Exercise 1. Give, for any category $C$ and any object $C : C$, a monoidal structure on the set $C \to C$.

Exercise 2. Prove that for any monoid $\mathcal{M}$ there is a category with one object $\star$ such that $\star \to \star$ equals $\mathcal{M}$.

Exercise 3. Show that the above extends to a functor from $\textbf{Mon}$ to $\textbf{Cat}$.

Exercise 4. Show that there is a functor $F : \textbf{Set} \to \textbf{Mon}$ and a functor $U : \textbf{Mon} \to \textbf{Set}$ such that $F ; U$ equals $\mathbb{L}$. Hint: $U$ maps a monoid to its underlying set.

Exercise 5. Prove that any category that has exactly one functor to it from each other category must be isomorphic to the category $\mathbf{1}$.

Exercise 6. Prove that any category that has exactly one functor from it to each other category must be isomorphic to the category $\mathbf{0}$.

Exercise 7. Given categories $A$ and $B$, define a category $A \times B$ with “projection” functors $\pi_A$ and $\pi_B$ from it to $A$ and $B$ respectively.