I. How Can I Use All or Parts of this Exercise in my Class?

(based on Project 2061 instructional materials design)

	Part 11.1	**Part 11.2**	**Part 11.3**
Title (of each part)	What do we think we know about the History of Antarctica Climate?	What is Antarctica's Geographic and Geologic Context?	Selecting The Best Drillsites for the Science Objectives
How much class time will I need? (per part)	20–40 mins (depends on how much review is needed)	60-120 mins (depends on amount of discussion and extra material used, or 'mini-lectures' given)	20-60 mins (depends on student level and amount of discussion)
Can this be done independently (i.e., as homework)?	Yes. Would need follow-up presentation and discussion in class	Yes. May need in-class preparation. Would need follow-up discussion in class	Yes. Would need follow-up discussion in class
What content will students be introduced to in this exercise?			
Science as human endeavor			
Judgement, decision-making, problem-solving	x	x	x
Science as an evolving process / Nature of Science	x		x
New Research builds on previous research	x	x	x
Unexpected discoveries	x	x	x
Exploratory research vs. focused questions			x
Research enabled by technology (technology change through time)			x

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Earth History Archives (nature of the sedimentary record)			
How do you know about earth history? Types of archives outcrops vs. cores	x	x	x
Where do you go to learn about earth history? Land vs. sea vs. ice	x	x	x
Geographic awareness	x	x	x
Awareness of deep time			
Marine sediments (distribution & controls on distribution)	x	x	x
Stratigraphic Principles			
Relative dating	x	x	x
Correlation		x	x
Stable isotopes	x		
Subdivisions of geologic time	x	x	x
Unconformities, hiatuses, missing records		x	x
Climate Change			
Glacial-interglacial cycles	x		x
Climate change can be gradual	x		x
Greenhouse - Icehouse	x		x
Climate change can be abrupt	x		x
Present day rates of change		x	
Regional to global scales of change	x		
Ocean-atmosphere-biosphere-cryosphere system interactions/feedbacks	x	x	
High latitude climate change sensitivity	x	x	
What types of transportable skills will students practice in this exercise?			
Make observations (describe what you see)	x	x	x
Recognize trends (abrupt vs. gradual vs. patterns)	x		x
Plot data – map, graph, pictoral form		x	
Interpret graphs, diagrams, photos, tables	x	x	x
Make hypotheses or predictions	x		
Test a hypothesis	x		

Critical reading & analysis		x	
Synthesize/integrate & draw broad conclusions		x	x
Perform calculations (rates, averages, unit conversions) & develop quantitative skills		x	x
Written communication	x	x	x
Oral communication			
Making persuasive, well supported arguments	x	x	x
Identifying assumptions & ambiguity	x		
Levels & types of uncertainty (quantitative vs. qualitative)	x		x
Significance/evaluation of uncertainties & ambiguity	x		
What general prerequisite knowledge & skills are required?	None required, but prior exposure to the following topics would be helpful: 1.Use of oxygen isotopes 2. Nature of sediment cores 3. General stratigraphic principles 4.General geologic time scale 5. Simple map and graph reading	1.Basic map- reading skills (incl. geologic maps) 2. Basic knowledge of rock types 3. Basic understanding of geologic time scale 4. Basic math skills	1.Basic map-reading skills 2. Basic understanding of geologic time scale 3. Basic knowledge of what a sed core is 4.Basic math skills
What Anchor Exercises (or Parts of Exercises) should be done prior to this to guide student interpretation & reasoning?	1.Intro to Cores exercises; 2.Cenozoic Overview exercises; 3.Seafloor Sediments exercises	1.None required, but helpful to do Part 1 of this exercise 2.Could provide additional background by doing Intro to cores exercise, Sea floor sediments exercise, & Cenozoic Overview exercise	1. Parts 1 and 2 of this exercise 2. Could provide additional background by doing Intro to cores exercise, Sea floor sediments exercise, & Cenozoic Overview exercise

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What other resources or materials do I need? (e.g., internet access to show on-line video; access to maps, colored pencils)	1.World map or globe 2.Geologic time scale 3.Document camera or over head projector for discussions 4.Online connection for access to additional drillcore information and videos	1.World map or globe 2. Geologic time scale 3.Internet/projector to show/watch NASA & ANDRILL videos 4. Maps / materials for reviewing 'reasons for the seasons' and east vs. west in Antarctica 5.Calculators	1.World map or globe 2.Map of Antarctica & Ross Sea region 3.Internet & projector to show maps/cross sections 4. Maps / materials for reviewing 'reasons for the seasons' and east vs. west in Antarctica 5.Calculators
What student misconception does this exercise address?	1.Antarctica is just ice 2.There have always been ice sheets in Antarctica 3.Volcanic rocks are only found in 'warm' areas 4.Because it is far away Antarctica is not relevant 5.Generalized data (i.e. global data) tell one about exact conditions at a specific locality 6.Sediment cores only tell one about what happened in their immediate vicinity	1.Variability within the cryosphere 2.Hemispheric control on seasons 3.Antarctica has always been cold 4. Polar deserts 5. No rocks in Antarctica 6.We can infer events when we don't have a direct record of them 7. Good datasets are not usually pure luck–the research is carefully planned	1.There is nothing on the seafloor 2.The sedimentary record is discontinuous 3.Antarctica's climate has changed 4.Scientists can always figure out the 'right' answer straight away 5.Scientists may 'get lucky' with results sometimes, but most science requires careful planning
What forms of data are used in this? (e.g., graphs, tables, photos, maps)	Graph, map	Videos, maps, tables, cross-sections	Map, stratigraphic summary chart, table, cross section
What geographic locations are these datasets from?	Global distribution of data	Antarctica (Ross Sea Region)	Antarctica (Ross Sea region)

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How can I use this exercise to identify my students' prior knowledge (i.e., student misconceptions, commonly held beliefs)?	Instructor 'grading' of exercises checks on student understanding of: 1.Oxygen isotope curve 2.Role Antarctica plays in controlling global climate (global conveyor belt) 3.How sediment core data is used to interpret past climate	Instructor 'grading' of exercises checks on student understanding of: 1.Reasons for the seasons & seasonality in the southern hemisphere 2.Latitude & Longitude 3.Reading time scales, geologic maps and cross- sections	Instructor 'grading' of exercises checks on student understanding of: 1.Map reading skills 2.Unconformities 3.Stratigraphic summary charts 4.What data are needed to support a hypothesis 5.Ability to think geologically 6. Ability to place detailed study in global context
How can I encourage students to reflect on what they have learned in this exercise? [Formative Assessment]	1.Ask students: what they found interesting/useful? 2.Ask students: what was new? 3.Ask students: what questions it makes them want to ask?		
How can I assess student learning after they complete all or part of the exercise? [Summative Assessment]	See suggestions in Summative Assessment section below.		
Where can I go to for more information on the science in this exercise?	See the supplemental materials and reference sections below.		
What is the Context for use of these exercises?	This could be used as a final review & capstone activity in an introductory geoscience course, or as an introductory review in an upper-level geoscience course. Part 2 could simply be used to introduce students to the cryosphere. Part 1 assumes some awareness of oxygen isotopes – Use the Cenozoic Overview exercises. Part 1 could be a stand-alone exercise. Part 1 could be done after Part 2. Part 3 could be a stand-alone exercise IF students are adequately prepared.		