```
(*Video 1: Antiderivatives / Indefinite integral *)
```

In[40]:= `F[x_] := x^3`

In[41]:= `F'[x]`

Out[41]= $3 x^2$

`Integrate[3 x^2, x](*Command to find an antiderivative*)`

Out[42]= x^3

```
(*Are antiderivatives unique?
   No! All antiderivatives of the same function differ by constants*)
```

In[48]:= `D[x^3 + c , x]`

Out[48]= $3 x^2$

```
(*Antiderivative of a polynomial:*)
```

`Integrate[x^n, x] (* n ≠ -1*)`

Out[59]= $\frac{x^{1+n}}{1+n}$

In[60]:= $D\left[\frac{x^{1+n}}{1+n}, x\right]$

Out[60]= x^n

In[67]:= `Integrate[4 x^5 + 2 x^3 + 1 / 2 x + 1, x]`

Out[67]= $x + \frac{x^2}{4} + \frac{x^4}{2} + \frac{2 x^6}{3}$

In[70]:= `Integrate[6 x^6 + 4 x^8 + 1 / 3 x^2 + 12, x]`

Out[70]= $12 x + \frac{x^3}{9} + \frac{6 x^7}{7} + \frac{4 x^9}{9}$

In[72]:= $D\left[12 x + \frac{x^3}{9} + \frac{6 x^7}{7} + \frac{4 x^9}{9} + 15, x\right]$

Out[72]= $12 + \frac{x^2}{3} + 6 x^6 + 4 x^8$

```
Integrate[x^2, y]
(*Careful: second argument given is the variable of integration!*)
```

Out[76]= $x^2 y$

In[77]:= $D\left[x^2 y, y\right]$

Out[77]= x^2

In[81]:=
```
Integrate[a x^3 + b x^2 + c x + d, x]
```

Out[81]= $d\,x + \frac{c\,x^2}{2} + \frac{b\,x^3}{3} + \frac{a\,x^4}{4}$

In[82]:= $D\left[d\,x + \frac{c\,x^2}{2} + \frac{b\,x^3}{3} + \frac{a\,x^4}{4}, x\right]$

Out[82]= $d + c\,x + b\,x^2 + a\,x^3$

```
(*Video 2: Definite integrals*)
```

```
HoldForm[Integrate[x^2, x]] == Integrate[x^2, x]
(*Antiderivative of x^2, also known as indefinite integral of x^2 *)
```

Out[105]= $\int x^2\,dx == \frac{x^3}{3}$

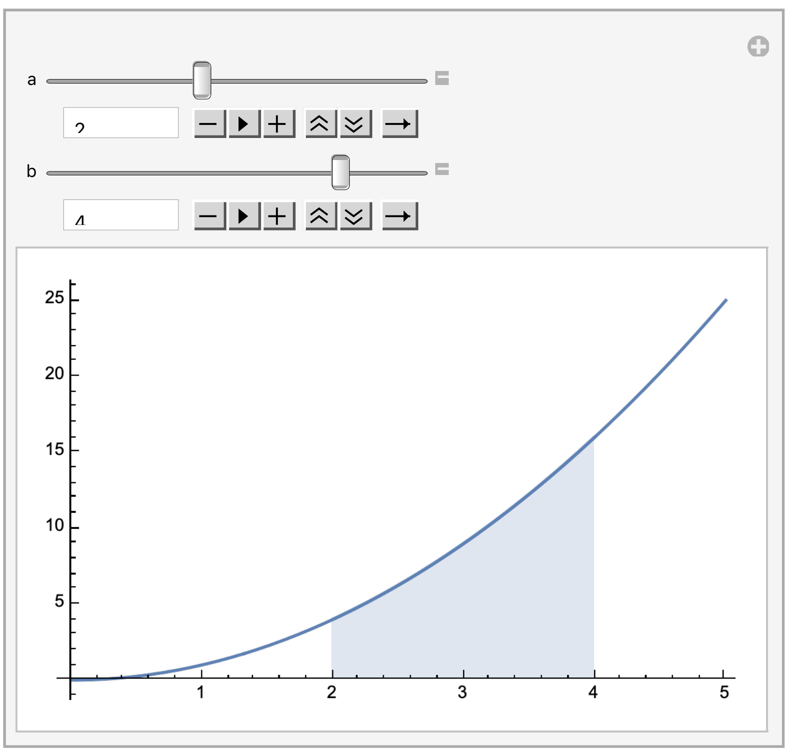
```
HoldForm[Integrate[x^2, {x, a, b}]](*Definite integral of x^2, from x=a to x=b*)
```

Out[96]= $\int_a^b x^2\,dx$

```
(*The above definite integral, by definition,
is the area under the graph of y=x^2 that lies between x=a and x=b*)
```

In[94]:=
```
Manipulate[Show[Plot[x^2, {x, 0, 5}], Plot[x^2, {x, a, b},
   Filling → Bottom, PlotRange → {{0, 5}, {0, 25}}]], {a, 0.01, 5}, {b, 0.02, 5}]
```

Out[94]=



In[109]:=
```
Integrate[x^2, {x, 2, 4}]
```

Out[109]=
$$\frac{56}{3}$$