

Writing an NIH Grant

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Reality Check BY DAVID SIPRESS



Hi, Honey—how's everything in the world of academia?

INVESTIGATOR

**INITIATES
RESEARCH IDEA**

**SCHOOL OR OTHER
RESEARCH CENTER**

**SUBMITS
APPLICATION**

**ALLOCATES
FUNDS**

**CONDUCTS
RESEARCH**

**NATIONAL INSTITUTES
OF HEALTH**

**NIH
DIVISION OF
RESEARCH GRANTS
ASSIGNS TO STUDY SECTION
& INSTITUTE**

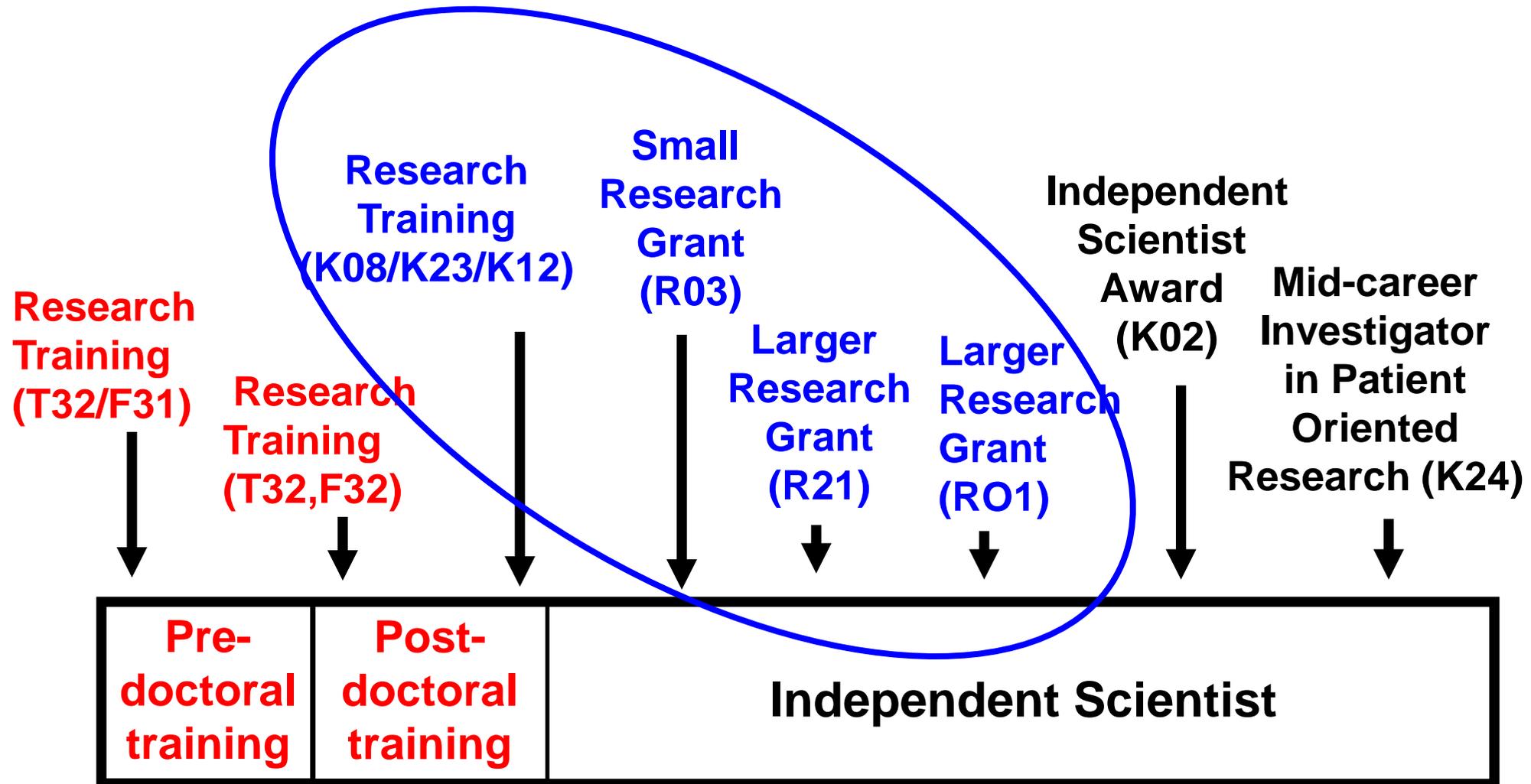
**STUDY SECTION
EVALUATES FOR SCIENTIFIC MERIT**

**INSTITUTE
EVALUATES FOR PROGRAM RELEVANCE**

**ADVISORY COUNCIL
RECOMMENDS ACTION**

**INSTITUTE DIRECTOR
TAKES FINAL ACTION
FOR NIH
DIRECTOR**

What To Apply For?



DEPARTMENT OF HEALTH AND HUMAN SERVICES PUBLIC HEALTH SERVICE		LEAVE BLANK FOR PHS USE ONLY.	
GRANT APPLICATION Follow instructions carefully. Type in the unshaded areas only. Type density must be 10 cpi.		Type	Number
		Review Group	Formality
		Council Board (Month, Year)	Date Received
1. TITLE OF PROJECT (Do not exceed 56 typewriter spaces)			
2a. RESPONSE TO SPECIFIC REQUEST FOR APPLICATIONS OR PROGRAM ANNOUNCEMENT <input type="checkbox"/> NO <input type="checkbox"/> YES (If "YES," state Number and title)			
2b. TYPE OF GRANT PROGRAM		3. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR	
3a. NAME (Last, first, middle)		3a. DEGREE(S)	3c. SOCIAL SECURITY NO.
3d. POSITION TITLE		3e. MAILING ADDRESS (Street, city, state, zip code)	
3f. DEPARTMENT, SERVICE, LABORATORY, OR EQUIVALENT		BITNET/INTERNET ADDRESS	
3g. MAJOR SUBDIVISION			
3h. TELEPHONE AND FAX (Area code, number and extension) TEL: FAX:			
4. HUMAN SUBJECTS		5. VERTEBRATE ANIMALS	
<input type="checkbox"/> 4a. NO <input type="checkbox"/> YES <input type="checkbox"/> "Yes," exemption no. of <input type="checkbox"/> approval date <input type="checkbox"/> Assurance of compliance no.		<input type="checkbox"/> 5a. NO <input type="checkbox"/> YES <input type="checkbox"/> "Yes," IACUC approval date <input type="checkbox"/> Animal welfare assurance no.	
6. DATES OF ENTIRE PROPOSED PROJECT PERIOD		7. COSTS REQUESTED FOR INITIAL BUDGET PERIOD	
From (MM/DD/YY) Through (MM/DD/YY)		7a. Direct Costs (\$) 7b. Total Costs (\$)	
		8. COSTS REQUESTED FOR ENTIRE PROPOSED PROJECT PERIOD	
		8a. Direct Costs (\$) 8b. Total Costs (\$)	
9. PERFORMANCE SITES (Organizations and addresses)		10. INVENTIONS AND PATENTS (Completing continuation application only)	
		<input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> Previously reported <input type="checkbox"/> Not previously reported	
		11. NAME OF APPLICANT ORGANIZATION	
		ADDRESS	
12. TYPE OF ORGANIZATION		13. ENTITY IDENTIFICATION NUMBER	
<input type="checkbox"/> Public: Specify <input type="checkbox"/> Federal <input type="checkbox"/> State <input type="checkbox"/> Local <input type="checkbox"/> Private Nonprofit <input type="checkbox"/> For-profit (General) <input type="checkbox"/> For-profit (Small Business)		Congressional District	
		14. BIOMEDICAL RESEARCH SUPPORT GRANT CREDIT	
		Code Identification	
15. NAME OF ADMINISTRATIVE OFFICIAL TO BE NOTIFIED IF AWARD IS MADE		16. NAME OF OFFICIAL SIGNING FOR APPLICANT ORGANIZATION	
TELEPHONE		TELEPHONE	
FAX		FAX	
TITLE		TITLE	
ADDRESS		ADDRESS	
BITNET/INTERNET ADDRESS		BITNET/INTERNET ADDRESS	
17. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR ASSUMES TO AGREE TO ALL PROVISIONS OF THE GRANT AGREEMENT AND TO PROVIDE ALL INFORMATION REQUESTED BY THE AWARDING AGENCY (PHS) AND/OR WHO PROVIDES INFORMATION SUBJECT TO 42 CFR 101.11.5 (U.S. Code, Title 42, Section 101.11) AND TO BE AWARE THAT UNDER 42 CFR 101.11.5 (U.S. Code, Title 42, Section 101.11) HE OR SHE IS OBLIGATED TO REPORT TO THE PROGRAM AWARDING AGENCY ALL INFORMATION SUBJECT TO 42 CFR 101.11.5 (U.S. Code, Title 42, Section 101.11) AND TO BE AWARE THAT UNDER 42 CFR 101.11.5 (U.S. Code, Title 42, Section 101.11) HE OR SHE IS OBLIGATED TO REPORT TO THE PROGRAM AWARDING AGENCY ALL INFORMATION SUBJECT TO 42 CFR 101.11.5 (U.S. Code, Title 42, Section 101.11)		18. DATE OF PHS AWARDING AGENCY	
18. CERTIFICATION AND ACCEPTANCE: I certify that the above information is true and correct and that I am aware of the obligations of the awarding agency and the conditions of the grant agreement and the terms of the awarding agency's policies and procedures. I understand that the awarding agency may require me to provide additional information and that I am aware that under 42 CFR 101.11.5 (U.S. Code, Title 42, Section 101.11) HE OR SHE IS OBLIGATED TO REPORT TO THE PROGRAM AWARDING AGENCY ALL INFORMATION SUBJECT TO 42 CFR 101.11.5 (U.S. Code, Title 42, Section 101.11)		DATE	

Face Page

DESCRIPTION: State the application's broad, long-term objectives and specific aims, making reference to the health relatedness of the project. Describe concisely the research design and methods for achieving these goals. Avoid summaries of past accomplishments and the use of the first person. This abstract is meant to serve as a succinct and accurate description of the proposed work when separated from the application. DO NOT EXCEED THE SPACE PROVIDED.

[Empty box for project description]

Description (Abstract)
WHAT you are going to do, **WHY** you are going to do it, **HOW** you are going to do it, and **VALUE** of doing it. Always emphasize its **IMPACT**.

PERSONNEL ENGAGED ON PROJECT, INCLUDING CONSULTANTS/COLLABORATORS. Use continuation pages as needed to provide the required information in the format shown below on all individuals participating in the scientific execution of the project.

Name _____	Degree(s) _____	Social Security No. _____
Position Title _____	Date of Birth (MM/DD/YY) _____	Role on Project _____
Organization _____		Department _____
Name _____	Degree(s) _____	Social Security No. _____
Position Title _____	Date of Birth (MM/DD/YY) _____	Role on Project _____
Organization _____		Department _____
Name _____	Degree(s) _____	Social Security No. _____
Position Title _____	Date of Birth (MM/DD/YY) _____	Role on Project _____
Organization _____		Department _____
Name _____	Degree(s) _____	Social Security No. _____
Position Title _____	Date of Birth (MM/DD/YY) _____	Role on Project _____
Organization _____		Department _____
Name _____	Degree(s) _____	Social Security No. _____
Position Title _____	Date of Birth (MM/DD/YY) _____	Role on Project _____
Organization _____		Department _____
Name _____	Degree(s) _____	Social Security No. _____
Position Title _____	Date of Birth (MM/DD/YY) _____	Role on Project _____
Organization _____		Department _____



Personnel engaged on project

DETAILED BUDGET FOR INITIAL BUDGET PERIOD DIRECT COSTS ONLY					FROM	THROUGH	
PERSONNEL (Applicant organization only)					DOLLAR AMOUNT REQUESTED (in thousands)		
NAME	ROLE ON PROJECT	TYPE APPT. (months)	% EFFORT ON PROJ.	INST. BASE SALARY	SALARY REQUESTED	FRINGE BENEFITS	TOTALS
	Principal Investigator						
SUBTOTALS →							
CONSULTANT COSTS							
EQUIPMENT (Itemize)							
SUPPLIES (Itemize by category)							
TRAVEL							
PATIENT CARE COSTS							
INPATIENT							
OUTPATIENT							
ALTERATIONS AND RENOVATIONS (Itemize by category)							
OTHER EXPENSES (Itemize by category)							
SUBTOTAL DIRECT COSTS FOR INITIAL BUDGET PERIOD							
CONSORTIUM CONTRACTUAL COSTS							
DIRECT COSTS \$							
INDIRECT COSTS \$							
TOTAL DIRECT COSTS FOR INITIAL BUDGET PERIOD (Item 2a, Face Page) →					\$		

Budget

Direct Costs

First Year

**BUDGET FOR ENTIRE PROPOSED PROJECT PERIOD
DIRECT COSTS ONLY**

BUDGET CATEGORY TOTALS	INITIAL BUDGET PERIOD (from page 4)	ADDITIONAL YEARS OF SUPPORT REQUESTED			
		2nd	3rd	4th	5th
PERSONNEL: Salary and fringe benefits Applicant organization only					
CONSULTANT COSTS					
EQUIPMENT					
SUPPLIES					
TRAVEL					
PATIENT CARE COSTS	INPATIENT				
	OUTPATIENT				
ALTERATIONS AND RENOVATIONS					
OTHER EXPENSES					
SUBTOTAL DIRECT COSTS					
CONSORTIUM/ CONTRACTUAL COSTS					
TOTAL DIRECT COSTS					
TOTAL DIRECT COSTS FOR ENTIRE PROPOSED PROJECT PERIOD (Item 5a) →					\$

JUSTIFICATION (Use continuation pages if necessary):

From Budget for Initial Period: Describe the specific functions of the personnel, collaborators, and consultants and identify individuals with appointments that are less than full time for a specific period of the year, including VA appointments.

For All Years: Explain and justify purchase of major equipment, unusual supplies requests, patient care costs, alterations and renovations, tuition remission, and donor/volunteer costs.

From Budget for Entire Period: Identify with an asterisk (*) on this page and justify any significant increase or decrease in any category over the initial budget period. Describe any change in effort of personnel.

For Competing Continuation Applications: Justify any significant increases or decreases in any category over the current level of support.

Budget

Direct Costs

Subsequent Years

BIOGRAPHICAL SKETCH

Give the following information for the key personnel and consultants and collaborators. Begin with the principal investigator/program director. Photocopy this page for each person.

NAME	POSITION/TITLE		
EDUCATION: (Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)			
INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	FIELD OF STUDY

RESEARCH AND PROFESSIONAL EXPERIENCE: Concluding with present position, list, in chronological order, previous employment, experience, and honors. Key personnel include the principal investigator and any other individuals who participate in the scientific development or execution of the project. Key personnel typically will include all individuals with doctoral or other professional degrees, but in some projects will include individuals at the masters or baccalaureate level provided they contribute in a substantive way to the scientific development or execution of the project. Include present membership on any Federal Government public advisory committee. List, in chronological order, the titles, all authors, and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. If the list of publications in the last three years exceeds two pages, select the most pertinent publications. **DO NOT EXCEED TWO PAGES.**

Biographical Sketch

OTHER SUPPORT

(Use continuation pages if necessary)

FOLLOW INSTRUCTIONS CAREFULLY. Incomplete, inaccurate, or ambiguous information about OTHER SUPPORT could lead to significant delays in the review and/or possible funding of the application. If there are changes in the information after submission, notify the scientific review administrator of the initial review group before the review; if changes occur after the review, notify the appropriate institute.

Other support is defined as all funds or resources, whether Federal, non-Federal, or institutional, available to the principal investigator/program director (and other key personnel named in the application) in direct support of their research endeavors through research or training grants, cooperative agreements, contracts, fellowships, gifts, prizes, and other means. However, in the case of prizes and gifts, only those that support the specific project must be reported. Key personnel are defined as all individuals who participate in the scientific development or execution of the project. Key personnel typically will include all individuals with doctoral or other professional degrees, but in some projects will include individuals at the masters or baccalaureate level provided they contribute in a substantive way to the scientific development or execution of the project.

Reporting requirements are for each of the key personnel, describing (1) all currently active support and (2) all applications and proposals pending review or award, whether related to this application or not. If the support is part of a larger project, identify the principal investigator/program director and provide the name for the relevant subproject(s). If an individual has no active or pending support, check "None." Use continuation pages as needed to provide the required information in the format as shown below. Information may be continued as long as the format remains the same. For example, all key personnel who have no other support may be listed on a single page. **DO NOT SEND** in a separate page for each person listed for whom "None" is checked.

Name _____ Active _____ Pending _____ None _____

a. Source and identifying no. _____ P.I. _____

Title _____

b. Your role on project _____ % Effort _____

c. Dates and costs of prior project (For renewals, include only the most recent completed award. List direct and indirect costs separately.)

d. Dates and costs of current year _____

e. Specific aims of project _____

f. Describe scientific and budgetary overlap

g. Describe adjustments you will make if the present application is funded (budget, effort, aims, etc.)

Other Support

RESOURCES AND ENVIRONMENT

FACILITIES: Mark the facilities to be used at each performance site listed in Item 9, Face Page, and briefly indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Use "Other" to describe the facilities at any other performance sites listed in Item 9 on the Face Page and at sites for field studies. Use continuation pages if necessary. Include an explanation of any consortium/contractual arrangements with other organizations.

 Laboratory Clinical Animal Computer Office Other (_____)

MAJOR EQUIPMENT: List the most important equipment items already available for this project, noting the location and pertinent capabilities of each.

ADDITIONAL INFORMATION: Provide any other information describing the environment for the project. Identify support services such as consultant, secretarial, machine shop, and electronics shop, and the extent to which they will be available to the project.

Resources and Environment

Writing an NIH Grant

Face Page ✓

Description ✓

Budget ✓

Biographical Sketch ✓

Other Support ✓

Resources and Environment ✓

Research Plan

Checklist and Assurances

Writing a Grant: Start Early!!

- Receipt Dates:
 - New (K, R, P, P revision)- 2/1, 6/1, 10/1
 - Revisions (K, R)- 3/1, 7/1, 11/1
 - NRSA (F31-5/1, 11/1; F32- 4/1, 8/1, 12/1; T32- 5/1)
 - SBIR/STTR (R43, R44/R41, R42)- 4/1, 8/1, 12/1
- Review: 5-6 months later
- Council: 3-4 months
- Award: 1-2 months
- Total time until award: 9-10 months--thus, start preparing for a grant application at least a year in advance of when you think you will need the money.

Essentials for Grant Proposals

1. Title & Abstract—the idea, what will be done, why, how, and long term value (goal)
2. Hypotheses and Specific Aims (what)
3. Background and Significance (why, or Rationale)
4. Convincing preliminary data; expertise of the investigator and collaborators
5. Methods (how)
6. Statistical design
7. Summary, including long term value (goal)

Writing a Grant: General Principles

1. The reviewer evaluating your application is a human being.
2. The reviewer will have several applications to evaluate.
3. To help the reviewer objectively evaluate your application, the following points are crucial:

Organization: Outline first, write second

Clarity: Appropriate syntax, clear and lucid style

Short sentences (active voice helps)

Use Figures to emphasize the important points

Be concise (don't even think about exceeding page limitations)

Assistance:

Have others read it (expert and non-expert)

- **Start fresh!** Don't use applications that were rejected.
- Finish early and ask your colleagues to **review** it.
- Tell reviewers the **ultimate utility** of your research - even if it's years down the road.
- Use **specific examples of how it will be important**, not just that it will be important.
- Pay attention to **new criteria**. Use the word **“impact”** as needed.
- Don't use any words you don't absolutely need. You have only **12 pages**.

Writing a Grant: Getting Started

The absolute requirement for a grant is a good idea.

Hypotheses or questions or models formulated from this idea must be:

Clear, testable, answerable, verifiable (consult with a statistician)

Of limited scope (i.e., can be completed in a 3-5 year period)

Important, not just interesting

New, unique, extend knowledge, solve an important problem, fill in an essential missing link, predict/generalize to future similar situations.

Focus the research on

better understanding of how mechanisms control a key biological process;

better disease recognition, prevention, or treatment.

Observation, Hypothesis, Question, Model— what should you use?

Study Sections prefer Inductive Reasoning.

They want you to have some preliminary data and a review of the literature to provide a rationale for what you want to do. They do not want to fund you to “go looking” (observe, characterize, describe, and so forth).

“From this preliminary data in our lab and information in the literature, we—

1. will test the following hypothesis (is it not true less than 5% of the time?);
2. answer the following question (how does something work?);
3. prove the generalizability of this model (predicts that the same mechanism or model will behave in the same way in the future).

Observation, Hypothesis, Question, Model— what should you use?

This bottoms up approach prevents preconceived notions, including dogma, from determining an outcome without a rational basis. Emphasizes DISCOVERY (“See, that’s how it works!”) over VERIFICATION (“See, I was correct!”).

Experiments will allow the scientist to make claims as to how things work, based on the process of refining a model (testing a hypothesis, answering a question, showing that a model predicts how something works >95% of the time) by the systematic, controlled (unbiased) gathering of repeatable data consisting of negatives and affirmatives.

“The relation between a thing [*mechanism*] and the rule that controls that thing [*how the mechanism works*] may be shown to be nonseparable by experience [*experimentation*].”

(Bertrand Russell, 1912)

Observation, Hypothesis, Question, Model— what should you use?

If you don't have much preliminary data—the “idea” you have really is new—how do you frame the first experiment before sufficient data are gathered to produce a model and request funds to test it?

Ask a Question!

You are in a state of ignorance. The question is used as a basis to accumulate new data. From the data one then builds a model, which can be subjected to tests (experiments—gathering “affirmatives” and “negatives” to refine the model) for its inductive ability—the capacity to predict the future.

Substitutes the Question for settings where experiments are performed before sufficient data exist and the “model” for situations where the scientist is working with sufficient data to produce a construct than can be tested for inductive power. (Glass, 2008)

Observation, Hypothesis, Question, Model— what should you use?

True for both biological and clinical research—

Gain a sufficiently large data set that is representative of the variations observed in the lab or the clinic (“in nature”).

Achieve this by demonstrating the reproducibility of the data by experimentation.

Pose a straightforward question of a system and then receive an answer (by experimentation); use that answer to model reality; and then test the reproducibility and predictive power of the model, modifying it as necessary (more experiments and more data) to be sure “probably” (>95% of the time) that the model accurately predicts reality. (Glass DJ, Hall N. A brief history of the hypothesis. *Cell* 2008; 134: 378-381)

Current Research Plan (Section 5.5)

- **Introduction to Application
(Resubmission or Revision
Applications only)**
- **Specific Aims**
- **Background and Significance**
- **Preliminary Studies/Progress
Report**
- **Research Design and Methods**

Restructured Research Plan (Section 5.5)

- **Introduction to Application
(Resubmission or Revision
Applications only)**
- **Specific Aims**
- **Research Strategy**
- **Significance**
- **Innovation**
- **Approach (methods)**
- **Preliminary Studies for New
Applications**
- **Progress Report for
Renewal/Revision Applications**

Specific Aims

The Methods Section begins with a brief (no more than one page) statement of the Specific Aims of the research.

The objectives of the Specific Aims page are to:

- **Generate interest**
- **Demonstrate importance**
- **Give a concise overview of the Research**

Specific Aims

- 1. More than two or three Specific Aims usually are too many.**
- 2. Each Aim should be stated in one simple sentence, saying as directly as possible what will be done.**
- 3. Each Aim either should be, or include, a hypothesis to be tested or a question to be answered or a model to be tested for predictability.**
- 4. A *brief* statement of the purpose, rationale (including significance, impact, and innovation), and methodological approach for each Aim is useful.**

For each Specific Aim, state the--

Expected Outcomes

What your experiments will tell you, and why that outcome is particularly important to obtain.

Potential Problems and Alternative Strategies

Show an awareness of the problems that may arise, and of the alternative approaches that can be used if the problems do indeed occur.

Timelines

Use a chart to illustrate when specific experiments will start and finish.

Research Strategy (Background, Rationale)

**Not just a literature review (although this must be included).
Provides the rationale for what you propose to do.**

Significance

**Puts your proposed research in perspective---what it will do
and the importance of the results.**

**How, if the aims of the application are achieved, scientific
knowledge will be advanced.**

**What the effect of these studies will be on the concepts or
methods that drive this field.**

Innovation

**How the project employs novel concepts, approaches, or
methods.**

**How the project challenges existing paradigms or develops
new methodologies or technologies.**

Approach (Methods)

Your Experiments.

The main part of the grant!

Repeat each specific aim (and hypothesis).

Then the model or general approach.

Then the specific experiments.

Approach (Methods)

Experiments

Emphasize the essential experiments

Refer to literature for established methods

Identify new methods and their value and proof that they work

Statistical design and analyses

How will data be interpreted?

Pitfalls, and how they will be handled

Alternatives (if the primary approach fails)

Preliminary Data

**Demonstrates feasibility. Can it be done? Can you do it?
Will the results be accurate? Are your methods state-of-the-art? Will the hypotheses probably be supported?
Prove that assays and other technical methods in your lab are in working order.**

Balance between preliminary data that show feasibility and likelihood of success

vs.

proof of hypothesis which guarantees success and definitive conclusion

Too much prior proof - no reason to fund - it's done; just filling in "n"

Not enough prior proof - too risky; too unlikely to succeed

Summary of Progress Report

What will be learned?

How will the results support the hypotheses (answer the question, test predictability of the model) and meet the specific aims and goals?

How will the results be new and important?

Gaps in our knowledge that this project will fill:

“These studies will determine the fundamental mechanisms responsible for producing cardiorespiratory rhythms that originate in the medulla.”

Why this is important (essential) to do:

“These studies will identify which receptors and processes are probably altered in diseases of the cardiorespiratory system such as SIDS, allowing novel, specific, more effective therapy.”

Animal Care and Use / Human Subjects

Follow the guidelines in the application exactly

Do not assume that your IACUC or IRB protocol is sufficient.

Document that this work has not been done before, that it does require an animal model or a human subject and why, and that all possible non-animal or non-human alternatives have been considered and shown to be insufficient to solve the problem(s) that the research addresses.

Above all, show that all possible discomfort of any kind to the animal or the human subject is known, anticipated, and prevented or minimized

Timeline:

What will be done when

NUMBER OF ANIMALS AND TIME TABLE:

<u>Protocol</u>	<u>Year 1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
1. Developmental changes in placental glucose and amino acid metabolism	----- 20	----- 15			
2. Effect of glucose and amino acid supply on placental amino acid metabolism	----- 5	----- 10	----- 25	----- 25	----- 25
<u>Total # of animals</u>	25	25	25	25	25

Budget Justification: Prescribed

All Training Grants

T32, F31/32, KO8, K23, K12

salary (usually for 75% time)

lab support

(usually limited, e.g. \$25K)

travel (limited, e.g., \$1,500)

F & A (“Indirects”; limited, e.g., 8%)

Budget Justification: Modular

\$25,000/module up to \$250,000 (10 modules)

Explain and justify roles of investigators

Rationale for highly expensive

Budget Justification: Itemized

Direct costs > \$250,000

Explain and justify each and every item in the budget.

Personnel: name, degree, title, role--justify by specific expertise and what they exactly will do and why the allotted time is essential.

Equipment: Rationale and evidence for cost and need for expensive, unusual, or absolutely essential items (“convenience” or “efficiency” are not sufficient justifications); show cost-sharing if available.

Supplies: As close to “line item” as possible; provide historical and current use and prices; explain per experiment, pre subject, per animal, per year; charts and tables are helpful; include local special or exceptional requirements.

Travel: \$1,500 per year for PI is customary, to attend scientific meeting to present results of research

Other: Do not over inflate costs of communications, publications, etc.

Consortium, Contract, and Consultant costs: get these done well ahead of grant due date; they should accomplish a specific task that you clearly show to be essential.

Budget Justification: Just in Time

- **Detailed budget not required—details (how much money you will get) will be worked out by the Institute after funding approved and Institute budget and spending priorities determined**
- **IRB and IACUC approvals can wait for approval of funding**



Writer's Block
(“Block Island”)

**Even if you are on the right track, you'll
get run over if you just sit there.**

Will Rogers

Good Editing—The Most Essential Aspect of Good Writing

- **Why? Because bad editing preserves bad writing, which leads to misunderstanding, and all too often to confused and therefore sometimes hostile (or stupefied) reviewers.**
- **For example, you do not want these in your grant—**
- **“...causes of which include, but are not limited to, maternal malnutrition, maternal hypertension, and **idiopathic** placental insufficiency.”**
- **“These fetuses are at increased risk of hypoglycemia, hypoxia, and **academia**, as well as spontaneous preterm delivery...”**

Good Editing—Over and Over Again

“... everything you do you have to do again, and your capacity for rewriting is the only thing that separates you from people who do things in a hurry.”

John Irving

**We are what we repeatedly do;
Excellence, then, is not an act,
But a habit.**

Aristotle

Words NOT to use

Describe
Evaluate
Characterize
Look at
Check
Estimate
Correlate
Study
Ask / Question
Compare

And don't use "alter"
or "change"

Words OK to use

Test
Define
Determine
Measure
Quantify
Prove / Disprove

use "increase" or
or "decrease"—
or "changed from ... to ..."

Be specific!

Make the Application look good.

“Appearance is everything”

“Clothes maketh the man (or woman).”

Not quite true, but never, ever underestimate
the **“power of presentation”**

Bad research page, difficult to read, poorly organized.

water content to hematocrit⁴⁶. Blood ¹⁴C-glucose is measured using ion exchange chromatography according to Hay et al.⁴⁷.

Calculations: Umbilical and uterine blood flow rates are calculated using tritiated water (³H₂O) by the transplacental steady state diffusion technique.²⁸

Net uterine or umbilical uptake rates by the fetus from the placenta of amino acids (including leucine), KIC, glucose, and oxygen are determined by application of the Fick principle:

Uterine or umbilical uptake rate = Uterine or umbilical blood flow (mL/min) x (C_v-C_a) or (C_a-C_v) where C_a and C_v, and C_a and C_v are the concentrations (μmol/mL) of the metabolite measured in the Uterine arterial and venous, or umbilical venous and fetal arterial blood, respectively. Similarly, net fluxes of ¹⁴C-leucine, ¹³C-leucine, and ¹³C-KIC across the umbilical (or Uterine) circulation are measured by the Fick principle as umbilical (or uterine) blood flow times the umbilical (or Uterine) tracer arteriovenous concentration difference.

Tracer fluxes: Maternal plasma leucine disposal rate (DR_m) is calculated as:

$$DR_m = Inf \cdot ([MPE_{m,a}]/MPE_a) - 1$$

where Inf is the infusion rate of L-[1-¹³C] leucine into the mother and MPE_{m,a} and MPE_a are the leucine enrichments in the maternal infusate and maternal arterial plasma, respectively. This equation does not account for the disposal rate of the naturally occurring ¹³C-labelled leucine which is about 1.1% of the ¹³C-leucine.⁴⁸⁻⁴⁹ This equation assumes 100% enrichment of the infused isotope. Plasma [1-¹³C leucine] is calculated as the product of the leucine concentration and the molar percent excess for ¹³C leucine in each vessel.

Tracer fluxes between the placenta and the fetal plasma, and between the fetal plasma and fetal tissues, are calculated according to Carver, et al.⁵ Loy, et al.,⁴⁵ and Ross, et al.⁴³

The fraction of fetal leucine tracer infusion taken up by the placenta (¹⁴f_{plac}) is calculated as:

$$({}^{14}f_{plac}) = ([1\text{-}^{14}\text{C leucine}]_{plac} \times \text{umbilical blood flow}) / [1\text{-}^{14}\text{C}] \text{ leucine infusion rate,}$$

The fraction of L-[1-¹⁴C] leucine infusion rate excreted as ¹⁴CO₂ via the umbilical circulation (¹⁴f_{CO₂}) is calculated as:

$$({}^{14}f_{CO_2}) = ([^{14}CO_2]_{plac} \times \text{umbilical blood flow}) / [1\text{-}^{14}\text{C}] \text{ leucine infusion rate}$$

The net ¹⁴CO₂ flux from the fetus to the placenta is calculated as:

$$r^{14}CO_{2plac}, \text{ dpm/min} = \text{umbilical blood flow} \cdot ([^{14}CO_2]_a - [^{14}CO_2]_v)$$

where [¹⁴CO₂]_a and [¹⁴CO₂]_v are the concentrations of ¹⁴CO₂ (dpm/mL) in the umbilical arterial and venous blood, respectively.

Tracer model: The model (Carver, et al., Appen. II, Pub. Man. 8) is adapted from Loy, et al.,⁴⁵ van Veen, et al.,³⁴ and Ross, et al.⁴³ In steady state, the fetal plasma leucine pool is constant in amount, balanced by equal rates of entry (from placenta and fetal tissues) and disposal (into placenta and into fetal tissues). These fluxes of leucine into and out of the fetal plasma, fetal tissues, and the placenta, which apply to the two tracers as well, are shown in the figures below; each flux is labelled with a Roman numeral after Carver, et al.⁵

A Good Research Plan Page

water content to hematocrit⁴⁶. Blood ¹⁴C-glucose is measured using ion exchange chromatography according to Hay et al.⁴⁷.

Calculations: Umbilical and uterine blood flow rates are calculated using tritiated water (³H₂O) by the transplacental steady state diffusion technique.²⁸

Net uterine or umbilical uptake rates by the fetus from the placenta of amino acids (including leucine), KIC, glucose, and oxygen are determined by application of the Fick principle:

Uterine or umbilical uptake rate =

Uterine or umbilical blood flow (mL/min) x (C_v-C_a) or (C_x-C_v)

where C_A and C_V, and C_v and C_a, are the concentrations (μmol/mL) of the metabolite measured in the Uterine arterial and venous, or umbilical venous and fetal arterial blood, respectively. Similarly, net fluxes of ¹⁴C-leucine, ¹³C-leucine, and ¹³C-KIC across the umbilical (or Uterine) circulation are measured by the Fick principle as umbilical (or uterine) blood flow times the umbilical (or Uterine) tracer arteriovenous concentration difference.

Tracer fluxes: Maternal plasma leucine disposal rate (DR_m) is calculated as:

$$DR_m = Inf \cdot ((MPE_m/MPE_a)-1)$$

where Inf is the infusion rate of L-[1-¹³C] leucine into the mother and MPE_m and MPE_a are the leucine enrichments in the maternal infusate and maternal arterial plasma, respectively. This equation does not account for the disposal rate of the naturally occurring ¹³C-labelled leucine which is about 1.1% of the ¹³C-leucine.^{48,49} This equation assumes 100% enrichment of the infused isotope. Plasma [1-¹³C leucine] is calculated as the product of the leucine concentration and the molar percent excess for ¹³C leucine in each vessel.

Tracer fluxes between the placenta and the fetal plasma, and between the fetal plasma and fetal tissues, are calculated according to Carver, et al.,⁵ Loy, et al.,⁴³ and Ross, et al.⁴³

The fraction of fetal leucine tracer infusion taken up by the placenta (¹⁴φ_{plac}) is calculated as:

$$({}^{14}\phi_{plac}) = ([1-{}^{14}\text{C leucine}]_{plac} \times \text{umbilical blood flow}) / [1-{}^{14}\text{C}] \text{ leucine infusion rate,}$$

The fraction of L-[1-¹⁴C] leucine infusion rate excreted as ¹⁴CO₂ via the umbilical circulation (¹⁴φ_{CO₂}) is calculated as:

$$({}^{14}\phi_{CO_2}) = ([{}^{14}\text{CO}_2]_{plac} \times \text{umbilical blood flow}) / [1-{}^{14}\text{C}] \text{ leucine infusion rate}$$

The net ¹⁴CO₂ flux from the fetus to the placenta is calculated as:

$${}^{14}\text{CO}_{2,net} \text{ dpm/min} = \text{umbilical blood flow} \cdot ([{}^{14}\text{CO}_2]_a - [{}^{14}\text{CO}_2]_v)$$

where [¹⁴CO₂]_a and [¹⁴CO₂]_v are the concentrations of ¹⁴CO₂ (dpm/mL) in the umbilical arterial and venous blood, respectively.

Tracer model: The model (Carver, et al., Appen. II, Pub. Man. B) is adapted from Loy, et al.,⁴⁵ van Veen, et al.,²⁴ and Ross, et al.⁴³ In steady state, the fetal plasma leucine pool is constant in amount, balanced by equal rates of entry (from placenta and fetal tissues) and disposal (into placenta and into fetal tissues). These fluxes of leucine into and out of the fetal plasma, fetal

Too much text; outline and separate sections not clearly set off

uptake and utilization; an increase in the placental/fetal glucose utilization rate ratio, fetal hypoinsulinemia, and decreased placental and fetal growth (Appen. Pub. 3).

4. Fetal amino acid metabolism: we have published before our methods for measuring maternal and fetal amino acid concentrations and the transfer of amino acids into the fetus (42,43), including details about how to measure fetal amino acid metabolism for several amino acids, and for glucose (11,38,45). These studies have been modified recently for leucine (see details below, in Methods, and Appen., Pub. Man. 8) and for glutamine, and glutamate (); more recent pilot studies with arginine are reviewed below.

5. Leucine metabolism model: Leucine metabolism in the chronically (6 weeks) hypoglycemic/hypoinsulinemic sheep model, produced by infusing insulin into the mother, was studied by infusing 1-[¹³C] and 1-[¹⁴C] leucine tracers into the fetus. In contrast to acute increased leucine oxidation with short term hypoglycemia (42), long term hypoglycemia produced an adaptation of lower energy expenditure for protein accretion and thus a slower rate of growth in the fetus, allowing the fetus to maintain normal weight-specific rates of nitrogen uptake as amino acids, oxygen consumption, fetal plasma leucine disposal rate, and leucine incorporation into protein synthesis. The umbilical uptakes of some amino acids, particularly leucine, were decreased; leucine consumption by the uteroplacenta was increased. The decreased umbilical leucine uptake and decreased leucine incorporation into protein accretion in these fetuses were accounted for by increased leucine release from fetal protein breakdown. These studies demonstrated important mechanisms by which chronic glucose deprivation regulates placental and fetal amino acid metabolism and fetal growth, and defined new tracer approaches to quantifying placental and fetal leucine metabolism. (Appendix II, Pub. Man. 8).

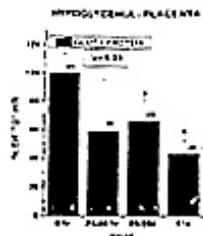
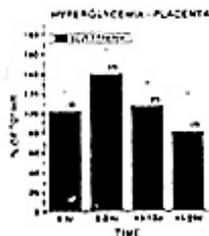
6. Maternal glucose tracer metabolism by the placenta: We conducted the first ever studies of the fate of maternal glucose carbon, traced with [U-¹⁴C]glucose infused into the maternal circulation, taken up and metabolized by the placenta and/or transported to the fetus. As shown in the figures below, the fraction of glucose ¹⁴C showing up on amino acids was small and was not affected by short or long-term hyperglycemia, whereas chronic hyperglycemia increased the fraction of glucose carbon that was converted to CO₂, both in the fetus and in the placenta.

7. Placental metabolism: We also measured with [U-¹⁴C]glucose net uteroplacental glucose consumption rate (UPGC), lactate and fructose production rates, and glucose oxidation in late gestation pregnant sheep after 18 hours each of low and high maternal and fetal glucose concentrations. A major fraction of UPGC went to non-oxidative metabolism; UP oxygen consumption was not affected; UP lactate production was a major product of UPGC (69% during low glucose, 53% during high glucose); UP fructose production was 5% under low and 3% under high glucose, and tracer-derived umbilical vein lactate uptake from the placenta was accounted for completely by net fetal lactate uptake from the placenta, i.e., there was no substrate source of UP lactate production into the fetus other than UPGC (Appen. Abst. 4).

8. Maternal low protein diet: Although we have had considerable experience manipulating maternal diet (fasted states, several week periods of glucose and insulin clamps), for the specific purpose of developing a low protein diet in the mother that will lead to reductions in maternal amino acid concentrations, we have engaged the assistance of Dr. Alan Bell (Cornell Univ.), an expert in maternal and fetal effects of maternal dietary changes who has developed and studied maternal low protein diets in pregnant sheep that have produced fetal growth restriction (Appendix IV). Dr. Bell will help to determine the necessary diet formulation to produce an energy complete, low protein diet (see Methods).

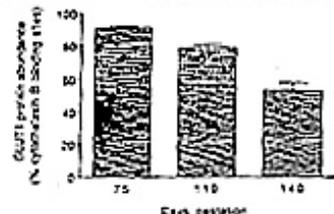
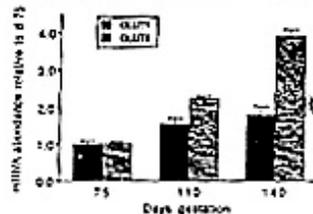
9. Leucine infusion into normal and growth restricted fetuses or their mothers. Leucine infusion into ewes with placental insufficiency showed markedly increased uterine leucine uptake but only slight increase in fetal leucine uptake. Leucine infusion into normal fetuses produced increased leucine oxidation (accounting for increased disposal) and decreased umbilical leucine uptake. Other amino acids were affected by this infusion. Thus, although the placenta actively transports amino acids from the maternal to the fetal circulation, such transport can be affected by the relative maternal and fetal amino acid concentrations.

Another Bad Page
 Figures and table too small to see



CONTINUATION PAGE: STAY WITHIN MARGINS INDICATED

We also have engaged the assistance of Dr. Alan Bell and his doctoral student, Richard Erhardt, to measure GLUT-3 and GLUT-1 mRNA using their ovine-specific cDNA probes. They have nearly completed development of ovine-specific GLUT-3 and GLUT-1 antibodies that will allow us to measure protein abundances for more direct correlation with glucose uptake and transport studies in vivo. Data below show a relative increase in GLUT-3 vs 1 mRNA (left) over the second half of gestation, with a corresponding decrease in the fraction of total cytochlaian binding capacity (representing "functional" protein abundance) accounted for by GLUT-1 (right).



13. Effect of IGF-1 infusion on maternal, placental, and fetal insulin, glucose, and amino acid concentrations. Recombinant human IGF-1 from Eli Lilly Co. was infused at constant rate (30 µg/hour/kg) into 5 near-term pregnant sheep, increasing mat. [IGF-1] 3.2-fold (comparable to Gluckman's study¹¹), decreasing mat. [insulin] from 23 to 3 µU/mL, and decreasing mat. [glucose] from 3.7 to 3.2 mM; on balance, maternal glucose turnover, uptake and utilization of glucose by the placenta and fetus, and placental lactate production were not significantly altered. Most maternal amino acid concentrations were decreased (* p < 0.05 in table below).

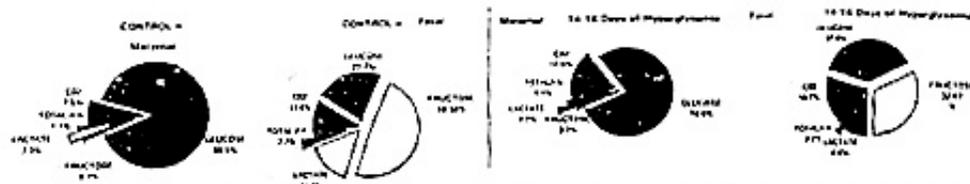
Time	Infusion	N	Ins	Glucose	IGF-1													
Maternal	Pre	5	23	3.7	23	3.7	23	3.7	23	3.7	23	3.7	23	3.7	23	3.7	23	3.7
Maternal	During	5	3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Fetal	Pre	5	10	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Fetal	During	5	10	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

14. Statistical methods: We have developed unique statistical methods, including two and three dimensional generalized Michaelis-Menten response surface methods (Hirst et al) and curve fitting methods (Young et al), to interpret and develop models from our complex data that involve multiple measurements within an animal, at different times, of different parameters that may or may not have separate and/or joint effects, and among groups with different numbers of subjects (Appendix II, Pub. Man. 6,7). For the first time, these important advances in statistical modeling will be applied to placental metabolism to address the separate and/or joint effects of substrate supply on selected substrate metabolism in the placenta.

A BAD Page

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CONTINUATION PAGE: STAY WITHIN MARGINS INDICATED



7. Placental metabolism: We also measured with $[U-^{14}C]$ glucose net uteroplacental glucose consumption rate (UPGC), lactate and fructose production rates, and glucose oxidation in late gestation pregnant sheep after 18 hours each of low and high maternal and fetal glucose concentrations. A major fraction of UPGC went to non-oxidative metabolism; UP oxygen consumption was not affected; UP lactate production was a major product of UPGC (69% during low glucose, 53% during high glucose); UP fructose production was 5% under low and 3% under high glucose, and tracer-derived umbilical vein lactate uptake from the placenta was accounted for completely by net fetal lactate uptake from the placenta, i.e., there was no substrate source of UP lactate production into the fetus other than UPGC (Appen. Abst. 4).

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A "GOOD" Background/Preliminary Data Page

3. Maternal insulin infusion chronic hypoglycemia model: These studies showed that we can maintain maternal glucose concentrations at different levels over several weeks (as well as more acutely [11,41]), by glucose/insulin clamp technique, to produce sustained decrease in fetal glucose uptake and utilization, an increase in the placental/fetal glucose utilization rate ratio, fetal hypoinsulinemia, and decreased placental and fetal growth (Appen. Pub. 3).

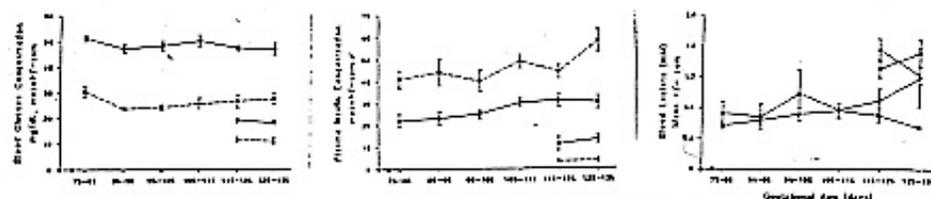


Fig. Stability of maternal and fetal [glucose] and [insulin] over gestation in the maternal hypoglycemia model.

4. Fetal amino acid metabolism: we have published before our methods for measuring maternal and fetal amino acid concentrations and the transfer of amino acids into the fetus (42,43), including details about how to measure fetal amino acid metabolism for several amino acids, and for glucose (11,38,45). These studies have been modified recently for leucine (see details below, in Methods, and Appen., Pub. Man. 8) and for glutamine, and glutamate (); more recent pilot studies with arginine are reviewed below.

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Flux rates (mean±sem) (**P<0.01)	Control	Hypoglycemia
[1- ¹³ C] Ieu fetal plasma disposal rate	8.7±0.9	8.2±0.9
[1- ¹⁴ C] Ieu fetal plasma disposal rate	8.5±0.9	8.4±0.8
net fetal leucine uptake from placenta	4.2±0.6	2.1±0.4**
leucine into blood from fetal proteins	2.0±0.1	3.8±0.2**
CO ₂ produced by fetus from Ieu 1-C	2.1±0.1	1.9±0.3
leucine into fetal protein accretion	2.6±0.2	0.8±0.1**
leucine into fetal protein synthesis	4.6±0.3	4.6±0.2

CONTINUATION PAGE: STAY WITHIN MARGINS INDICATED

Submit the Grant—Study Section Review

Study sections will continue to give each application a single overall score to reflect “the study section’s notion of what the likely impact of the proposal will be on our understanding of biology and behavior and on the practice of medicine.”

Study sections are supposed to **pay more attention to the potential impact** of a grant application and less to its feasibility.

“**Study Sections** and NIH should be looking for **the stuff that is truly distinguished.**”

Harold Varmus, J. NIH Research 9:31-32, 1997

And then your grant goes to study section for review of its overall quality and scientific merit.

What really happens at Study Section: 9-Point Score Chart for NIH Grants

Impact	Score	Descriptor	Strengths/Weaknesses
High Impact	1	Exceptional	
	2	Outstanding	
	3	Excellent	
Moderate Impact	4	Very Good	
	5	Good	
	6	Satisfactory	
Low Impact	7	Fair	
	8	Marginal	
	9	Poor	

Non-numeric score options: NR = Not Recommended for Further Consideration, DF = Deferred, AB = Abstention, CF = Conflict, NP = Not Present, ND=Not Discussed

<u>Score</u>	<u>Descriptor</u>	<u>Additional Guidance on Strengths / Weaknesses</u>
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1	Exceptional	Exceptionally strong with essentially no weaknesses
2	Outstanding	Extremely strong with negligible weaknesses
3	Excellent	Very strong with only some minor weaknesses
4	Very Good	Strong but with numerous minor weaknesses
5	Good	Strong but with at least one moderate weakness
6	Satisfactory	Some strengths but also some moderate weaknesses
7	Fair	Some strengths but at least one major weakness
8	Marginal	A few strengths and a few major weaknesses
9	Poor	Very few strengths and numerous major weaknesses

Minor Weakness: An easily addressable weakness that does not substantially lessen impact

Moderate Weakness: A weakness that lessens impact

Major Weakness: A weakness that severely limits impact

What happens?

Either —

Your grant scores well and gets funded,

Now get to work, and come back and tell the next group of young investigators how you did it.

Or—

Your grant is not so well scored and does not get funded.

What do you do now?

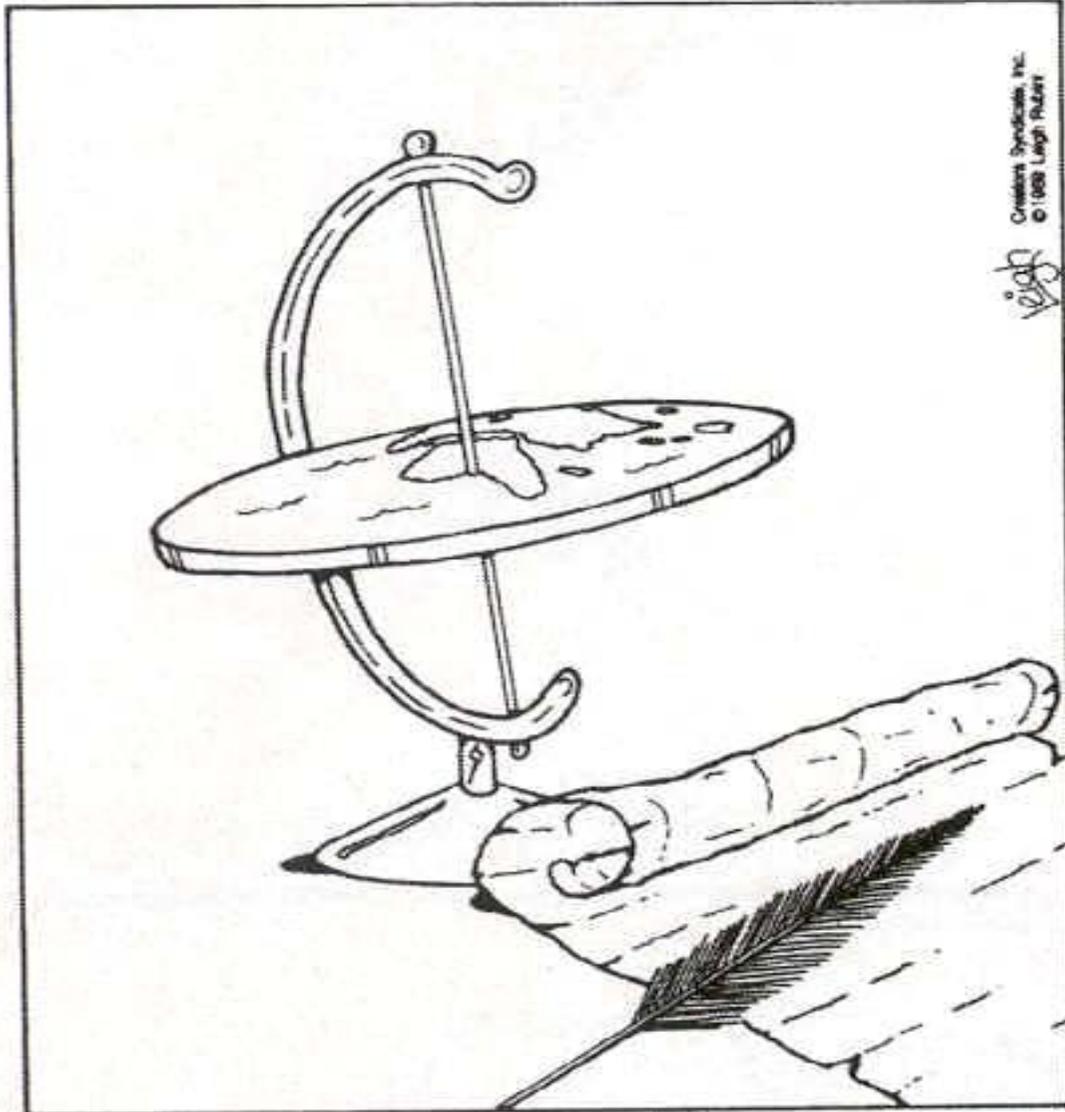
An understandable but inappropriate form of rebuttal.



Rubes

By Leigh Rubin

**Remember,
Columbus
didn't get it
right the first
time either.**



Columbus' first globe.

And remember the AccentureTM line—

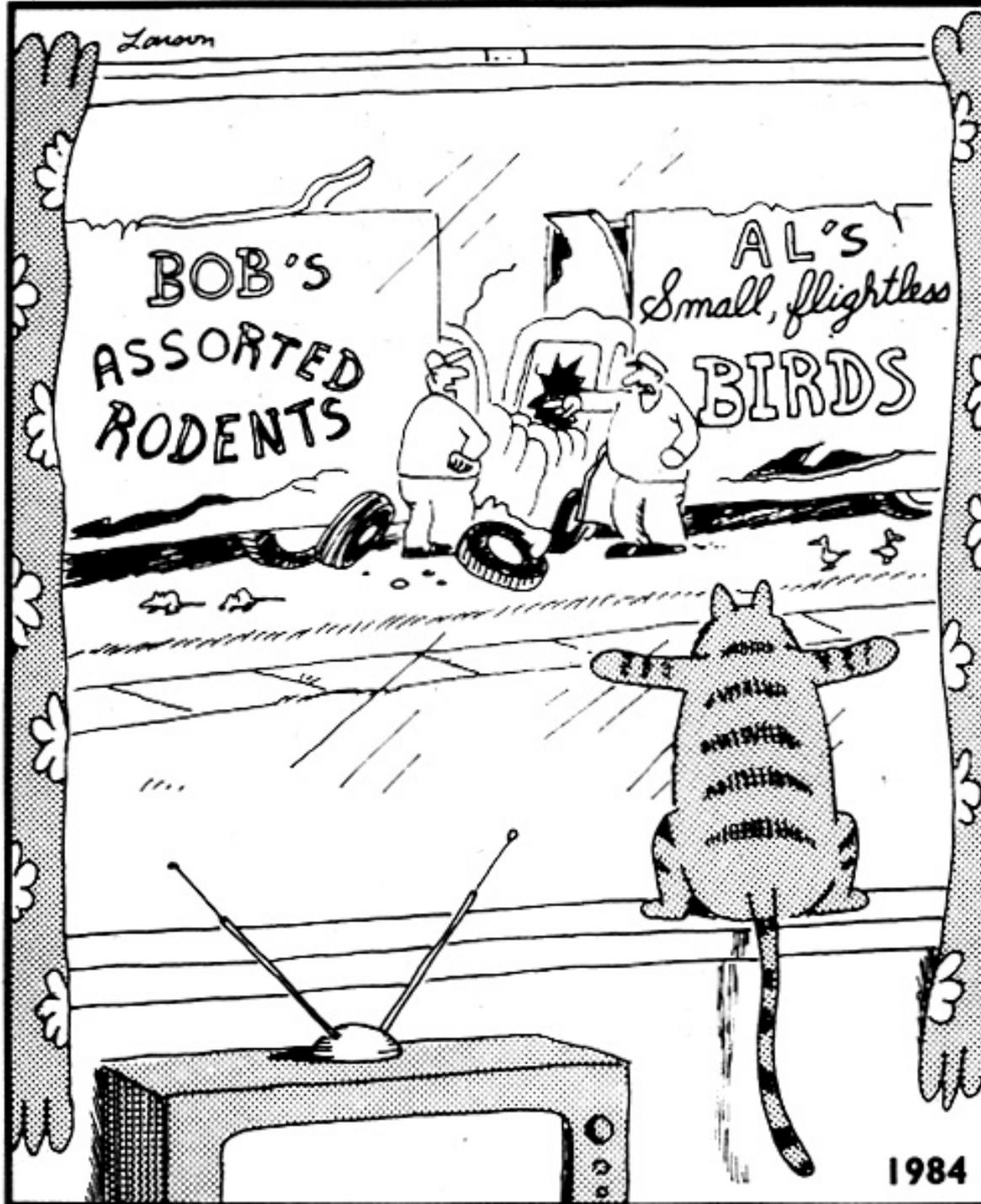
What it takes to be successful—

What you did—10%

What you do next—90%

Resubmission

1. Only more try !!
2. One page of introduction for response and/or rebuttal.
3. Address exactly each and every concern raised by the review.
4. But--focus response directed at the principal problems.
5. Rebuttal should be well documented to support your position if you disagree with any point in the study section review.
6. Do not expand the grant unless directed to do so.
7. Keep the approved budget, but if you do change, make sure you tie the changes to a specific request of the study section.
8. No grant is perfect; use the revision opportunity to improve yours.
9. Above all, be polite.



**Give
them
what
they
want.**

Critique Oriented Application

NIH now requires that your grant application be written in a template fashion that addresses each of the major review criteria.

1. SIGNIFICANCE

Does this study address an important problem?

If the aims of the application are achieved, how will scientific knowledge be advanced?

What will be the effect of these studies on the concepts or methods that drive this field?

2. APPROACH

Are the conceptual framework, design, methods, and analyses adequately developed, well-integrated, and appropriate to the aims of the project?

Does the applicant acknowledge potential problem areas and consider alternative tactics?

3. INNOVATION

Does the project employ novel concepts, approaches, or methods?

Are the aims original and innovative?

Does the project challenge existing paradigms or develop new methodologies or technologies?

4. INVESTIGATOR

Is the investigator appropriately trained and well suited to carry out this work?

Is the work proposed appropriate to the experience level of the principal investigator and other researchers (if any)?

5. ENVIRONMENT

Does the scientific environment in which the work will be done contribute to the probability of success?

Do the proposed experiments take advantage of unique features of the scientific environment or employ useful collaborative arrangements?

Is there evidence of institutional support?

OVERALL EVALUATION

Summary of the important strengths and weaknesses of the application.

Recommended score reflecting the overall impact of the project on the field, weighting the above criteria as appropriate.

An application does not need to be strong in all categories to be judged likely to have major scientific impact and thus deserve a high merit rating.

For example, an investigator may propose to carry out important work, that by its nature is not innovative, but is essential to move a field forward.

Criteria that study section reviewers use to determine their enthusiasm for the grant application and their priority score.

Critique Oriented Application

- **Write your grant application to specially address the 5 major evaluation criteria used for the critique: Significance, Approach, Innovation, Investigator, Environment, and include a Summary of these for the Abstract and at the end of the Text.**
- **Put the words you want the reviewer's critique to contain in your application.**
- **Document and justify every statement that relates to these evaluation criteria.**

1. Significance

- **State how this study addresses an important problem.**
- **State how, if the aims of the application are achieved, scientific knowledge will be advanced.**
- **State what the effect of these studies will be on the concepts or methods that drive this field.**

2. Approach

State how the conceptual framework, design, methods, and analyses are adequately developed, well integrated, and appropriate to the aims of the project.

State/Acknowledge (with specific examples) potential problem areas and alternative tactics.

3. Innovation

- **State how the project employs novel concepts, approaches or methods.**
- **State how aims are original and innovative.**
- **State how the project challenges existing paradigms or develops new methodologies or technologies.**

4. Investigator

- **State (and document) how the investigator is appropriately trained and well suited to carry out the proposed work.**
- **State how the proposed research is appropriate to the experience level of the principal investigator and other researchers (if any).**

5. Environment

State how the scientific environment in which the work will be done will contribute to the probability of success.

State how the proposed experiments will take advantage of unique features of the scientific environment or employ useful collaborative arrangements.

Show evidence of institutional support.

Critique Oriented Application: Overall Evaluation

- **Summary of the important strengths and weaknesses of the application**
- **Recommended score reflecting the overall impact of the project on the field, weighing the 5 principal criteria as appropriate**
- **An application does not need to be outstandingly strong in all of the 5 principal areas of evaluation to be judged likely to have a major scientific impact and thus deserve a highly meritorious rating.**

Preparing a Grant: COMMON MISTAKES

1. poorly written: bad grammar, typographical errors, poor outline, looks sloppy, too many words on a page, too much technical jargon
2. too much work proposed
3. not “ crystal clear” what you want to do, why, and how
4. poorly justified; does not advance knowledge
5. necessary expertise is not demonstrated
6. too expensive

Preparing a Grant: COMMON SUCCESSES

1. The grant is easy to read
2. The science is “outstanding”
3. Written with evidence of confidence and enthusiasm for the importance and potential success of the proposed research
4. Figures, graphs, tables, charts, flow diagrams are self-explanatory as well as related to the text
5. The preliminary data/experience are organized to show how they will make the proposed experiments work successfully
6. The budget is accurately and thoroughly justified
7. Descriptive work is acknowledged as such; but the bulk of the research is testable hypotheses

Information

- **NICHD WEBSITE: “Funding by NICHD”**
<http://www.nichd.nih.gov/funding/funding-mechs.htm>
- **NIH WEBSITE “ Welcome to Extramural Research at the NIH”**
<http://grants.nih.gov/grants/welcome.htm>
- **NIH CAREER AWARD WEBSITE “K Kiosk”**
<http://grants.nih.gov/training/careerdevelopmentawards.htm>