**What is claimed is:**

1. A composition comprising:

a biologically active composition of matter comprising a first D-biotin that alone is conjugated directly, via an amide bond, to an ε-amine of a C-terminal lysine residue of a water-soluble, cell-permeable, mitochondria-targeted peptide sequence to form a biotinylated polypeptide sequence, wherein the mitochondria-targeted peptide sequence:

comprises a plurality of amino acids arranged with a general alternating aromatic-cationic motif; and

comprises a minimum of four amino acids and a maximum of six amino acids; andis selected from the group consisting of:

D-Arg-L-Tyr-D-Arg-L-Phe-L-Lys-$NH_2$ ;

D-Trp-D-Arg-D-Trp-D-Lys-OH ;

L-Trp-L-Arg-L-Trp-L-Lys-$NH_2$ (SEQ ID NO:1);

D-Trp-D-Arg-D-Trp-D-Lys-$NH_2$ ; and

L-Trp-L-Arg-L-Trp-L-Lys-OH (SEQ ID NO:2).

2. The composition of claim 1, wherein a second D-biotin is conjugated to an N-terminus $\alpha$-amine of the mitochondria-targeted peptide sequence.

3. The composition of claim 1, wherein the mitochondria-targeted peptide sequence is:

D-Biotin-D-Trp-D-Arg-D-Trp-D-Lys-OH.

4. The composition of claim 1, wherein the biotinylated polypeptide is selected from the group consisting of:

D-Trp-D-Arg-D-Trp-D-Lys(biotinyl)-OH ;

L-Trp-L-Arg-L-Trp-L-Lys(biotinyl)-$NH_2$ ; and

D-Arg-L-Tyr-D-Arg-L-Phe-L-Lys(biotinyl)-$NH_2$ .

5. The composition of claim 1, wherein the biotinylated polypeptide is selected from the group consisting of:

D-Biotin-L-Trp-L-Arg-L-Trp-L-Lys(biotinyl)-$NH_2$ ; and

D-Biotin-D-Arg-L-Tyr-D-Arg-L-Phe-L-Lys(biotinyl)-$NH_2$ .

6. The composition of claim 1, wherein the composition comprises:

a therapeutically inert and pharmaceutically acceptable carrier.

7. The composition of claim 1, wherein the composition comprises:

a pharmaceutically acceptable carrier.

8. The composition of claim 1, wherein:

the composition is a therapeutically effective formulation.

9. A composition of matter, comprising:

a therapeutically effective formulation comprising:

one or more biologically active, water-soluble, cell-permeable, mitochondria-targeted compounds selected from a biotinylated polypeptide group; and

a pharmaceutically acceptable carrier for each of the one or more biologically active, water-soluble, cell-permeable, mitochondria-targeted compounds;

wherein each biologically active, water-soluble, cell-permeable, mitochondria-targeted compound in the biotinylated polypeptide group is defined by:

a plurality of amino acids arranged with a general alternating aromatic-cationic motif;

a minimum of four amino acids and a maximum of six amino acids; and

a first D-biotin that alone is conjugated directly, via an amide bond, to an ε-amine of a C-terminal lysine residue; and

wherein the biotinylated polypeptide group consists of:

D-Trp-D-Arg-D-Trp-D-Lys(biotinyl)-OH ;

L-Trp-L-Arg-L-Trp-L-Lys(biotinyl)-$NH_2$ ;

D-Arg-L-Tyr-D-Arg-L-Phe-L-Lys(biotinyl)-$NH_2$ ;

D-Biotin-L-Trp-L-Arg-L-Trp-L-Lys(biotinyl)-$NH_2$ ; and

D-Biotin-D-Arg-L-Tyr-D-Arg-L-Phe-L-Lys(biotinyl)-$NH_2$ .

10. The composition of claim 9, further comprising:

one or more vitamins selected from the vitamin group consisting of:

vitamin B1 (thiamine);

vitamin B2 (riboflavin);

niacin;

niacinamide);

vitamin B5 (pantothenic acid); and

pyridoxine .

11. The composition of claim 9, further comprising:

one or more metabolic supplements selected from the metabolic supplement group consisting of:

pyruvate;

carnitine;

acetylcarnitine;

creatine;

$\alpha$-ketoglutarate;

$\alpha$-lipoic acid;

nicotinamide riboside; and

nicotinamide mononucleotide.

12. The composition of claim 9, further comprising:

one or more amino acids selected from the amino acid group consisting of:

L-Leucine;

L-Isoleucine;

L-Valine;

L-Glutamine;

L-Serine;

L-Arginine;
L-Methionine;
L-Tryptophan;
Glycine;
and
Taurine.

13. A pharmaceutically acceptable and therapeutically effective composition comprising:
one or more biologically active, water-soluble, cell-permeable, mitochondria-targeted compounds selected from a biotinylated polypeptide group, each biologically active, water-soluble, cell-permeable, mitochondria-targeted compound in the biotinylated polypeptide group defined by:
a plurality of amino acids arranged with a general alternating aromatic-cationic motif;
a minimum of four amino acids and a maximum of six amino acids; and
a D-biotin that alone is conjugated directly to a ε-amine of a C-terminal lysine residue via an amide bond; and
wherein the biotinylated polypeptide group consists of:
D-Trp-D-Arg-D-Trp-D-Lys(biotinyl)-OH (SPN09);
L-Trp-L-Arg-L-Trp-L-Lys(biotinyl)-$NH_2$ (SPN11);
D-Arg-L-Tyr-D-Arg-L-Phe-L-Lys(biotinyl)-$NH_2$ (SPN15);
D-Biotin-L-Trp-L-Arg-L-Trp-L-Lys(biotinyl)-$NH_2$ (SPN12); and
D-Biotin-D-Arg-L-Tyr-D-Arg-L-Phe-L-Lys(biotinyl)-$NH_2$ (SPN16).

14. The pharmaceutically acceptable and therapeutically effective composition of claim 13, wherein an additional D-biotin is conjugated to an N-terminus $\alpha$-amine of the biologically active, water-soluble, cell-permeable, mitochondria-targeted compound.

15. The pharmaceutically acceptable and therapeutically effective composition of claim 13, wherein the composition comprises one or more vitamins selected from a vitamin group consisting of:

vitamin B1 (thiamine);
vitamin B2 (riboflavin);
niacin;
niacinamide;
vitamin B5 (pantothenic acid); and
pyridoxine.

16. The pharmaceutically acceptable and therapeutically effective composition of claim 13, wherein the composition comprises one or more amino acids selected from an amino acid group consisting of:
L-Leucine;
L-Isoleucine;
L-Valine;
L-Glutamine;
L-Serine;
L-Arginine;
L-Methionine;
L-Tryptophan;
Glycine; and
Taurine.

17. The pharmaceutically acceptable and therapeutically effective composition of claim 13, wherein the composition comprises one or more metabolic supplements selected from a metabolic supplement group consisting of:
pyruvate;
carnitine;
acetylcarnitine;
creatine;
$\alpha$-ketoglutarate;
$\alpha$-lipoic acid;
nicotinamide riboside; and

nicotinamide mononucleotide.

18. The pharmaceutically acceptable and therapeutically effective composition of claim 13, wherein the composition comprises:

a pharmaceutically acceptable carrier.