Exploration missions will require a robust, lightweight, and maintainable portable life support system. Technology development is needed for long-life and high-capacity chemical oxygen storage systems for an emergency supply of oxygen for breathing; low-venting or non-venting regenerable individual life support subsystem(s) concepts for crew member cooling, heat rejection, and removal of expired water vapor and \( \text{CO}_2 \); convection and freezable radiators that will be low cost and lightweight for thermal control; innovative garments that provide direct thermal control to crew member; high reliability pumps and fans that will provide flow for a space suit but can be stacked to give greater flow for a vehicle; \( \text{CO}_2 \) and humidity control devices that, while minimizing expendables, function in a \( \text{CO}_2 \) environment; and a non-toxic, non-flammable, super cooled below 32\(^\circ\)F phase change material that can absorb metabolic heat for an 8 hour duration.

Also for removing metabolic heat from the astronaut, research is needed for a variable conductance flexible suit garment that can function as a radiator for high metabolic loads and as an insulator for low metabolic loads.