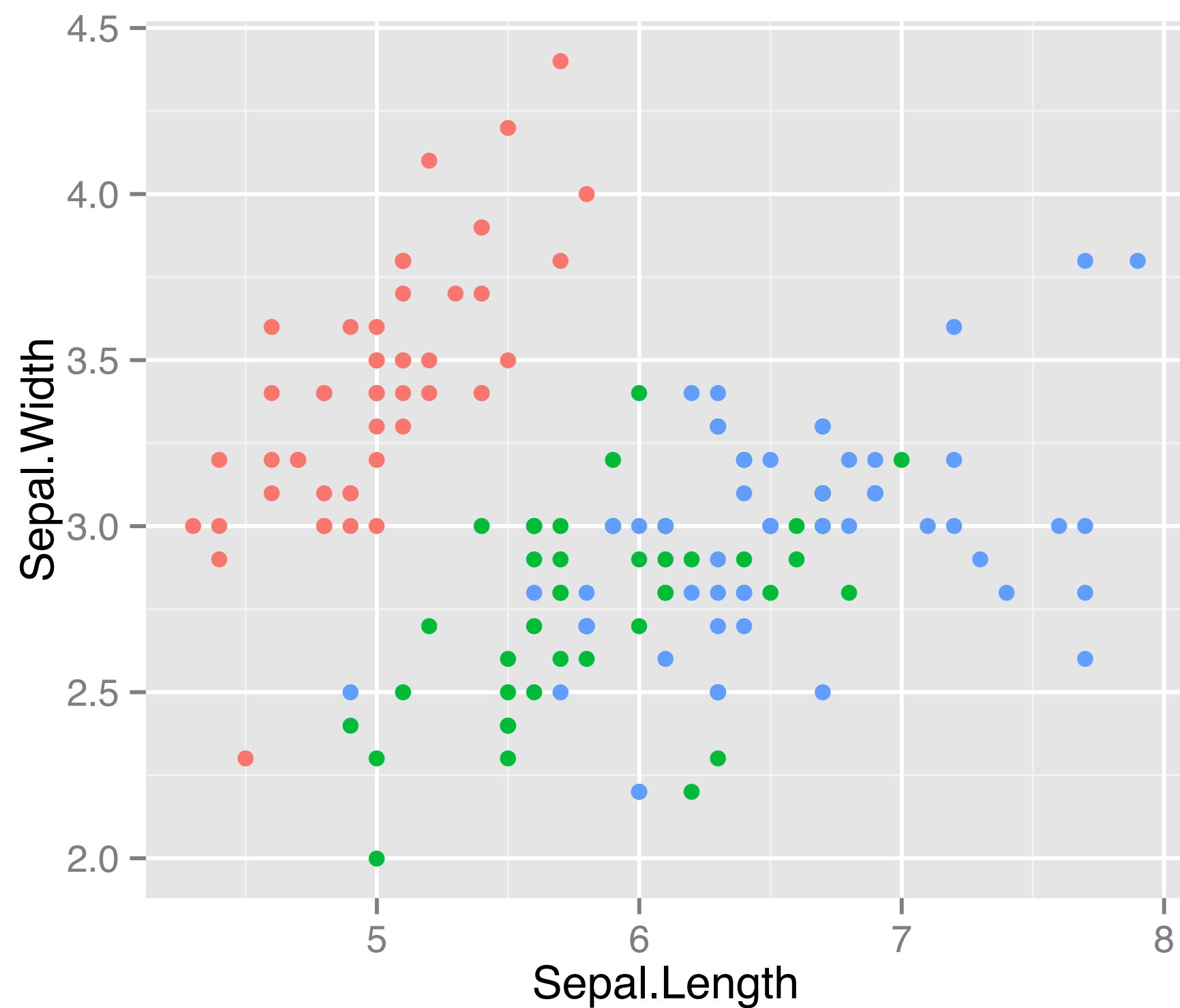
Attribute

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) +  
  geom_point(col = "red")
```



Mapping onto color

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width,  
                  col = Species)) +  
  geom_point()
```



Data frame column mapped onto visible aesthetic

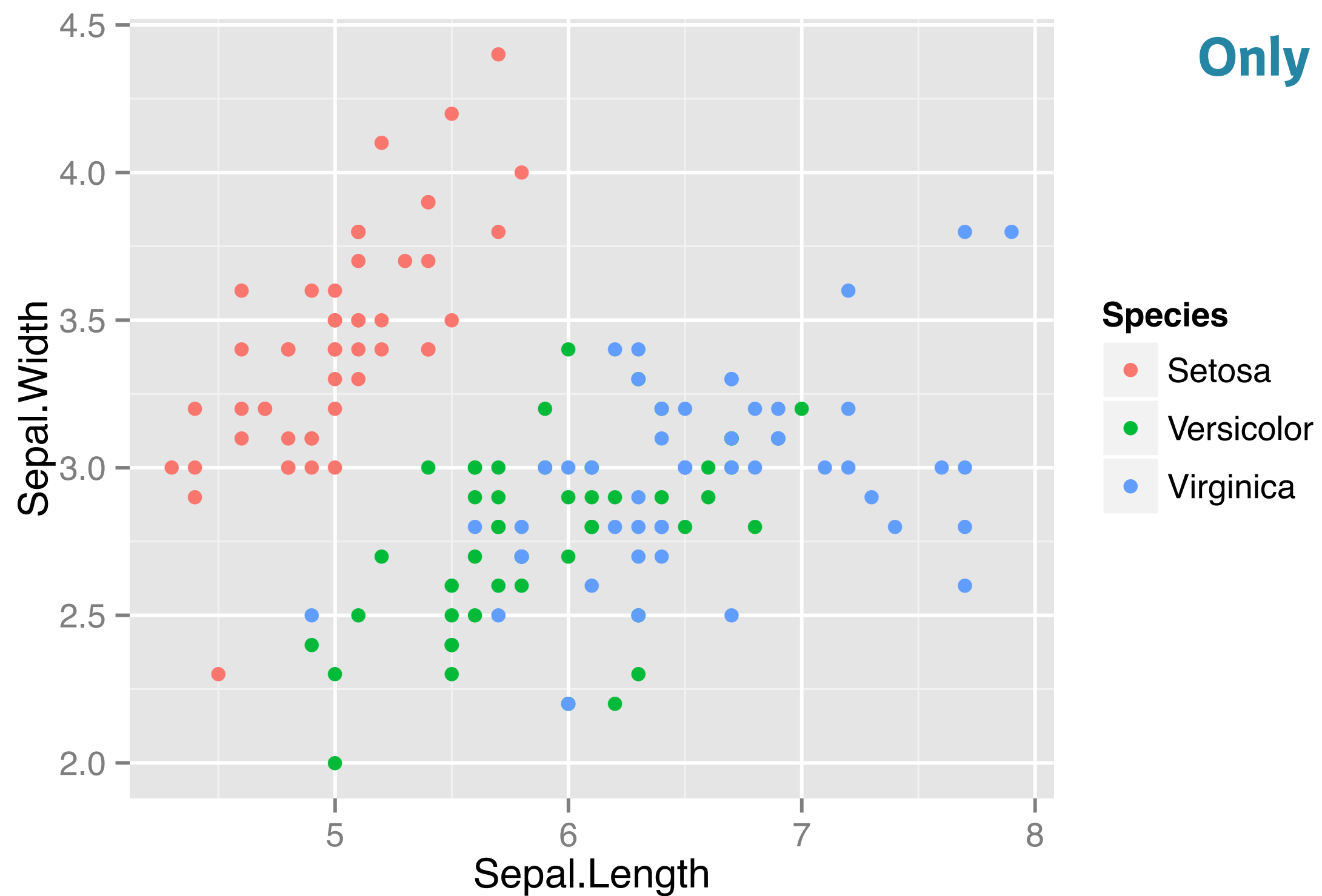
Aesthetics in aes(), attributes in geom_()

Species

- Setosa
- Versicolor
- Virginica

Mapping onto color (2)

```
> ggplot(iris) +  
  geom_point(aes(x = Sepal.Length, y = Sepal.Width,  
                 col = Species))
```



Only if different data sources

Typical Aesthetics

Aesthetic	Description
x	X axis position
y	Y axis position
colour	Colour of dots, outlines of other shapes
fill	Fill colour
size	Diameter of points, thickness of lines
alpha	Transparency
linetype	Line dash pattern
labels	Text on a plot or axes
shape	Shape



DATA VISUALIZATION WITH GGPLOT2

Let's practice!



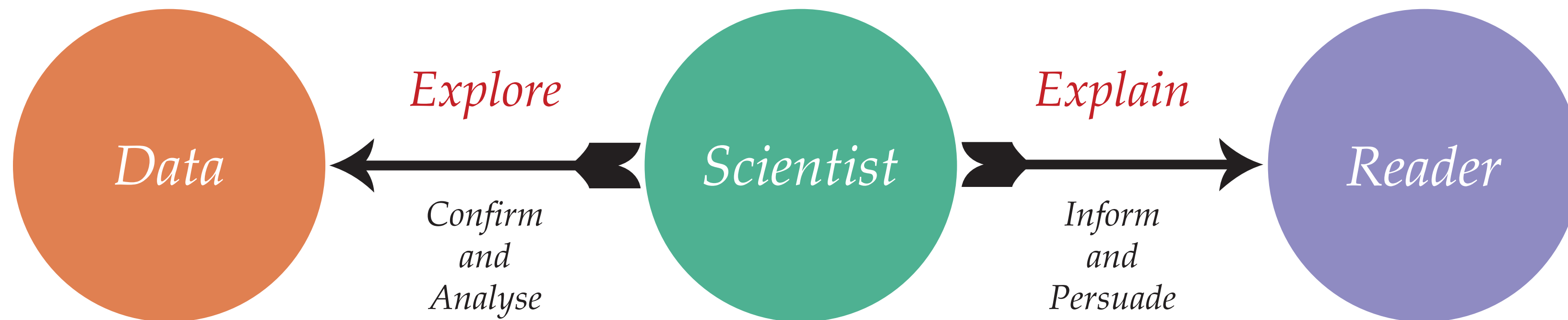
DATA VISUALIZATION WITH GGPLOT2

Aesthetics Best Practices

Which Aesthetic?

- Be creative
- Clear guidelines
- Jacques Bertin
 - *The Semiology of Graphics*, 1967
- William Cleveland
 - Perception of visual elements (90s)

Form follows Function

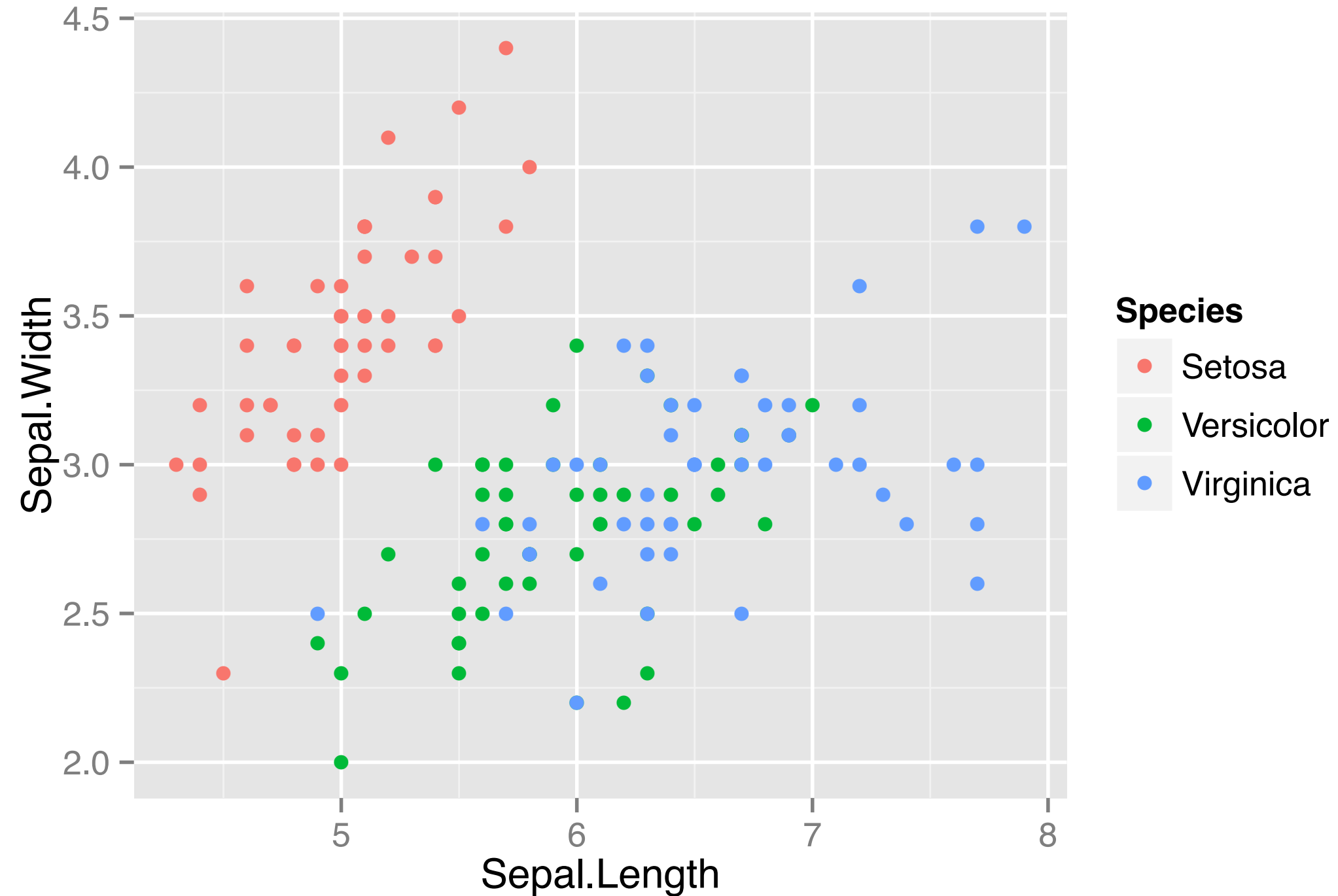


Aesthetics

Aesthetic	Description
x	X axis position
y	Y axis position
colour	Colour of dots, outlines of other shapes
fill	Fill colour
size	Diameter of points, thickness of lines
alpha	Transparency
linetype	Line dash pattern
labels	Text on a plot or axes
shape	Shape

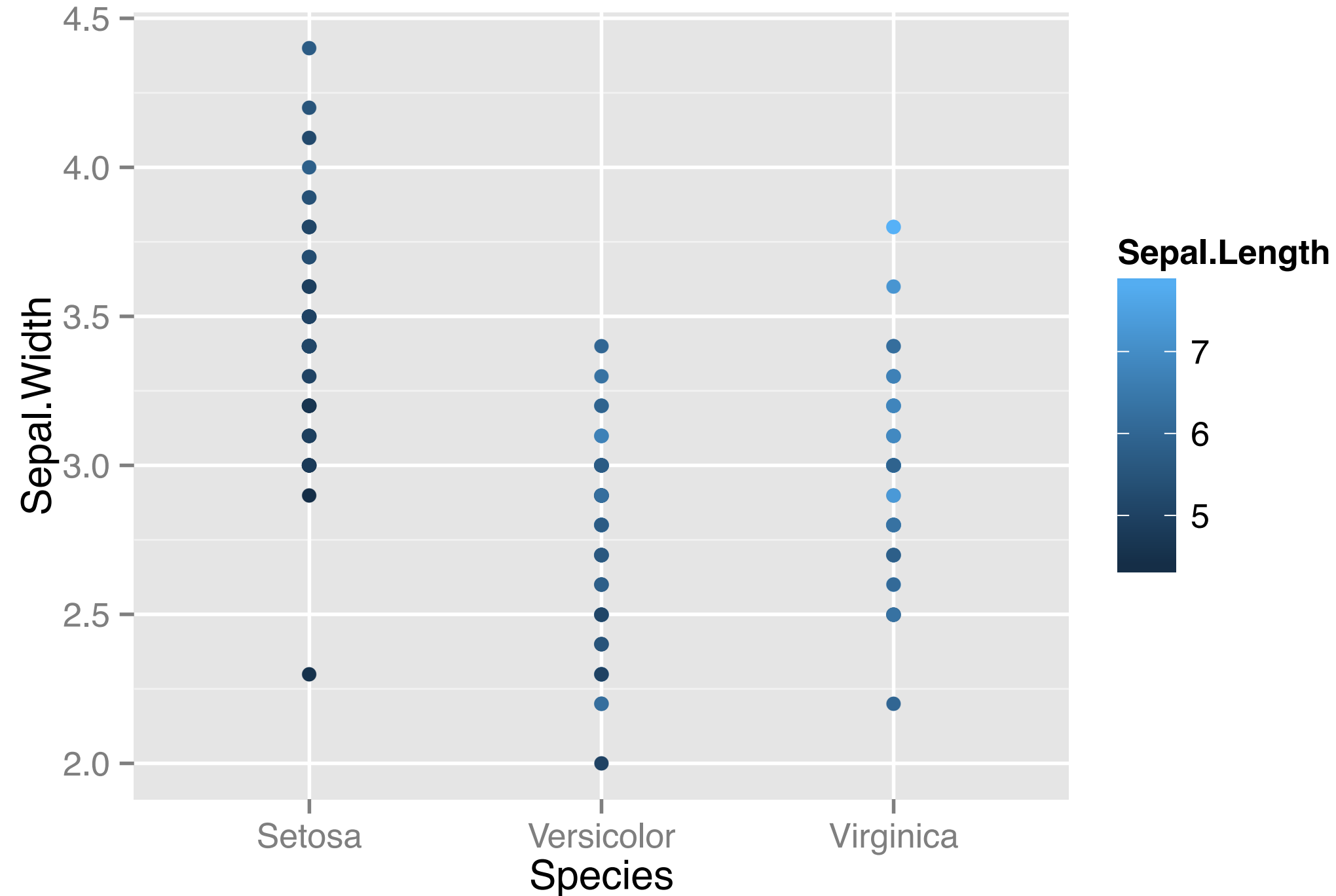
Aesthetics - Continuous Variables

```
> ggplot(iris.1, aes(x = Sepal.Length,  
                    y = Sepal.Width,  
                    col = Species)) +  
  geom_point()
```



Aesthetics - Continuous Variables

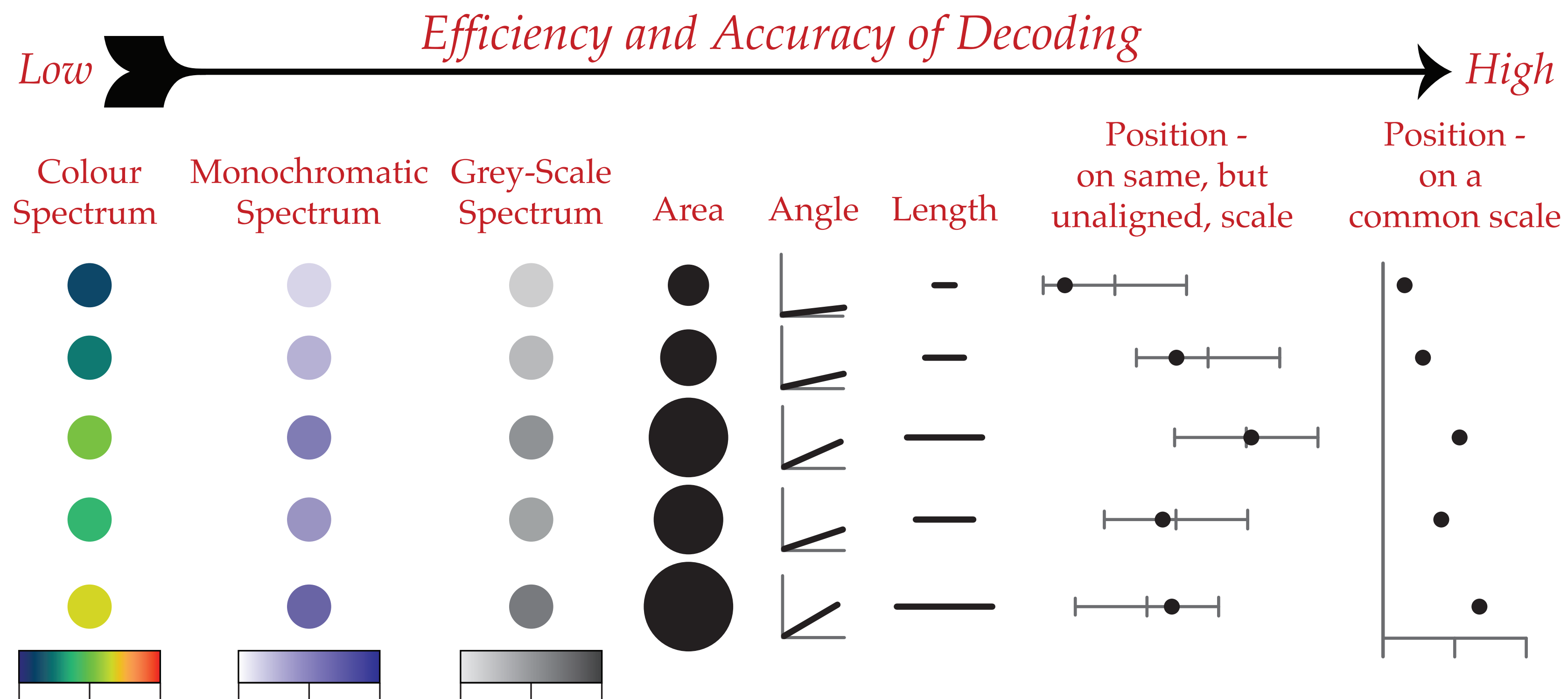
```
> ggplot(iris.1, aes(col = Sepal.Length,  
                    y = Sepal.Width,  
                    x = Species)) +  
  geom_point()
```



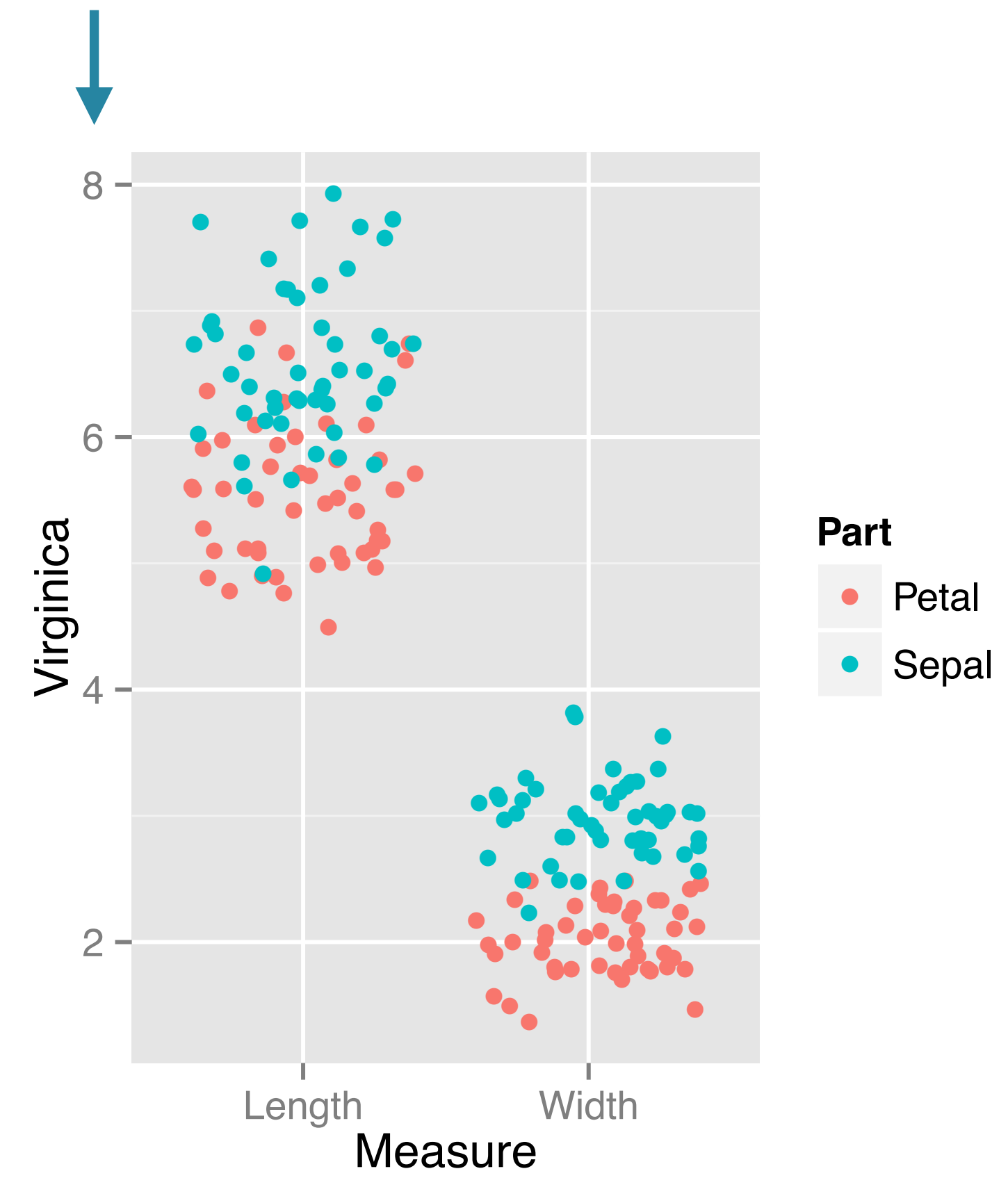
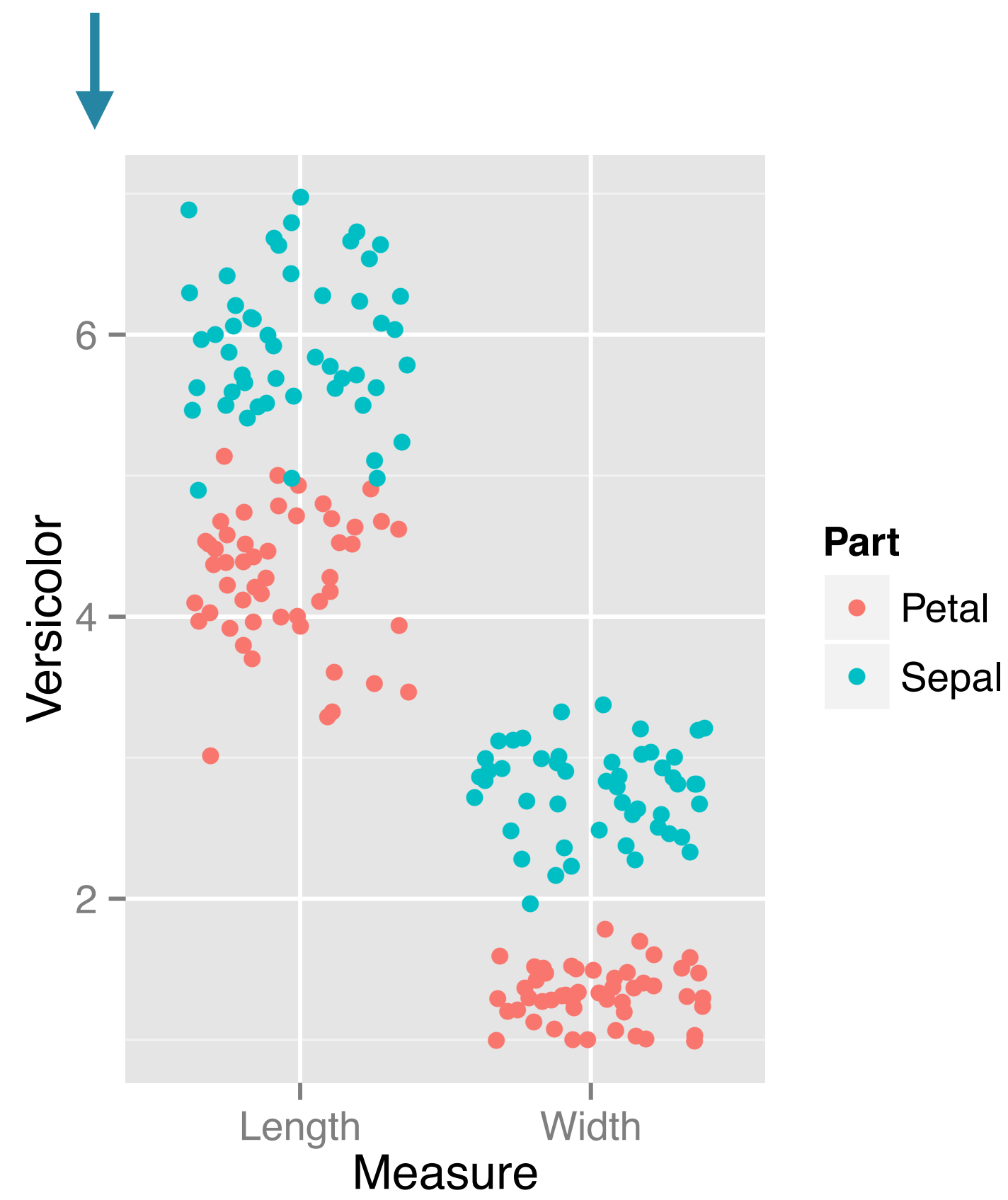
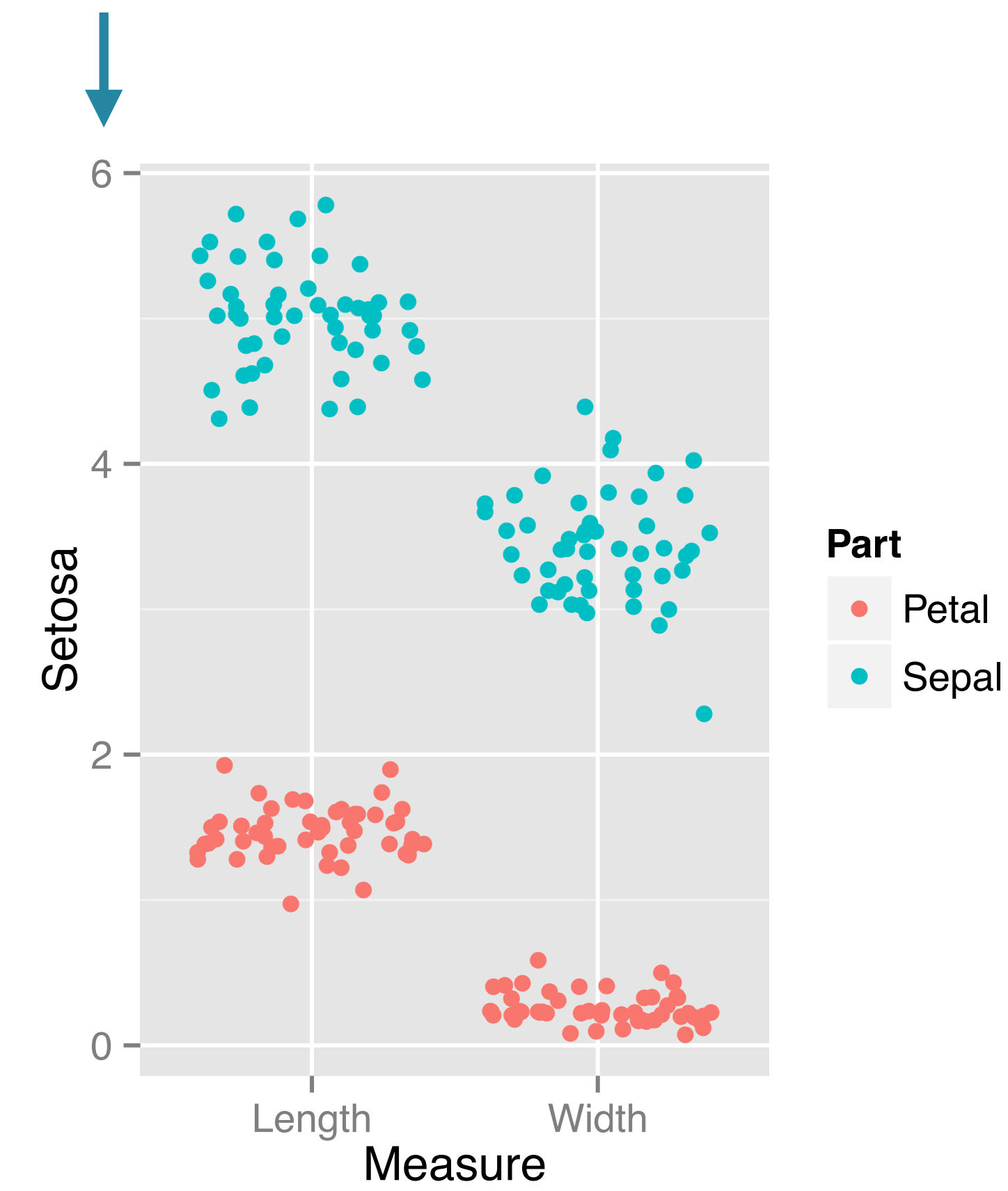
Aesthetics - Continuous Variables

Aesthetic	Description
x	X axis position
y	Y axis position
size	Diameter of points, thickness of lines
alpha	Transparency
colour	Colour of dots, outlines of other shapes
fill	Fill colour

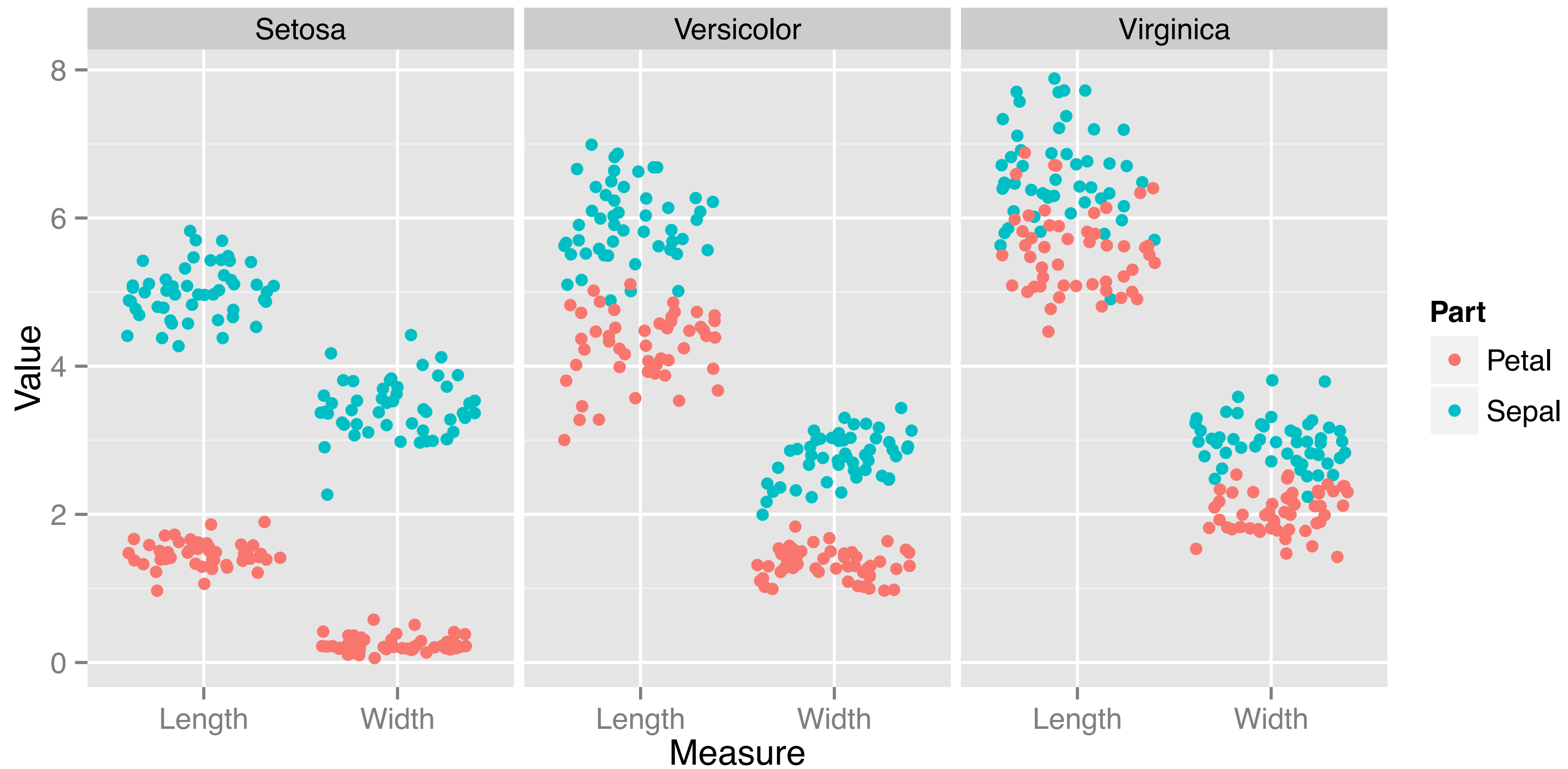
Guide - Continuous Variables



Unaligned y axes

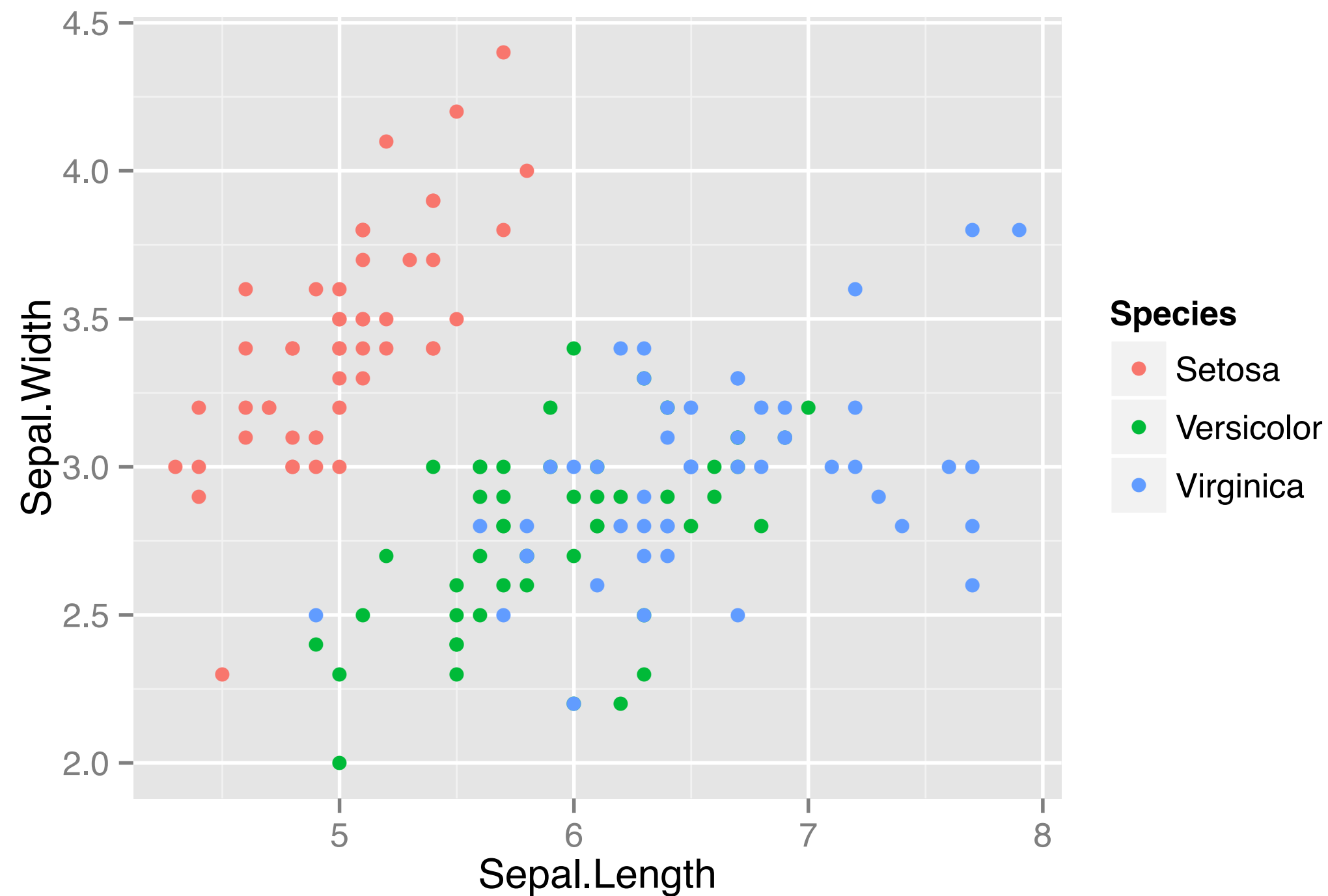


Common y axis



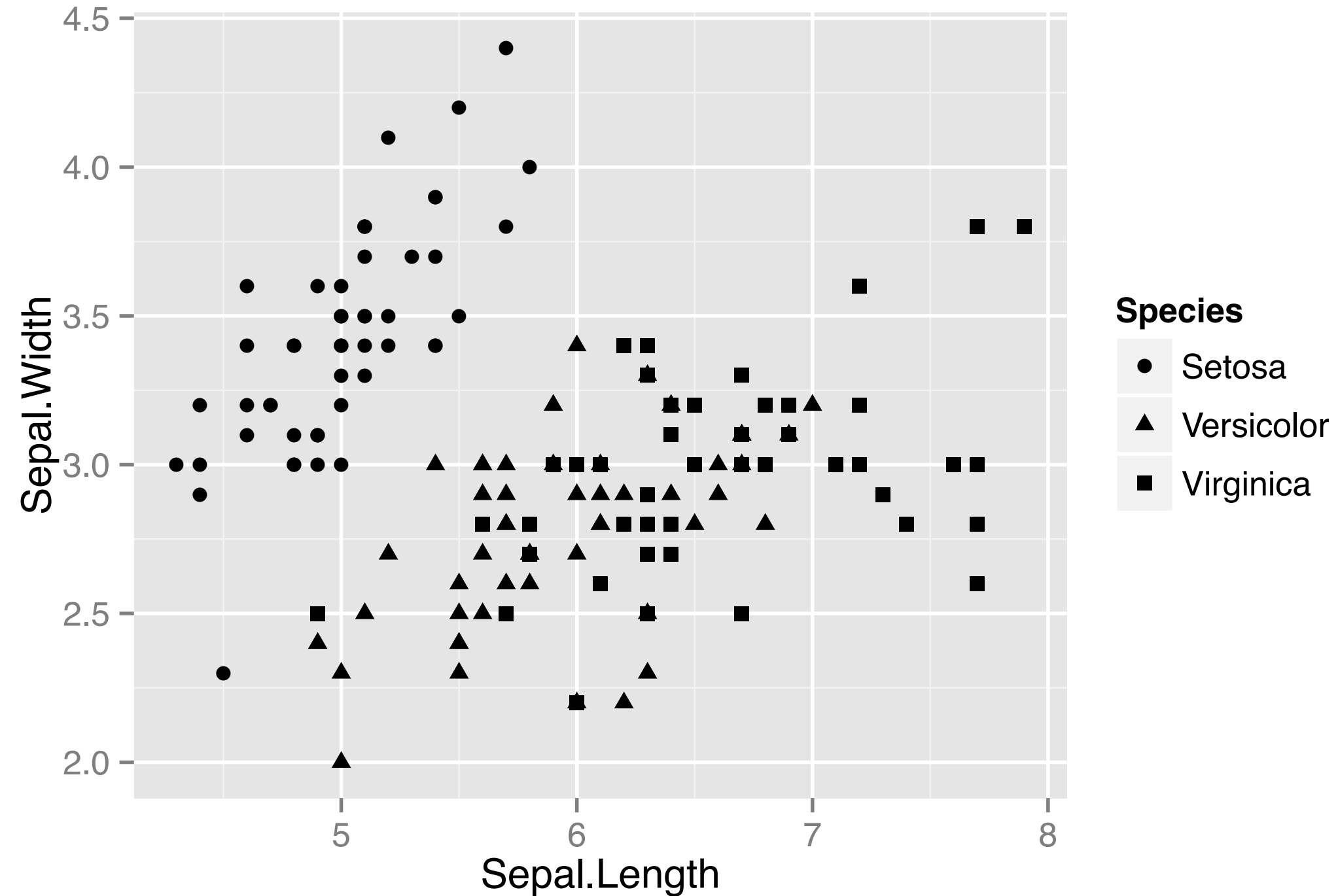
Aesthetics - Categorical Variables

```
> ggplot(iris.1, aes(x = Sepal.Length,  
                    y = Sepal.Width,  
                    col = Species)) +  
  geom_point()
```



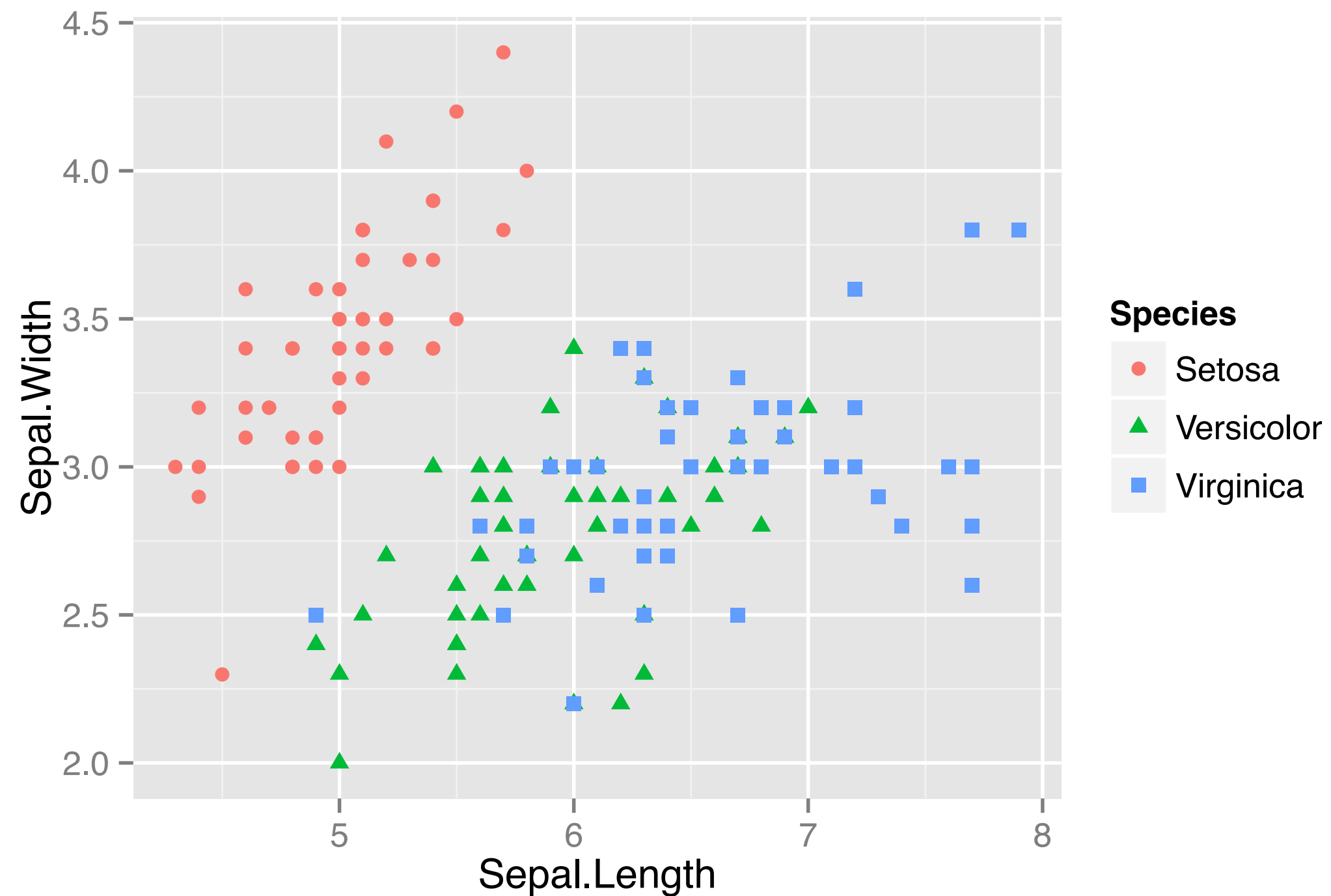
Aesthetics - Categorical Variables

```
> ggplot(iris.1, aes(x = Sepal.Length,  
                    y = Sepal.Width,  
                    shape = Species)) +  
  geom_point()
```



Aesthetics - Categorical Variables

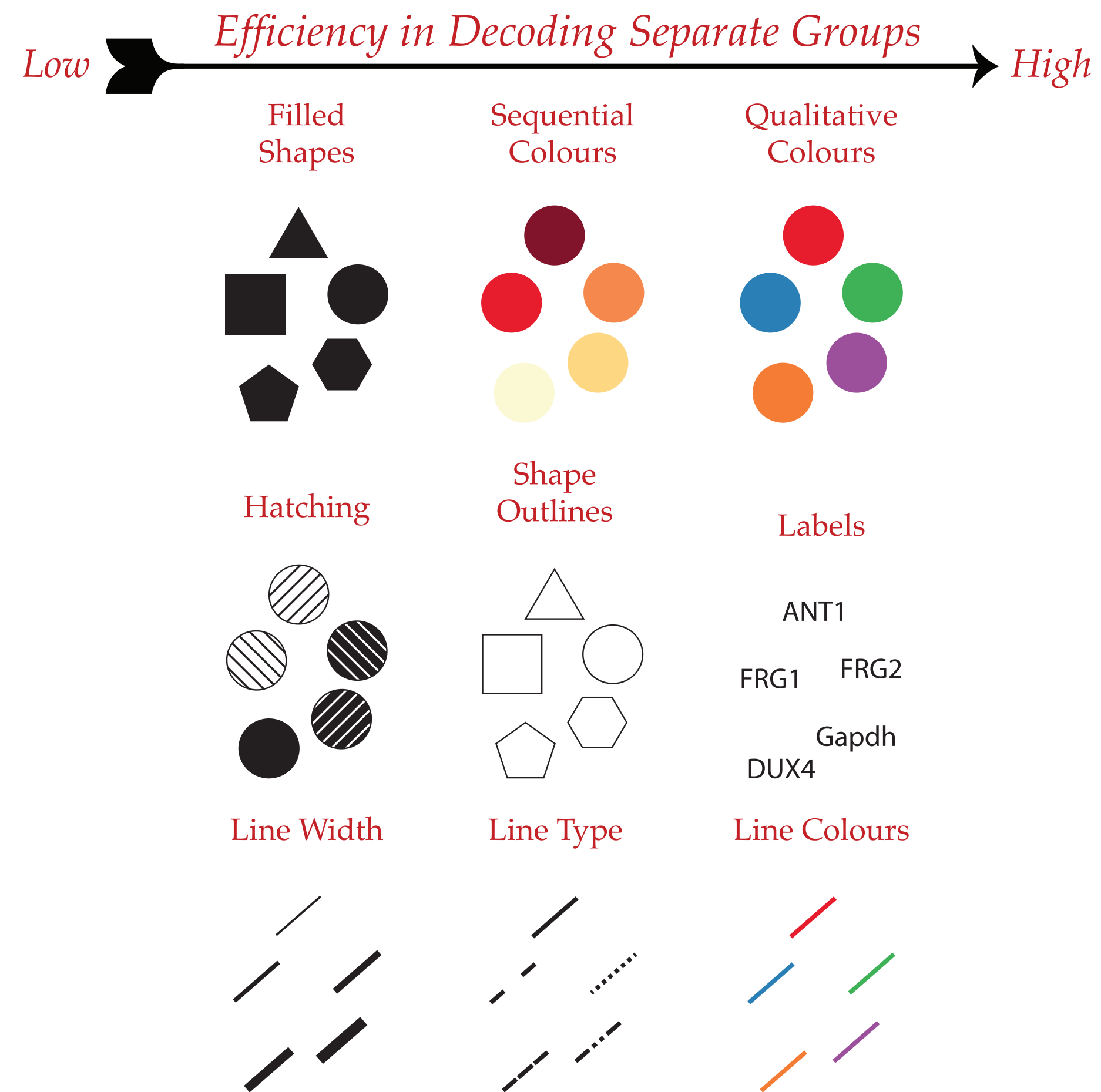
```
> ggplot(iris.1, aes(x = Sepal.Length, y = Sepal.Width,  
                    shape = Species, col = Species)) +  
  geom_point()
```



Aesthetics - Categorical Variables

Aesthetic	Description
labels	Text on a plot or axes
fill	Fill colour
shape	Shape of point
alpha	Transparency
linetype	Line dash pattern
size	Diameter of points, thickness of lines

Aesthetics - Categorical Variables





DATA VISUALIZATION WITH GGPLOT2

Let's practice!



DATA VISUALIZATION WITH GGPLOT2

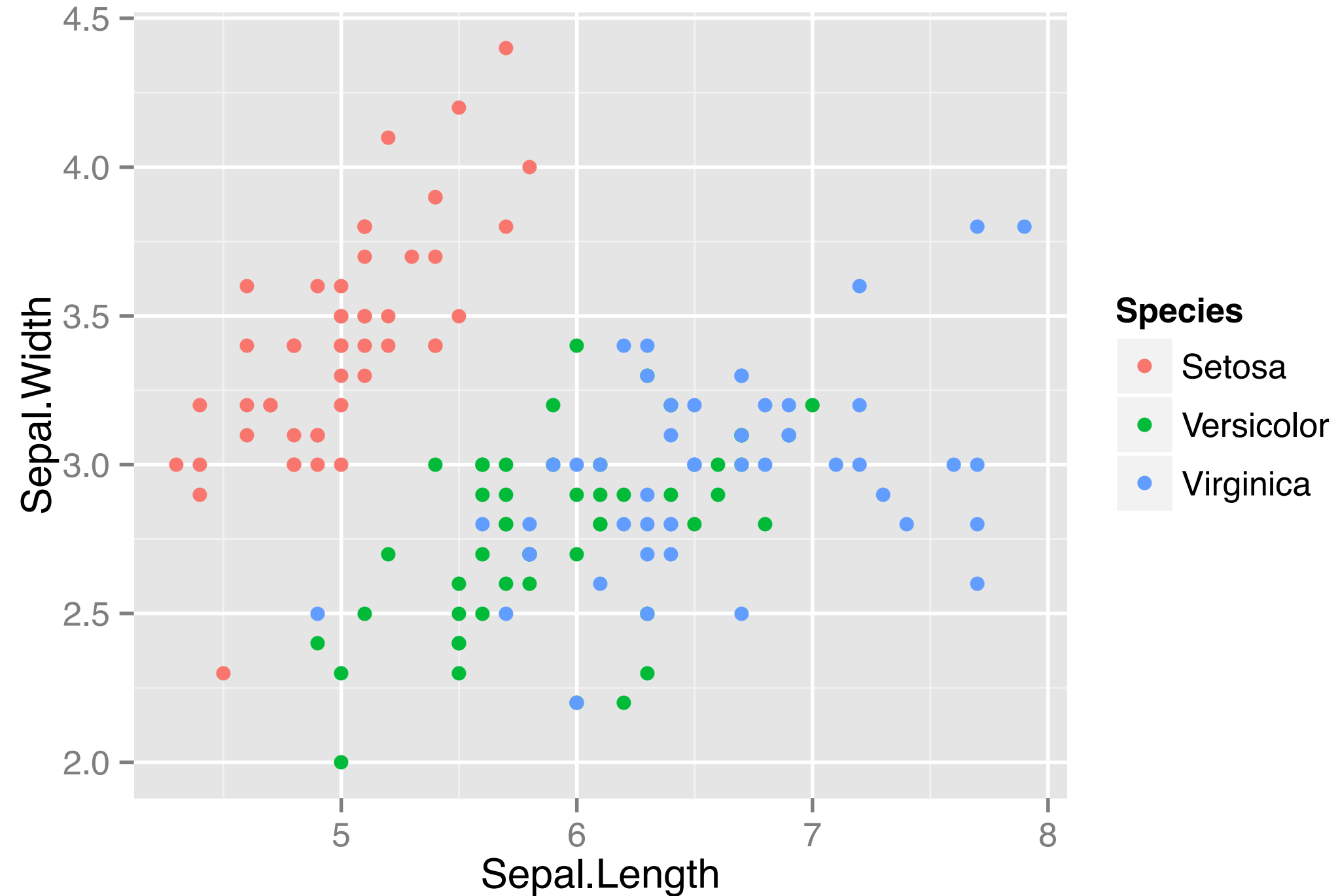
Modifying Aesthetics

Positions

- identity
- dodge
- stack
- fill
- jitter
- jitterdodge

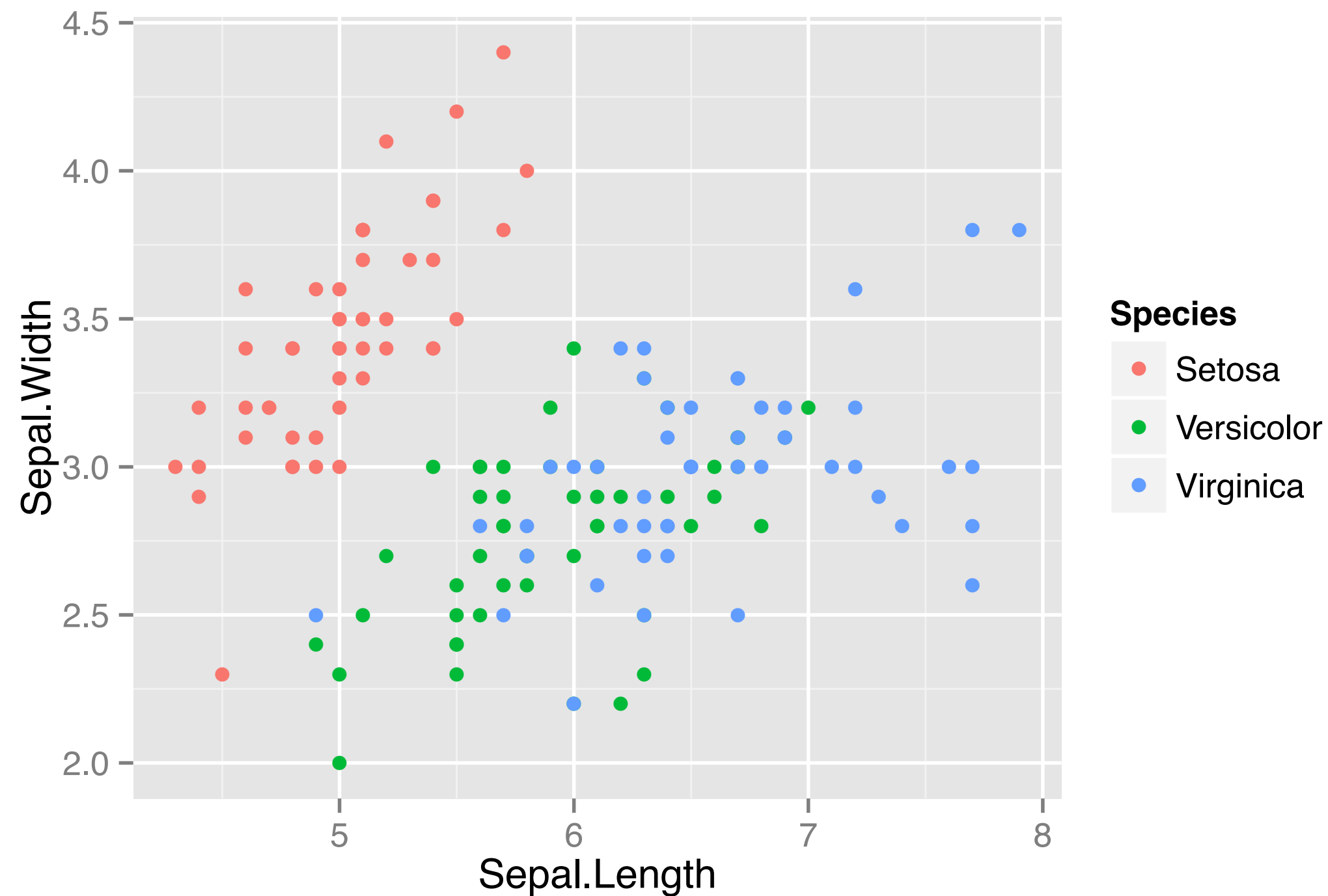
position identity (default)

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +  
  geom_point()
```



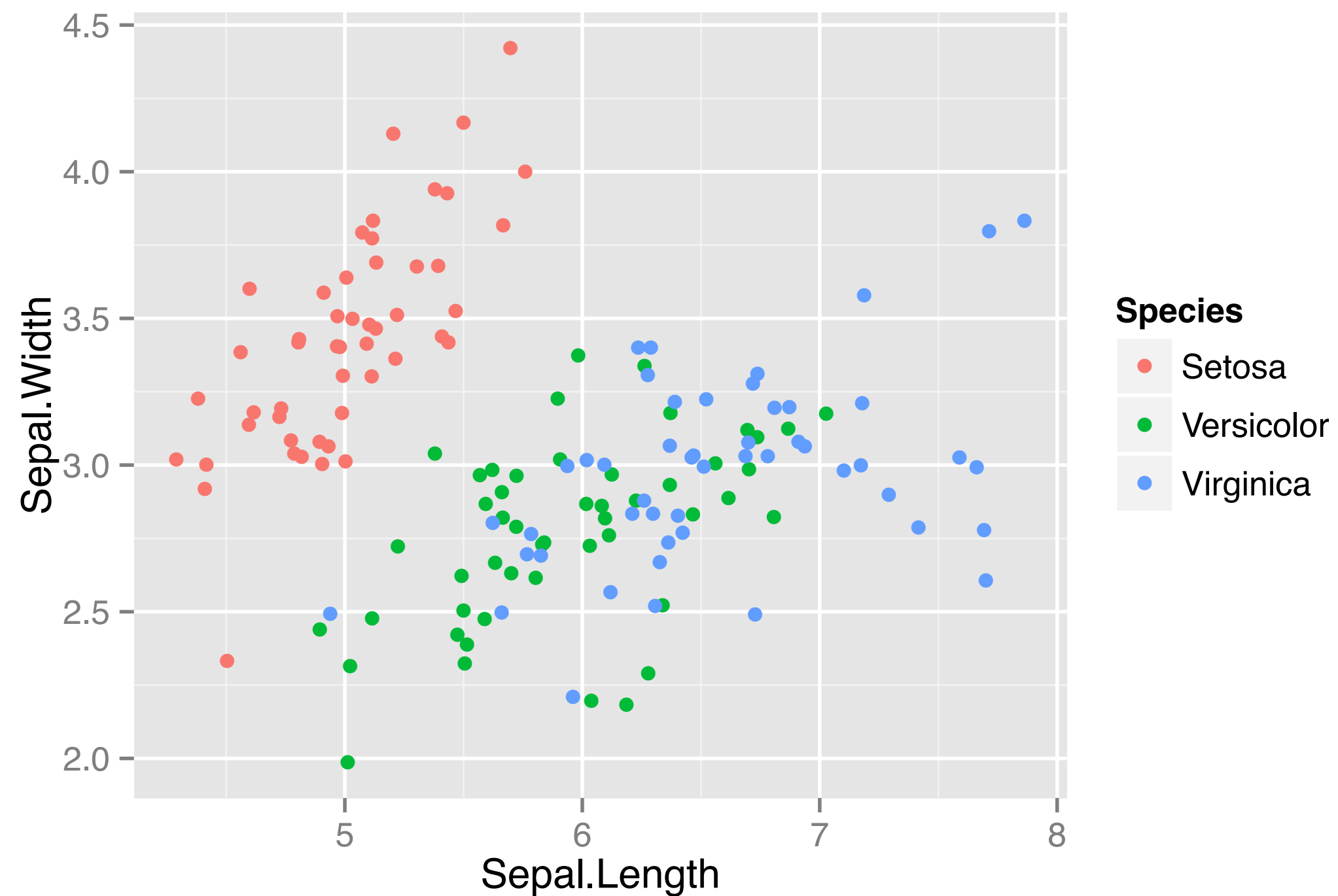
position identity (default)

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +  
  geom_point(position = "identity")
```



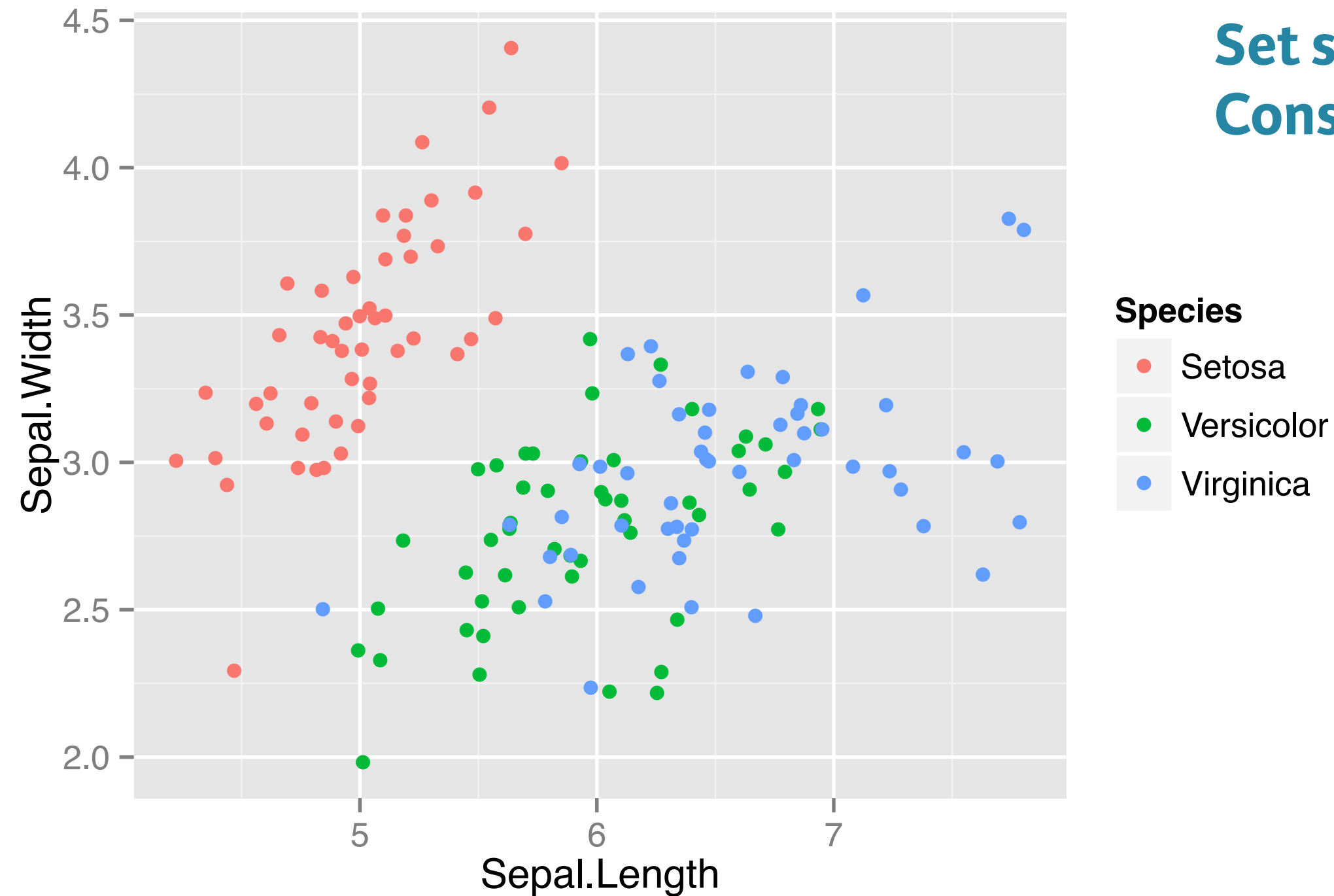
position jitter

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +  
  geom_point(position = "jitter")
```



position jitter (2)

```
> posn.j <- position_jitter(width = 0.1)
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = posn.j)
```



Set specific arguments for the position
Consistency in jitter across plots

Scale Functions

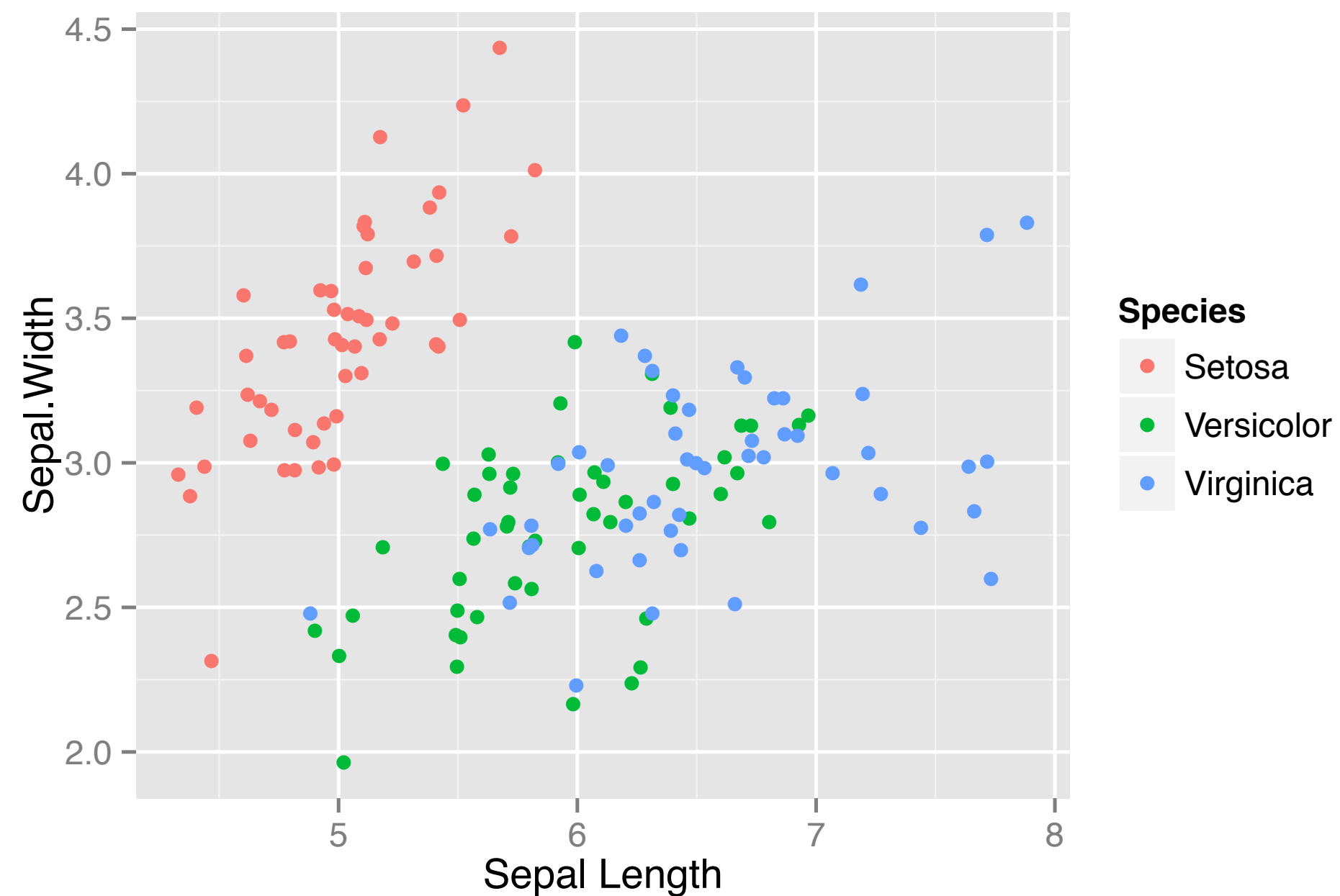
- `scale_x...`
- `scale_y...`
- `scale_color...`
- `scale_fill...`
- `scale_color...`
- `scale_shape...`
- `scale_linetype...`

Scale Functions

- `scale_x_continuous`
- `scale_y...`
- `scale_color_discrete`
- `scale_fill...`
- `scale_color...`
- `scale_shape...`
- `scale_linetype...`

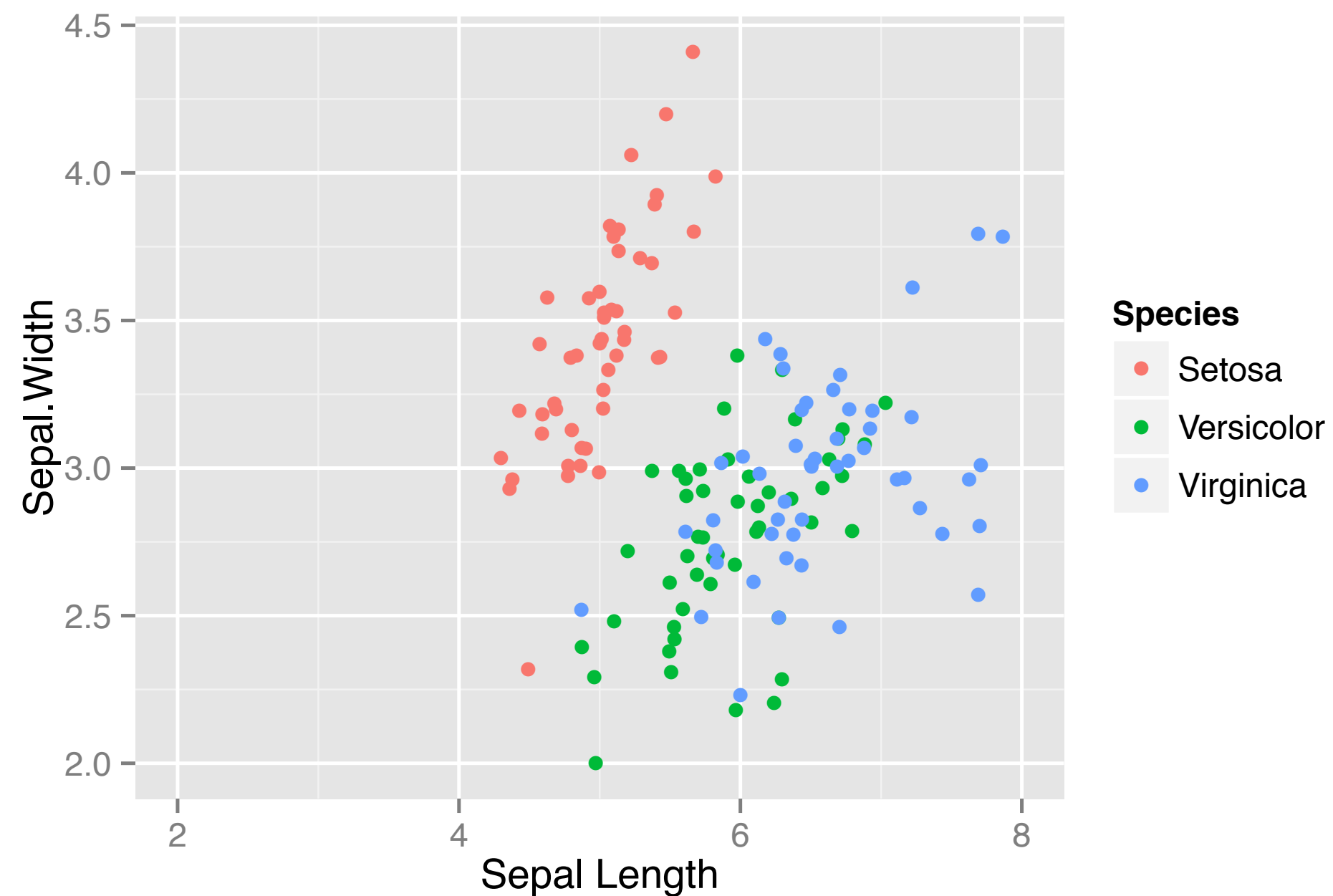
scale_

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +  
  geom_point(position = "jitter") +  
  scale_x_continuous("Sepal Length") +  
  scale_color_discrete("Species")
```



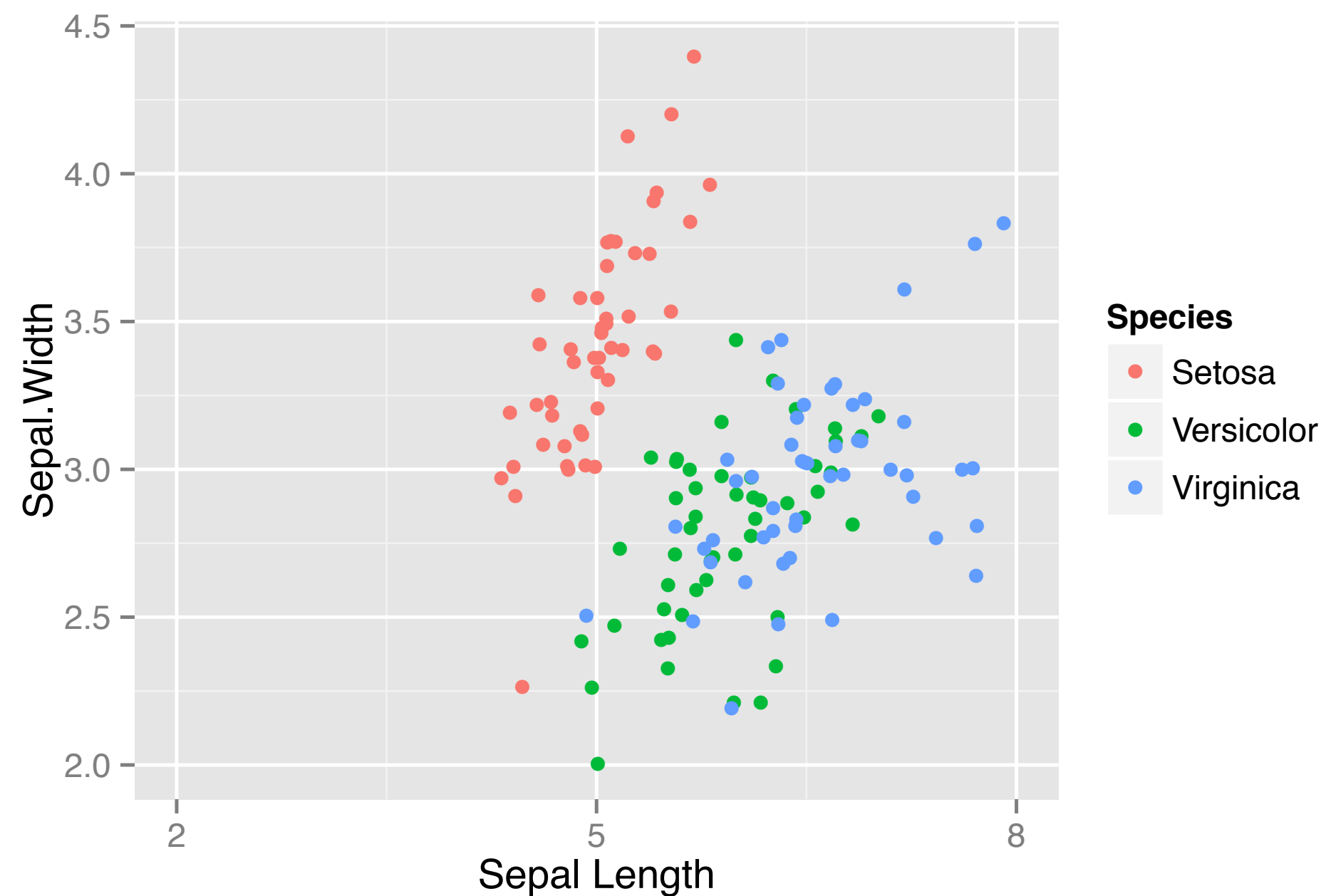
limit

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +  
  geom_point(position = "jitter") +  
  scale_x_continuous("Sepal Length", limits = c(2, 8)) +  
  scale_color_discrete("Species")
```



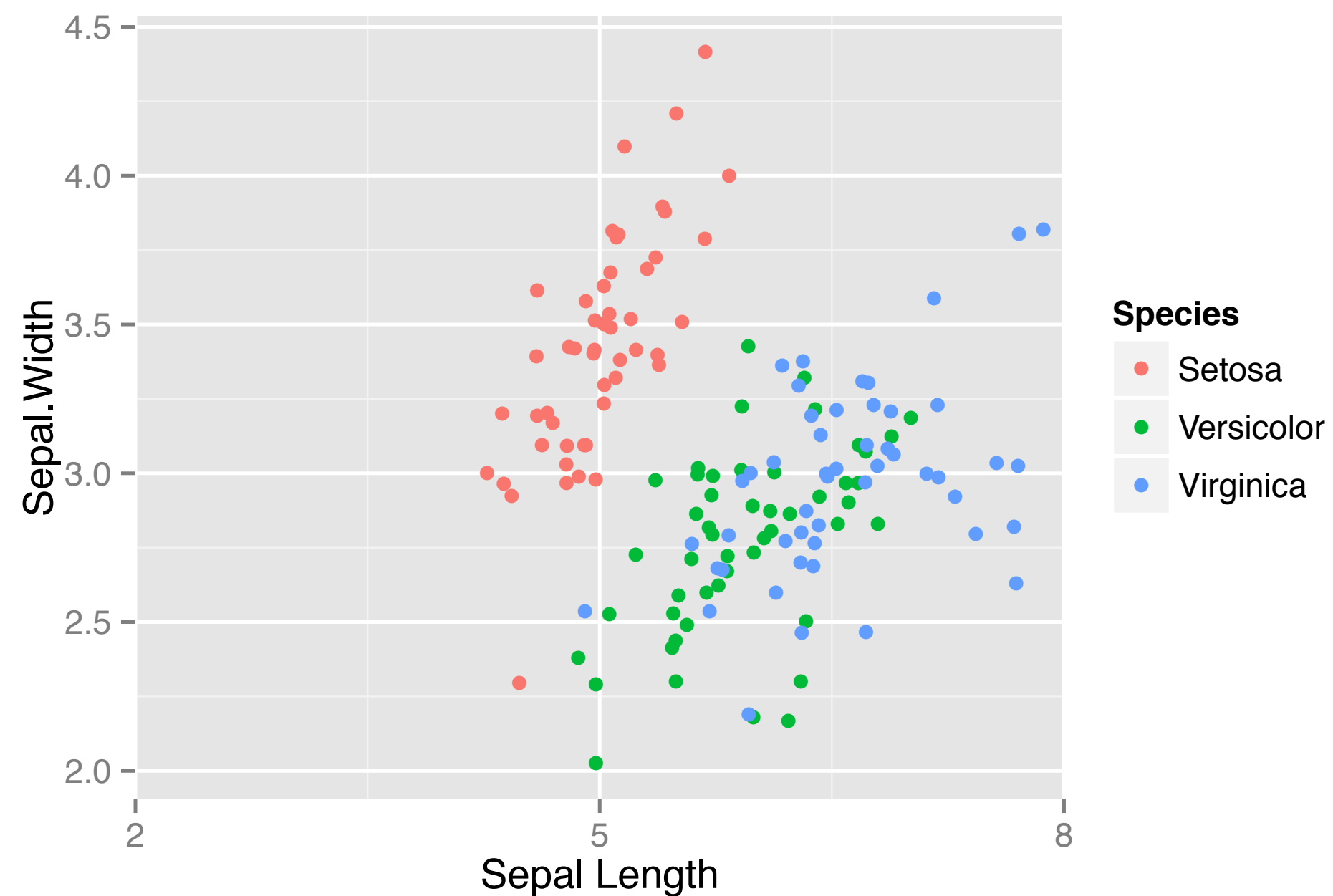
breaks

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +  
  geom_point(position = "jitter") +  
  scale_x_continuous("Sepal Length", limits = c(2, 8),  
                    breaks = seq(2, 8, 3)) +  
  scale_color_discrete("Species")
```



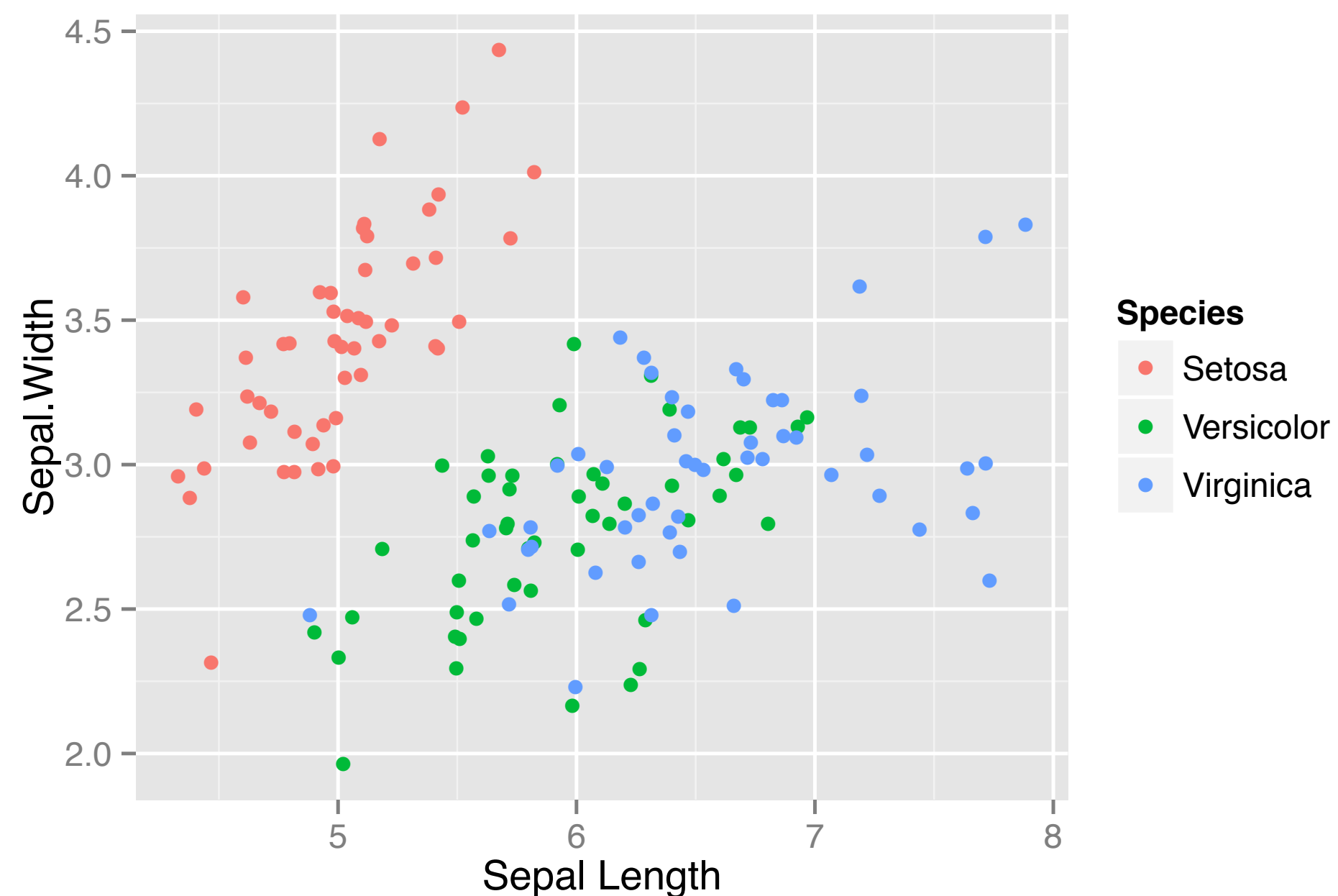
expand

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +  
  geom_point(position = "jitter") +  
  scale_x_continuous("Sepal Length", limits = c(2, 8),  
                    breaks = seq(2, 8, 3), expand = c(0, 0)) +  
  scale_color_discrete("Species")
```



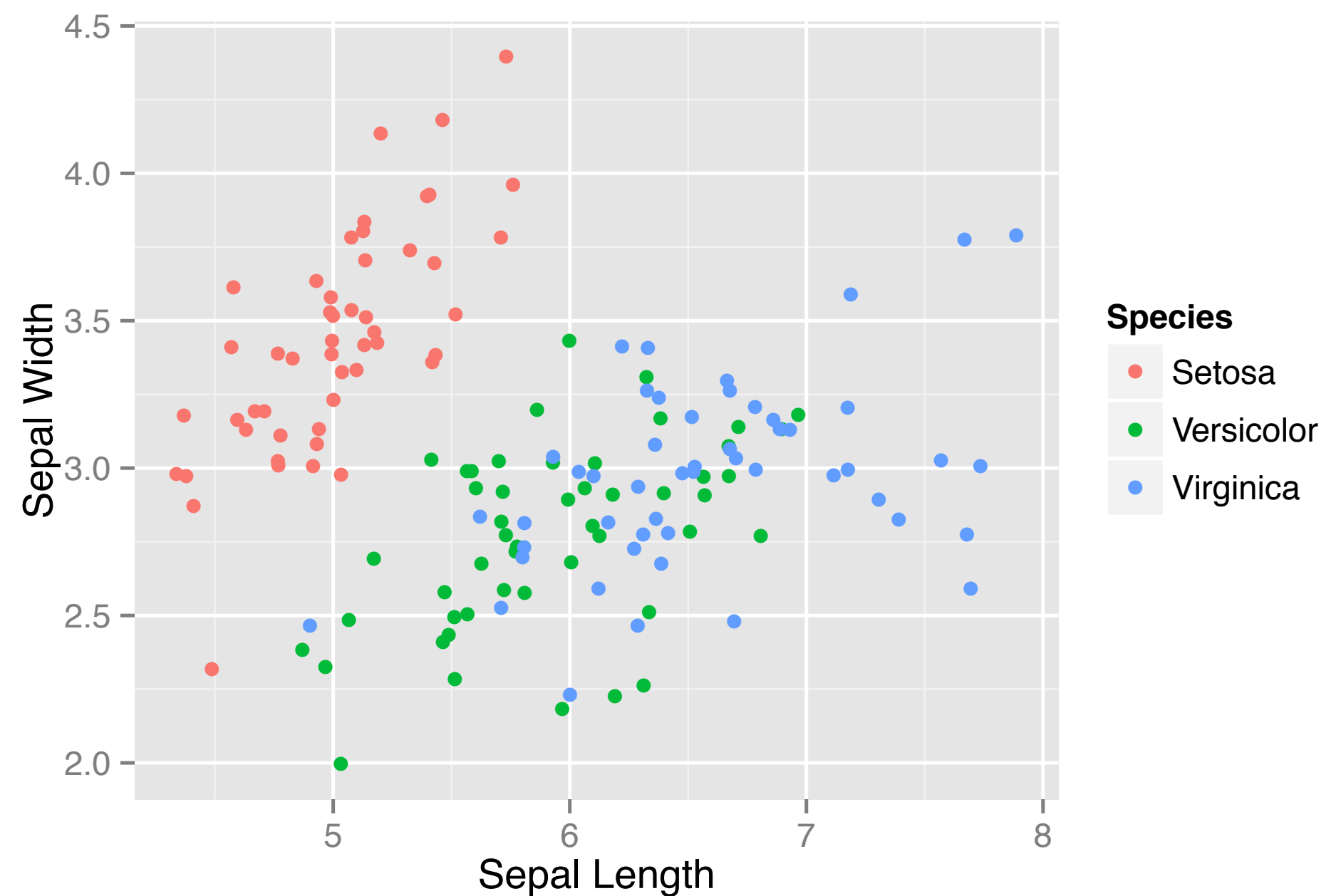
labels

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +  
  geom_point(position = "jitter") +  
  scale_x_continuous("Sepal Length", limits = c(2, 8),  
                    breaks = seq(2, 8, 3), expand = c(0, 0)) +  
  scale_color_discrete("Species",  
                      labels = c("Setosa", "Versicolour", "Virginica"))
```



labs

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +  
  geom_point(position = "jitter") +  
  labs(x = "Sepal Length", y = "Sepal Width", col = "Species")
```





DATA VISUALIZATION WITH GGPLOT2

Let's practice!