# CARE PACKAGES TO THE RESCUE!

**By Jennifer Phan**

Imagine you're lost in a forest, with nothing on your back. There's barely enough food and water in your stomach to get by for the day, possibly two if you're lucky. A care package would be fortunate at this point, wouldn't it? What if your cells were in a similar situation? They would need one as well. And that's what an exosome is: a care package sent out to other cells that may be in need of them. What if I told you that scientists are now figuring out how to use exosomes as potential treatments for a variety of diseases? Its pretty amazing stuff! Let's start with how the exosomes are formed…

It begins with a cell membrane folding back onto itself or invagination, creating an empty intracellular vesicle that goes on its way. During its journey, the vesicle becomes a molecular factory. And a very busy factory that it is. Its size will continue to grow in order to accommodate its bustle. Can you guess what the factory is creating?

Exosomes! More tiny vesicles within the factory, packaged with goodies such as RNA species or soluble proteins. The RNA species are like recipes for essential proteins, so the receiving cells can make their own. As for the soluble proteins, they are used in all sorts of daily activities and ready to use on the spot. Finally the exosomes are released to the surroundings for other cells, making them much like care packages!

So… what is it about the exosomes that is being researched? Among the many other ideas in the science community, my principle investigator's lab is looking at two things:

1. Increasing the number of exosomes produced by the cells
2. Engineering the surface of the exosomes

## THE MORE, THE BETTER!

We humans can be delicate beings. Injuries, the cold, allergies, and a whole litany of diseases and disorders. Any form of trauma to cells calls for exosomes, so there is huge demand for them. We shall focus on stem cell exosomes because they give a greater chance at regeneration due to their unique RNA species and soluble proteins. But stem cells produce a much lower amount of exosomes than other cells, partly because stem cell populations are rare in the human body. There is just no possible way for a small population of stem cells to produce exosomes to match with the human demand. So, how do we get more exosomes?

There are a number of potential approaches. Many components are involved in the process of creating the exosomes and releasing them from the stem cells. Those components can be manipulated—like putting the proteins that create exosomes into overdrive or silencing those that stand in the way of making exosomes. Then there is the environment that could be adjusted. Maybe the stem cells would be happier in certain conditions, and by making them happier they might release more exosomes. There are

likely more ways to increase exosome production from stem cells that haven't been discovered just yet…but that's what research is for.

**GO HERE, NOT THERE…**

Once the exosomes are released, the surrounding or far away cells can take them in. There are two assortments of cells, healthy cells and the not-so healthy cells. They are mixed up in our bodies and can range in their location. Remember, it is the not-so-healthy cells that could likely reap the most reward from the exosomes. So what if the exosomes are taken up by the healthy cells and there are no more for the not-so healthy cells? Or the exosomes just don't go to the not-so healthy cells?

This is where engineering the surfaces of exosomes come in. If you look back to the cartoon, the exosomes have ligands on their surface. Those ligands are molecules that act like a key, fitting into a unique keyhole to open the door. In essence, we can add ligands to the exosome surface that is specific for the not-so healthy cells, which would instruct the exosome to supply these cells with the much-needed goodies to help them recuperate. We also wouldn't want to overload healthy cells with extra materials, which could have adverse consequences. The one significant obstacle is we need to find a distinct ligand of the not-so-healthy cell population that no other cells have. It's like being Indiana Jones, hunting for that particular key.

**WHAT'S NEXT?**

Now you're armed with some background knowledge of what the exosomes are and how they're made. I've also given you some tidbits of their great potential in regenerative medicine. It's an exciting field that I'm eager to take part in! Now it's your turn.

What other ways can you think of that the exosomes can be utilized to their fullest abilities?