1. **(1)** It goes without saying what the objects are. As per morphisms if $0 \to A_* \to B_* \to C_* \to 0$ and $0 \to X_* \to Y_* \to Z_* \to 0$ are two short exact sequences of chain complexes, define a morphism f to be morphisms of chain complexes $(f^\alpha)_n^{\alpha=A,B,C}$ so that $f^A : A_* \to X_*$ and analogously for B, C. Moreover we require commutativity of the following:

$$\begin{tikzcd}
A_* \arrow[r, "\iota"] \arrow[d, "f"] & B_* \arrow[r, "q"] \arrow[d, "f"] & C_* \arrow[d, "f"] \\
X_* \arrow[r, "\iota"] & Y_* \arrow[r, "q"] & Z_*
\end{tikzcd}$$

(2) Since long exact sequences are chain complexes, we can simply view them as a subcategory.

(3) As mentioned in the problem statement the functor on objects has been constructed, namely it is the snake lemma. We need to define the action on morphisms and functoriality. Simply take $f \mapsto f_* : H_n(A) \to H_n(X)$ for all n, and likewise for $H_n(B), H_n(C)$. Since homology is functorial our construction satisfies identity and inverse properties, but we still need to show that the following commutes

$$\begin{tikzcd}
\cdots H_n(A) \arrow[r, "\iota_*"] \arrow[d, "f_*"] & H_n(B) \arrow[r, "q_*"] \arrow[d, "f_*"] & H_n(C) \arrow[r, "\delta"] \arrow[d, "f_*"] & H_{n-1}(A) \cdots \arrow[d, "f_*"] \\
\cdots H_n(X) \arrow[r, "\iota_*"] & H_n(Y) \arrow[r, "q_*"] & H_n(Z) \arrow[r, "\delta"] & H_{n-1}(X)
\end{tikzcd}$$

For the squares other than the one with δ, this follows directly from the commutativity conditions on f and functoriality of homology. For the square with the δ-s we need to check. Consider $[c] \in H_n(C)$, then we use the proof of snake lemma to show that $[x] = f_*\delta([c])$ is equal to $\delta(f_*[c])$.

Recall from the proof that $\delta([c])$ is defined by $[a]$ where for (an arbitrary) b such that $q(b) = c$ we have $a = \iota^{-1}(d(b))$. Now considering such a b, by