Table 1. Overview of SEARCH Priority Activities. *The first column, "Activity," lists the proposed activities organized by science question. The second column, "Priority/Phasing," rates the activity (1–3, with 1 representing highest priority) in terms of importance to SEARCH science objectives, fit with international activities, and readiness for implementation. The third column, "Additional Questions," references additional key science questions addressed by the activity, as described in Section 3 of the report. The fourth column lists the section(s) in the report that can be consulted for further information.*

Activity	Priority/ Phasing	Additional Questions	Section
1. Is the arctic system moving to a new state?			
Observing Activities (Page 9):			
(a) Construct a high-resolution (10^0–10^1 year) multiproxy spatial and temporal paleoclimate network extending back 2,000 years	1	2, 3, 5, 7	4.1.6
(b) Enhance and stabilize the distribution and continuity of the upper-air, surface climatology, and weather observation networks, including integration of cryospheric, hydrologic, and oceanic variables	1	2, 3, 4	4.1.1
(c) On land, initiate at least one intensive site for integrated time series measurements that include climate, surface energy balance, hydrology, glaciology, trace gases, permafrost/active layer, C/N/P budgets, species composition, vegetation structure, and contaminant compounds; apply new technology, numerical analyses, and remote sensing to extrapolate field measurements to high quality circumarctic gridded datasets	1	3, 4, 5, 7	4.1.4
(d) Develop an integrated observation network for identification and long-term monitoring of social and economic indicators of human subsystem changes that drive and/or feed back to arctic physical and biological system changes	1	2, 3, 4, 5, 6	4.1.5
(e) Implement automated monitoring in the ocean and for sea ice of key biological and chemical parameters coincident with physical observations (including key energy balance terms and fluxes) over annual cycles at critical representative locations	1	2, 4, 5	4.1.2
(f) Determine pan-arctic and regional mass budget parameters for sea ice and overlying snow (including key snow/ice properties) from remote sensing, surveys, and buoys, with adequate attention to both seasonal and perennial sea ice zones	1	2, 4, 5	4.1.2
(g) Determine water balance components in flagship research watersheds, key benchmark glaciers, and on the Greenland Ice Sheet through field measurements, remote sensing and modeling	1	2, 4, 7	4.1.3
(h) Determine the degree to which people across the Arctic are observing environmental change that exceeds the bounds of understood experience	2	2, 5, 6	4.1.5
Understanding Activities (Page 36):			
(i) Synthesize existing observations from the past several decades by an Integrative Data Assimilation for the Arctic System (IDAAS), producing a gridded database with maximum homogeneity for detection and attribution of arctic change	1	3, 4, 5	4.2.1
(j) Conduct observing system sensitivity experiments with models, drawing upon enhanced observations from the IPY, to design optimal observing networks and sampling strategies for monitoring the arctic system in the post-IPY period	1	5	4.2.1
(k) Synthesize human dimensions data on a pan-arctic scale, including data on resident socioeconomic changes, human perceptions (local, regional, and non-arctic) of arctic change, and on local and global-scale development and industrial activities	1	5, 6, 7	4.2.1

Responding Activities (Page 43):			
(l) Identify specific ways to improve knowledge of arctic environmental change such that people are enabled to make better-informed decisions	1	2, 3, 4, 5, 6, 7	4.3.1
(m) Determine and assess the ways in which stakeholder and residents' perceptions of an arctic state change affects responses to change	3	6	4.3.1
2. To what extent is the arctic system predictable (i.e., what are the potential accuracies and/or uncertainties in predictions of relevant arctic variables over different timescales)?			
Observing Activities (Page 9):			
(a) Repeat hydrographic sections across major frontal features of the Arctic Ocean; build on international programs and collaborations and use remote sensing to provide broader spatial coverage	1	1, 3, 4, 5, 7	4.1.2
(b) Determine spatial variation and temporal patterns of permafrost degradation, glacier ablation, and changing water resources	1	1, 4, 5, 6	4.1.3
Understanding Activities (Page 36):			
(c) Perform coordinated sets of model experiments targeted at understanding arctic change and reducing uncertainty in projections of future arctic change; include ensembles of simulations, process sensitivity studies, and downscaling to local information	2	1, 3, 4, 7	4.2.2
(d) Develop and conduct experiments with linked social-ecological models to assess the predictability of associated ecosystem changes and human adaptations	2	4, 5, 6	4.2.2
(e) Process climate datasets quickly enough to be useful for short-term forecasting, and calibrate and archive weather datasets for use in climate studies	3	6	4.2.2
Responding Activities (Page 43):			
(f) Identify predictions that will be most useful to stakeholder groups planning for and responding to change in areas such as fisheries, marine transportation and development, and renewable resource use/subsistence harvests	1	6	4.3.2
(g) Quantify and communicate the uncertainties in forecasts of changes in key variables in the arctic system	1	5, 6, 7	4.3.1
(h) Evaluate the effectiveness of different methods of expressing uncertainty in facilitating adaptive responses to change	3	6	4.3.1
3. To what extent can recent and ongoing climate changes in the Arctic be attributed to anthropogenic forcing, rather than to natural modes of variability?			
Observing Activities (Page 9):			
(a) Construct decadal-resolution multiproxy records from earlier warmer periods, particularly the early Holocene thermal maximum and Last Interglaciation	2	1, 3, 5, 7	4.1.6
(b) Coordinate atmosphere, ocean, and sea ice observation efforts to significantly enhance understanding of regional differences	2	1, 2	4.1.1, 4.1.2
(c) Improve quantification of essential paleo-proxies (sea ice, precipitation, temperature) through sampling and proxy measurements co-sited with terrestrial and marine instrumental observatories	3	1, 5	4.1.6
Understanding Activities (Page 36):			
(d) Conduct experiments and sensitivity tests with updated models to determine the portion of the recent changes in the Arctic attributable to increased greenhouse gas concentrations and aerosols relative to other large-scale drivers	1	1, 2, 4, 7	4.2.3

(e) Integrate observations of terrestrial, marine, and atmospheric variables from diverse sources into readily accessible databases suitable for integrated (across-variable) assessments of change, especially in the context of large-scale drivers such as the Arctic Oscillation, Pacific Decadal Oscillation, and greenhouse forcing	2	1, 4, 5, 6, 7	4.2.3
Responding Activities (Page 43):			
(f) Translate modeling results aimed at understanding the causes of climate change into a form useful to the many different groups of stakeholders	2	4	4.3.4
(g) Assess the effect of understanding the role of anthropogenic forcing on climate change in shaping responses to change	3	6	4.3.1
4. What is the direction and relative importance of system feedbacks?			
Observing Activities (Page 9):			
(a) Characterize permafrost and hydrological controls on vegetation change and quantify the resultant impact of ecosystem change on freshwater fluxes and biogeochemistry	2	2, 5, 6	4.1.3, 4.1.4
Understanding Activities (Page 36):			
(b) Improve and expand capabilities of models used for arctic simulations by enhancing formulations of key arctic processes (surface energy budget, clouds, vegetative effects, ocean/ice transports, and land and water use changes)	2	2, 3	4.2.4
Responding Activities (Page 43):			
(c) Assess the interaction of stakeholder responses to change with the direction and relative importance of system feedbacks	3	6	4.3.1
5. How are terrestrial and marine ecosystems and ecosystem services (i.e., processes by which the environment produces resources that support human life) affected by environmental change and its interaction with human activities?			
Observing Activities (Page 9):			
(a) Determine abundance and distribution of marine animals and pelagic/benthic communities, including measurements of key biophysical ocean and sea ice variables	2	6	4.1.2
(b) Work with stakeholders and resource managers to organize local ecological monitoring networks to collect and share data on regional ecological changes, including near-real time observations relevant to ecosystems and ecosystem services	2	1, 2, 6	4.1.5
(c) Integrate hydrology and glacier measurements with ecosystem dynamics	3	1, 2, 4, 6	4.1.3, 4.1.4
Understanding Activities (Page 36):			
(d) Synthesize information and modeling on ecosystem components and their interactions, assessment of freshwater flux, and marine ecosystem modeling, including the contribution of resource harvests and other human activities	2	6	4.2.5
(e) Develop an understanding of how to scale process and mechanistic knowledge in space and time, initially through focused studies on key variables and interactions (e.g., surface energy balance, trace gases, land vegetation cover); requires multi-scale observations, pan-arctic comparisons, modeling, and remote sensing	2	1, 2, 4, 6, 7	4.1.5

Responding Activities (Page 43):			
(f) Assess how human responses interact with changes in ecosystems and ecosystem services	3	6	4.3.1
6. How do cultural and socioeconomic systems interact with arctic environmental change?			
Observing Activities (Page 9):			
(a) Establish data outlets for near-real time observations relevant to stakeholder groups	1	1, 2, 4, 5, 7	4.1.5, 4.3.3
(b) Develop a pan-arctic database of key human dimensions indicators of population, employment, and subsistence	1	5	4.1.5
(c) Develop a coastal ocean-ice-atmosphere observation network providing data relevant to stakeholders (e.g., subsistence hunt safety, navigational hazards, storm surges, threats to coastal infrastructure, etc.)	2	5, 7	4.2.6
(d) Determine abundance and distribution of key commercial and subsistence species and integrate into database coupled with relevant environmental data	2	5	4.3.2
(e) Compile coastal dynamics and long-term tide and storm surge data	3	2, 5	4.1.2
Understanding Activities (Page 36):			
(f) Develop socioeconomic models incorporating ecosystem services; conduct qualitative and quantitative research on resilience of social-ecological systems	1	5	4.2.6
Responding Activities (Page 43):			
(g) Establish or identify community/industry networks and cooperatives, focusing on a variety of activities, including data gathering, identifying relevant predictions of change, and interpreting results in context of local and scientific knowledge	1	1, 2, 4, 5, 7	4.3.4
(h) Characterize the ongoing and potential effects on infrastructure resulting from permafrost degradation	2	5	4.1.3
(i) Assess the responsiveness and effectiveness of local, regional, and national institutions in addressing societal concerns about climate change in the context of other forces for change	3	5	4.3.2
7. What are the most consequential links between the arctic and the earth systems?			
Observing Activities (Page 9):			
(a) Enhance observations of heat, salt, and volume fluxes through straits connecting the Arctic with the north Pacific and Atlantic Oceans	2	1, 2, 3, 4, 5	4.1.2
(b) Monitor perceptions of temperate zone residents on arctic climate change and its consequences	2	6	4.1.5
(c) Integrate glacier and ice sheet mass balance measurements with observations of climate dynamics	2	1, 2, 4	4.1.3
Understanding Activities (Page 36):			
(d) Conduct controlled model experiments to understand global-arctic linkages focused on key physical linkages, effects of arctic warming on global sea level, and effects of hydrological changes on the North Atlantic	2	4	4.2.7
Responding Activities (Page 43):			
(e) Identify long-term effects of reduction in sea ice and sea level changes on arctic shipping, resource development and harvests, global markets, and international security	3	5	4.3.1

8. Data Management Strategy (Page 47)			
(a) Form a SEARCH Data Management Advisory Group:	1	All	5.3
Develop SEARCH Data Policy	1	All	5.3
Develop comprehensive SEARCH Data Management Plan	1	All	5.3
Develop SEARCH Data Inventory	1	All	5.3
Establish data management requirements for SEARCH investigators	1	All	5.3
Create a central SEARCH Data and Information Coordination Service	1	All	5.3
(b) Rescue and incorporate relevant historical data	2	All	5.3
9. Education and Outreach (Page 53)			
(a) Develop education and outreach sections and activities on SEARCH website, including K–12 and educational content, press links, and community-relevant content	1	All	6.4
(b) Develop comprehensive guide with information on ways in which individual SEARCH researchers and projects can participate in education and outreach efforts	1	All	6.4
(c) Implement a SEARCH-focused multi-agency Research Experience for Teachers program	2	All	6.4
(d) Initiate SEARCH-focused, student-centered informal science education programs integrated with community monitoring network activities, field research programs, and use of SEARCH datasets	2	All	6.4