Communicative framework for Broader Impacts (BI) sections in NSF grant proposals
(based on 2005-2012 data)

Move 1: Contextualizing broader impacts
　　　Step 1: Drawing on an established territory
　　　　　1a: Drawing on real-world context
　　　　　1b: Drawing on a targeted context
　　　　　1c: Drawing on previous research
　　　　　1d: Drawing on current proposal
　　　Step 2: Claiming centrality
　　　Step 3: Highlighting a problem
Move 2: Demonstrating tangible broader impacts
　　　Step 1: Describing BI intent*
　　　　　(Teaching, training and learning
　　　　　Participation of underrepresented groups
　　　　　Infrastructure for research and education
　　　　　Dissemination
　　　　　Benefits to targeted individuals/groups)
　　　Step 2: Claiming context relevance
　　　Step 3: Asserting competency
　　　Step 4: Evaluating BI
Move 3: Claiming importance
Step 1: Envisioning scientific contributions
Step 2: Envisioning practical contributions

*NSF has added: Increased partnerships between academia, industry, etc.; improved national security; and increased economic competitiveness of the U.S.

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Move 1: Contextualizing broader impacts

The purpose of this move is to contextualize the envisioned broader impacts, foregrounding BI claims with background information that is of relevance to the proposed research and/or follow-up BI activities. Authors typically integrate various details about the real world and/or the targeted context, supporting them with specific evidence that derives from empirical research or other credible sources. Such information is provided not only to build a frame of reference for the proposed BI activities, but also to implicitly emphasize the significance and relevance of the proposed work to important real-world problems and to further present the BI activities as opportunities to address those problems. The strategies that can help achieve the communicative goal of Move 1 are:

Step 1: Drawing on an established territory (i.e., real-world context, targeted context, previous research, current proposal)
Step 2: Claiming centrality
Step 3: Highlighting a problem

STEP: FUNCTIONAL REALIZATIONS	CONTENT REALIZATIONS	EXAMPLES
Step 1a: Drawing on real-world context situates the proposed project and/or BI activities in the world outside the proposed research project.	Can be realized by providing: - relevant general information - relevant domain-specific information - information regarding current state/ national/global policies and decisions - facts or statistics from credible sources (without attribution to research findings or publications, but may have citations from non-research documents).	• *They are found in three different families not related by amino acid sequence.* • *U.S. efforts to reduce its dependency on foreign crude oil through the use of domestic biofuel production are defended on three grounds: national security, energy security, and environmental protection.* • *The U.S. reserves of […] (~ 14% of world's reserves) are about 3,000 metric tons (http://www....).*
Step 1b: Drawing on a targeted context situates the proposed project and/or BI activities in a specific, local context surrounding the proposed research or the BI activities.	Can be realized by describing aspects of the targeted context/s: - current activities of the PIs (e.g. a course the PI is teaching) - current activities of the project participants as well as of representative student groups (e.g. completed assignments)	• *PI […] teaches the sophomore-level […] with an average enrollment of […] students per semester.* • *Currently our students are exposed to […] in three courses: at the freshman level, sophomore level and finally the capstone […] course at the senior level.* • *[…] also provides professional development seminars for undergraduates interested in a research career.*

	- structure, functionality, composition, role, etc. of participating units (e.g. organization, program, club) - existing resources and facilities - ongoing and/or future projects in the targeted context.	• *In this school district, […%] of the students participate in the free and reduced meal program.*
Step 1c: Drawing on previous research situates the proposed project and/or BI activities in a given research space by providing empirical background to the topic of investigation	Can be realized by: - referring to research-based knowledge in the field - referring to preliminary research conducted by the proposers in preparation for the grant and/or to evaluate related previous work.	• *Small […] viruses such as […] provide a viable alternative to the application of […] for […] management (20, 44).* • *This is a follow-up of an earlier experiment in which we found that […] caused lower reductions in […] than […] when each species was seeded three weeks before other species (Author, Author and Author in preparation).*
Step 1d: Drawing on current proposal establishes relevant connections to the current proposal.	Can be realized by: - restating the purpose of proposed research - referring to methodology of proposed research - rationalizing and justifying the methodological approach - referring to content presented elsewhere in the proposal - showing relevance of proposed work vis-s-vis NSF's goals or other standards.	• *The proposed research will investigate the capability of the […] generation of […] to simulate extreme daily […] and its […] causes.* • *A second benefit of this approach is that it demonstrates that a common set of experiences can have widespread effects within the same individuals.* • *See the attached letter of collaboration from the director of […]' […] Program.*
Step 2: Claiming centrality affirms that the topic/problem addressed in the proposal is important.	Can be realized by: - stating that there is a considerable degree of interest in the topic/problem - indicating that the topic/problem/proposed idea/activity is of great importance - indicating how prominent the topic/problem has become.	• *This is of the utmost importance as contemporary […] are not only expected to possess technical expertise but to integrate science and technology into society as a whole.* • *[…] is the essential component of […], our nation's key infrastructure component.*

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Step 3: Highlighting a problem calls attention to existing issues in the real world and/or research that cause challenges to particular areas of practice, and emphasizes the importance of addressing them.	Can be realized by: - stating an existing problem in the real-world or in the targeted context (e.g. controversies and debates at national/societal level, difficulty in finding alternatives or solutions, potential negative impacts, high costs) - identifying a gap or incomplete knowledge in previous research as well as lacking practical applications - justifying the need to address the problem or gap; may sound like a call for action.	• *However, in full recognition and admiration of the […]'s noble effort, this […] regulation could also cause substantial harm to the American public.* • *While […] is a fairly common method for increasing […], very few […] projects result in a production of an "engineering roadmap" for use by others.* • *If policy makers and land managers are to address these changes effectively and move our […]toward a positive future, they need to understand how these drivers affect local processes and which policies and decisions lead to outcomes that are sustainable, resilient, and preserve the adaptive capacity needed to adjust to new and unforeseen threats and opportunities.*

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Move 2: Demonstrating tangible broader impacts

The purpose of this move is to clearly address the merit review criterion by describing specific BI activities, which will exert tangible benefits. Authors generally demonstrate expected positive impact with very specific information about intended activities, means of implementation, and proof of expertise. They also discuss the relevance and suitability of their context for their BI plans, address their own competency and that of additional staff, students, and programs, and provide information about how they plan to evaluate the effectiveness of their BI activities. The strategies that can help achieve the communicative goal of Move 2 are:

> **Step 1: Describing BI intent** (teaching, training and learning; participation of underrepresented groups; infrastructure for research and education; increased partnerships between academia, industry, and other; dissemination; benefits to targeted individuals/groups; improved national security; increased economic competitiveness of the U.S.)
> **Step 2: Claiming context relevance**
> **Step 3: Asserting competency**
> **Step 4: Evaluating BI**

STEP: FUNCTIONAL REALIZATIONS	CONTENT REALIZATIONS	EXAMPLES
Step 1: Describing BI intent proposes and elaborates on specific BI activities to demonstrate tangible impacts of the proposed project.	Can be realized by: - announcing representative BI activities recommended by NSF - elaborating with details about the proposed BI activities - clarifying means that will be employed to accomplish the BI intent - specifying deliverables.	• *We will work closely with […] and […] in the […] to recruit participants from underrepresented groups who will engage in semester research experiences and as summer field research assistants.* • *Using hands-on activities, […] methods, and field study, students will explore the diversity of […] and their use as […] of […] quality.* • *Undergraduates who will work on this as an REU project will obtain a valuable […] science and […] understanding of such important fields as […].* • *In addition to providing collaborative links between [..] and […], this project will enhance infrastructure by providing for interactions between members of […] and members of […], which will foster interdisciplinary approaches to […] questions.*

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Step 2: Claiming context relevance demonstrates that the targeted context(s) is(are) appropriate for and indicative of successful implementation of the proposed BI activities.	Can be realized by showing the relevance of: - local programs, initiatives, courses, resources, technologies, equipment, products, etc. - existing relationships with partnering groups/organizations - evidence of interest/support from partnering organizations both within and outside of the university.	• *Iowa State University has a strong history of promoting the participation of underrepresented groups, as demonstrated by its […] program linked to underrepresented groups in inner-city schools.* • *For those who wish to remain in academia, ISU offers a comprehensive and intensive […] program that includes training in […] skills, […], and […] management.* • *The workshop will take place in a state-of-the-art teaching/research classroom.*
Step 3: Asserting competency provides evidence of competency acquired by the project proposers and/or participants, which underscore the potential success of the BI activities.	Can be realized by making claims about the reputation/skills/experience/attributes of the proposers, including: - research excellence - mentoring/teaching experience - current opportunities and achievements of mentored students - streamlining with previous grants and successes - initiating and/or maintaining relationships - sharing resources with non-university groups and/or individuals.	• *The PIs are leading faculty in that center.* • *PI's efforts in developing this […] were recently recognized by an award from […].* • *The three most recent undergraduate women who worked in the PI's lab are all pursuing careers in […]; two are graduate students at […] and one is a postdoc at […].* • *PI […] has been highly successful in obtaining extramural grants and establishing collaborations with other […] experts and leading […] around the globe.*
Step 4: Evaluating BI demonstrates how the BI activities will be assessed.	Can be realized by: - clearly mentioning outcome measures - making predictive claims of effectiveness of BI activity outcomes - implicitly indicating potential for success - showing compliance with NSF or national standards, regulations, laws, etc.	• *Since we will have "traditional" course sections in […] being taught in parallel with the […] sections, we will at one level evaluate student performance in […] by doing comparative testing during the semesters and at the finals.* • *We fully anticipate the female participation to increase significantly as the […] courses are more widely advertised across campus to the […](…% female) as well as […] (…% female) colleges.*

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Move 3: Claiming importance

The purpose of this move is to argue that the proposed project will have valuable societal implications, which go beyond the tangible impacts to be exerted through the proposed BI activities. Authors claim larger and longer term scientific and practical contributions of their work, showing how their work will expand the research territory and enrich the real-world territory with science-based practical implementations. The strategies that can help achieve the communicative goal of Move 3 are:

   Step 1: Envisioning scientific contributions

   Step 2: Envisioning practical contributions

STEP: FUNCTIONAL REALIZATIONS	CONTENT REALIZATIONS	EXAMPLES
Step 1: Envisioning scientific contributions claims significant contribution of the new scientific discoveries to the research field.	Can be realized by: - predicting notable advancements in the research field - anticipating use/applicability of findings for conducting future research.	• *The proposed […] framework will bring to the science community a new perspective and an invaluable tool for studying the functions of […] that are constantly in motion.* • *Collectively, these investigations will allow for the development of a detailed description of the […] and […] activity, and consequently more accurate descriptions of […] can be developed in future research projects.*
Step 2: Envisioning practical contributions claims significant potential to advance desired societal outcomes.	Can be realized by: - predicting contributions of science to the real world (e.g. to national/societal welfare, security, public policy, health, environment, critical situations, decision-making, etc.) - indicating the direction in which the contribution will be made.	• *In addition, this research will help […] businesses, governmental agencies, and non-governmental organizations deal with conflict and miscommunication when working in collectivist, honor-based cultures.* • *This will transform […] design the same way the design of […] was revolutionized because of these technologies' low-power fast-switching capabilities.* • *It has direct implications for the quantification and stability of […] that is buried by […] as well as development of cost-effective techniques to quantify stable […] in […] in general.*

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