



**Title of Project: Matryoshka-type evolution**

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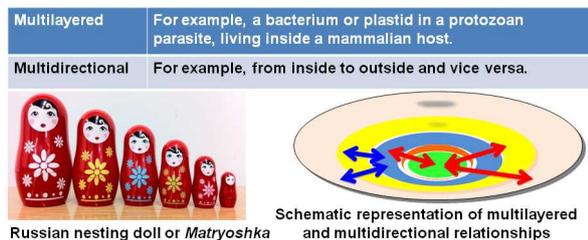
**【Purpose of the Research Project】**

The objective of this project is to understand the role of endosymbiosis in the evolution of eukaryotes and their organelles. The endosymbiotic theory for the origins of the mitochondria and chloroplasts is widely accepted, that is, these organelles originated as free-living bacteria taken inside another cell as endosymbionts. Our understanding, however, of the formation of secondary plastids and other complex structures, through successive rounds of endosymbiosis is incomplete. Similarly, adaptation mechanisms and enslavement in endosymbiont-host associations are poorly understood. The multilayered and multidirectional relationship between the endosymbiont and host cell mimics the Russian nesting doll called *Matryoshka*, and we designate the mechanisms involved in eukaryote evolution under such associations as *Matryoshka*-type evolution.

The objectives of our proposal are: (1) To discover ecosystems that facilitate the formation of endosymbiotic relationships, and understand the mechanisms involved; (2) To determine the diverse functions of endosymbiosis-derived compartments and organelles; (3) To establish the concept of organelle-driven evolution; and (4) To develop basic technologies to create artificial organelle-driven eukaryotic evolution *in vitro*.

**Fig. 1. New paradigm “Matryoshka-type evolution”**

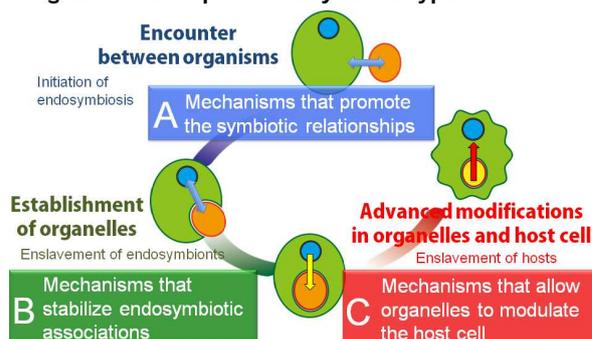
Multilayered and multidirectional relationship in endosymbiont-host associations lead to the evolution of eukaryotes and their organelles.



**【Content of the Research Project】**

The research project is divided into three parts based on the stages involved in the formation of endosymbiosis-derived compartments and organelles: (1) Requirements involved in the establishment of symbiosis and endosymbiosis; (2) Modifications undergone by endosymbionts and host cells during organelle establishment; (3) Advanced modifications in organelle functions that facilitate enslavement of the host cell to the endosymbiont.

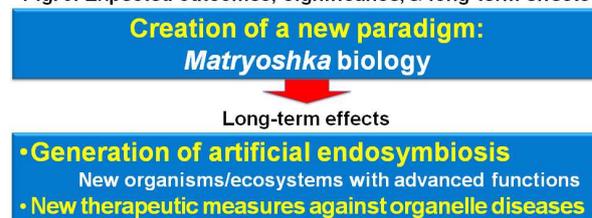
**Fig. 2. Three steps in “Matryoshka-type evolution”**



**【Expected Research Achievements and Scientific Significance】**

We expect to create and establish a new paradigm: that endosymbiosis is the major driving force in eukaryotic evolution, and that modifications in host cell functions are driven by endosymbiosis-derived organelles.

**Fig. 3. Expected outcomes, significance, & long-term effects**



**【Key Words】**

*Matryoshka*: Russian nesting doll; Endosymbiosis: A type of symbiotic relationship, or intimate and prolonged association between different organisms, in which one organism (endosymbiont) lives inside another organism (host) with the two participants typically behaving as a single organism.

**【Term of Project】** FY2011-2015

**【Budget Allocation】** 1,179,500 Thousand Yen

**【Homepage Address and Other Contact Information】**

<http://www.nih.go.jp/niid/para/matryoshka-evolution/>  
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