

Summary of Proposal

Host institution	Nagoya University
Chief entire-project officer (Head of host institution)	Dr. Michinari Hamaguchi, President of Nagoya University
Chief center-project officer	Dr. Kenichiro Itami Professor, Department of Chemistry, Graduate School of Science, Nagoya University
Center director	Dr. Kenichiro Itami Professor, Department of Chemistry, Graduate School of Science, Nagoya University
Center name	Institute of Transformative Bio-Molecules (ITbM)
Project Summary	Our goal is to develop innovative functional molecules that make a marked change in the form and nature of biological science and technology by taking full advantage of the cutting-edge molecular synthesis expertise of our chemistry principal investigators (PIs) and intense interactions with our leading plant/animal biology PIs. Through this interaction, which is fundamental to the Center, transformative bio-molecules will be synthesized that can (1) enhance biotic productivity and quality and (2) realize innovative bio-imaging . To ensure the advancement of these projects, we will (3) develop catalysts that enable incredibly efficient synthesis and molecule activation on demand . The ultimate goal is to have a positive impact on global issues such as food production. Our team of PIs is an innovative mix of chemists and biologists from Japan and abroad. A Co-PI system, and an efficient administration with English will ensure that international members will have significant involvement in the project.
Mission statement and/or Center identity	The mission of the Center is to develop diverse functional molecules that afford innovative impact on the operating principle of the biological systems. To accomplish this, we will harness our synthetic abilities based on molecule-activation chemistry (see below). We seek to effect a paradigm shift in science by creating a new field of research that aims to implement programmed chemical transformations in vivo for precisely controlling the production of bio-functional molecules of requisite structures and their functional expressions. The identity of this Center resides in the development of brand new synthetic bio-molecules that will affect this goal. To accomplish this, we will enlist the best synthetic chemists and plant and animal biologists worldwide.
Target research field	Target research field: Molecule-Activation Chemistry for Advanced Systems Biology (This is an area in which Nagoya University has significant international competitive advantages: synthetic chemistry, molecular catalysis, systems biology, plant science, peptide science, live-cell imaging.) The interface of chemistry and molecular biology has already resulted in important new research fields of significant scientific impact, such as chemical biology and medicinal chemistry. We plan to bring this to a new level by exploiting newly developed molecule-activation chemistry* partnered with fundamental biological systems of plants and animals. This research endeavor will have significant impacts in the closely related fields of chemical biology and medicinal chemistry, but most importantly, on areas that are of urgent global importance including world food production, medical care, and bioenergy. *Molecule-Activation Chemistry: The synthetic chemistry that enables the activation and direct transformation of stable, simple molecules into useful, complex structures. This methodology can rapidly convert biologically active "lead" molecules into more selective and active derivatives. Systems Biology: The biology to unveil the pivotal mechanism of how organisms function as a system. The discovery of key molecules operating biological systems at an individual organism level is crucial.
Research objectives	(1) To develop molecules that precisely control biotic function and production. Specifically, we will target (a) molecules that dramatically enhance plant growth based on the discovery of new signal transduction pathway of plant hormone auxin, (b) molecules that regulate season-sensing systems and reproduction in animals, and (c) molecules that can overcome species barriers in plant breeding to produce novel crops. (2) To develop innovative bio-imaging molecules and related photoelectronic molecular technologies that enable the visualization of biological phenomena at will. For instance, we will design and synthesize new fluorescent molecules that feature high luminance, low molecular weight, and controlled labeling properties. Meanwhile, we will propel the development of small-molecule catalysts for achieving ideal chemical synthesis, which can also be used for the selective activation and

	transformation of bio-molecules in vivo, in order to provide a viable method for realizing the two main objectives. Through these endeavors, we will create “transformative bio-molecules” that will dramatically change the way of research in chemistry, biology, and other related fields. Most importantly, we will make these molecules readily available for all the researchers in the world to expand the global impact of the Center.						
Outline of management	<p>The Center will take number of measures to remove the barriers that hinder interdisciplinary research and internationalization thereby triggering a fundamental transformation of existing academic systems.</p> <ol style="list-style-type: none"> (1) The Center Director will have the authority to make the final decisions over the appointment of personnel, the Center budget, and research priorities etc. (2) A rigorous evaluation of researchers will be made by the Evaluation Committees, and the results will be reflected in the salaries of researchers. (3) We will establish an effective and efficient administration with English-speaking staff for accelerating the true internationalization of the Center as well as the fusion of different research fields. This includes a talented administrative director with a strong background of scientific research. (4) We will introduce a Co-PI system, whereby bright young scientists are paired with overseas PIs to facilitate the research activities of the eminent foreign PIs in the Center. This will increase the worldwide visibility of the Center, facilitate research in Japan under the direction of overseas PIs and also help train the young researchers (Co-PIs) to be the scientific leaders of the next generation. (5) An international promotion unit will be developed. This unit will play the crucial role of providing researchers worldwide with access to the transformative bio-molecules developed at Nagoya. This will include negotiating issues with regard to intellectual property, accessibility of the molecules and technologies, and also the distribution and scale up of any molecules discovered at the Center. (6) We will support promising results that emerge from other researchers in Nagoya University. We will also make a strong commitment to nurture the next-generation of researchers through a productive cooperation with Nagoya University Program for Leading Graduate Schools and Global 30 International Programs. 						
Researchers and other center staffs, satellites, partner institutions	<table border="0"> <tr> <td>Number of Principal Investigators (number of foreign researchers)</td> <td>15 (5)</td> </tr> <tr> <td>Total number of researchers (number of foreign researchers)</td> <td>70 (35)</td> </tr> <tr> <td>Total number of people at the “core” of the Center</td> <td>130</td> </tr> </table> <p style="text-align: right;">as of March, 2016</p> <p>Principal Investigators (PIs): Kenichiro ITAMI, Tetsuya HIGASHIYAMA, <u>Jeffrey W. BODE</u>, Cathleen M. CRUDDEN*, Stephan IRLE, Toshinori KINOSHITA, Takashi OOI, Keiko TORII*, Shigehiro YAMAGUCHI, Takashi YOSHIMURA</p> <p style="text-align: center;"><i>10 PIs in total (we will hire additional 5 PIs), average age 43</i> <i><u>underlined names represent PIs from abroad; asterisks represent female PIs</u></i></p> <p>Cooperating Institutes: Queen’s University (Canada), University of Washington (USA), Eidgenössische Technische Hochschule, Zürich (Switzerland). These institutes are considered to be gateways to our Center and the PI who holds a position in the institute will engage in active collaboration directly and through research exchanges.</p> <p>Co-PI System: Overseas PIs are talented research stars in the world and will have double affiliations. We will introduce a system of Co-Principal Investigators (Co-PIs) to: (1) ensure close contact and continuity in the research maintained; and (2) mentor leading young researchers. Co-PIs will be based at Nagoya, but chosen and guided by the foreign PIs for actively managing their research groups in the Center. Co-PIs will be considered for promotion to full PI status when their research potential is realized.</p>	Number of Principal Investigators (number of foreign researchers)	15 (5)	Total number of researchers (number of foreign researchers)	70 (35)	Total number of people at the “core” of the Center	130
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Administrative director	Dr. Yoshihito Watanabe (Trustee, Vice-President, Nagoya University)						
Outline of research environment	<ol style="list-style-type: none"> (1) We will establish a Mix-Lab system, where international young researchers from different fields will work together in order to accelerate multidisciplinary advances through informal discussions on a daily basis. (2) All postdoctoral researchers and students will be supervised by two PIs from different fields (Co-supervising system) in order to accelerate collaboration and nurture the next generation of cutting-edge research, unrestricted by the bounds of traditional disciplines. (3) In order to ensure that excellent foreign PIs and Co-PIs will spend significant time at Nagoya, we will provide the following: (a) a team that is responsible for assisting them in applications for competitive domestic (Japanese) research funds; (b) opportunities for partners/spouses to hold positions in the University based on their skill sets (Dual Career Support); and (c) adequate information on education opportunities for the children of foreign PIs who may join them during their time at Nagoya. Through these mechanisms, we expect foreign PIs to base a significant portion of their activities at Nagoya, and we aim to attract a certain percentage of researchers permanently to Nagoya. 						

	<p>(4) Each new researcher will be provided sufficient research space and start-up funds.</p> <p>(5) We will locate the world's most advanced equipment and facilities in a single space at Nagoya University, staffed with expert equipment managers such that it is fully accessible for promoting research, international collaboration, and discovery.</p> <p>(6) We will engage in high-profile recruitment campaigns to attract highly qualified postdoctoral researchers using web sites with a global appeal describing current efforts of the Institute, University, and the international appeal of Nagoya City.</p>																																																
Outline of indicators for evaluating a center's global standing	<p>Three aspects are important for the global standing of the Center: 1) research quality and impact, 2) breakthroughs resulting from the inter-disciplinary research activities, and 3) human resources development as an international institute. The following is a selection of data for the current 10 PIs, which clearly indicate that we have a group of outstanding individuals.</p> <p>Numbers of paper in Science, Nature, and Nature sister journals: 15 Numbers of paper in high-impact journals (impact factor >9): 253 Numbers of keynote/plenary/invited lectures (last 4 years): >500 Selected awards, honors, and prestigious positions: <i>German Innovation Award (Itami), Novartis-MIT Lectureship Award (Itami), Vice President of International Association of Sexual Plant Reproduction Research (Higashiyama), President of Canadian Society for Chemistry (Crudden), IBM Japan Science Prize (Ooi), EJ Corey Award (Bode), Society of Biology Fellow (Yoshimura), Tokyo Techno Forum 21 Gold Medal (Yamaguchi), JSPS Prize (Torii, Yoshimura, Ooi, Higashiyama), Elected Fellow of AAAS, HHMI Investigator (Torii)</i></p>																																																
Securing research funding	<p>The PIs of this Center have received competitive research funding such as ERATO, CREST, NEXT Program, ALCA, and a Grant-in-Aid for Scientific Research on Innovative Areas (the average of FY 2007-2011 is 7.7 million USD / year). Thus, we are confident that similar or even greater amounts of funds will be obtained in future.</p>																																																
Exploiting the results of previously-initiated center-building efforts	<p>None: However, we will exploit the results of following past and current projects. <i>Chemistry Global COE program (JSPS), Biology Global COE program (JSPS), Research and Education Funding for Inter-University Research Project (MEXT), Japanese-German Graduate Externship (JSPS/DFG), Program for Leading Graduate Schools (JSPS), Re-Inventing Japan Project – Campus Asia Program (JSPS), Japan Advanced Plant Science Research Network, Live Imaging Center (MEXT).</i></p>																																																
Appropriations plan (Exchange Rate: JPY/USD=80)	<table border="1"> <thead> <tr> <th>FY</th> <th>2012</th> <th>2013</th> <th>2014</th> <th>2015</th> <th>2016</th> <th>2017</th> <th>2018</th> <th>2019</th> <th>2020</th> <th>2021</th> <th>Total (\$ millions)</th> </tr> </thead> <tbody> <tr> <td>WPI grant</td> <td>4.61</td> <td>7.76</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>82.37</td> </tr> <tr> <td>Funding for previously-initiated center-building efforts</td> <td>0</td> </tr> <tr> <td>Total</td> <td>4.61</td> <td>7.76</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>8.75</td> <td>82.37</td> </tr> </tbody> </table>	FY	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total (\$ millions)	WPI grant	4.61	7.76	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	82.37	Funding for previously-initiated center-building efforts	0	0	0	0	0	0	0	0	0	0	0	Total	4.61	7.76	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	82.37
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Summary of host institution's commitment	<p>Nagoya University (hereinafter referred to as "NU") aims to conduct world-class research and internationalization based on the Academic Charter and the Hamaguchi Plan. In accord with these declarations, NU will treat the Center with special rules enabling the Center to most easily achieve its goals, thus playing a key role in the academic mission of NU. If this proposal is successful, NU will amend its <i>Midterm Plans</i> and <i>Research Promotion and Strategy Plans</i> specifically with regard to the WPI and the Center. The major ways in which NU is supporting this Center are given below.</p> <p>Perpetuation of the Center: NU has agreed to sustain the Center's pioneering research activities after the WPI-grant period ends. In order to do so, NU will allocate the Center as part of the Institute of Advanced Research, which has been established as an institute independent from the other departments and research centers at NU.</p> <p>System Reform: The University rules will be revised to: give executive authority to the Center Director to make top-down decisions on the important matters of the Center; enable the Center to be independent in the execution of its budget; and allow the Center to develop its own personnel policies and management, such as allowing double affiliation and introducing performance-based salaries. NU will assign a member of their Board of Trustees/Vice-President as the Administrative Director to help accelerate the system reform in not only the Center but also the entire university.</p> <p>Provision of Building Space: NU will provide 6,000 m² of building space to establish the Center. To further promote the WPI-catalyzed interdisciplinary research, NU is planning to build a new building within the context of NU's strategy for research system reform. NU will also offer living accommodations for foreign PIs and collaborators.</p> <p>Financial and Personnel Assistance: NU will continue to cover the equivalent amount of the salaries of researchers at the Center who already hold posts at NU. NU will assign 7 associate professors, who will assist in teaching at the departmental level, and to maintain high-level education. NU will provide opportunities for partners/spouses of foreign PIs to hold positions in NU (Dual Career Support).</p>																																																

Note: Supplemental documents in PPT format may be attached to make the summary of the center project easier to understand (up to 10 pages, in English).