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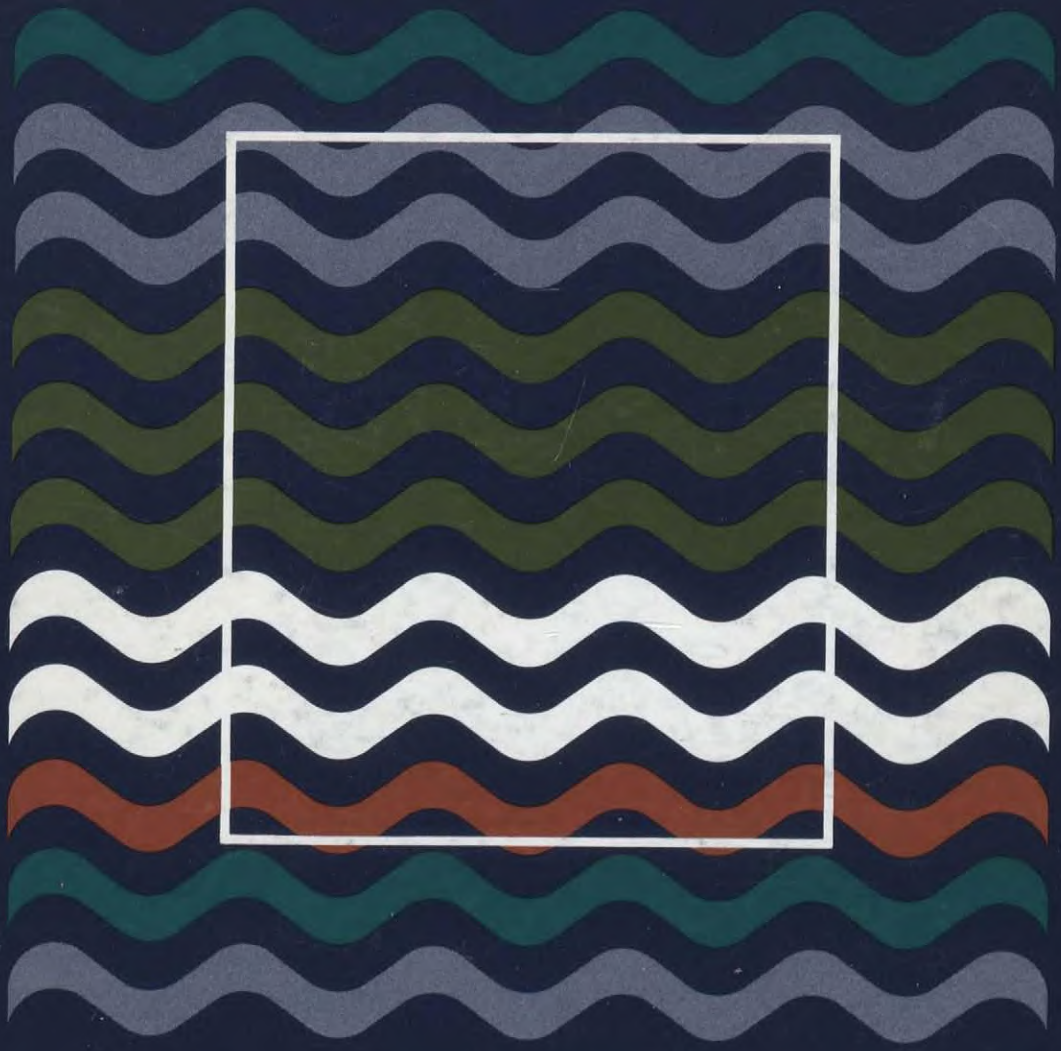

The Government of Canada's Investment in Science

Canada

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An Overview of Federal Science Activities: 1982/83

Minister of Supply and Services Canada 1982
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Research and development (R&D) and industrial innovation are key elements in the federal government's policies and strategies to meet the economic challenges of the future. The paper, *Economic Development for Canada in the 1980's*, emphasizes the importance of technology to Canada's economic development priorities. It confirms the importance of achieving the goal of the R&D Planning Framework announced in January 1981.

This booklet presents an overview of federal support to investment in Canada's science activities. It highlights:

- the progress made by government, industry and universities towards achieving Canada's goal of investing 1.5% of our GNP in R&D by 1985; and,

- the funds budgeted by the federal government in 1982/83 to help reach these goals.

To introduce the general reader to the complexities of federal expenditures on science, the booklet includes a short glossary of unavoidable technical terms and simplifies, as far as possible, the presentation of the data. Readers requiring more complete or detailed information are referred to the publication "Federal Science Activities: 1982/83" and the background tables contained in "Science Expenditures and Personnel: 1982/83". Both are available from the Communications Services Division of the Ministry of State for Science and Technology.

John Roberts
Minister

Highlights

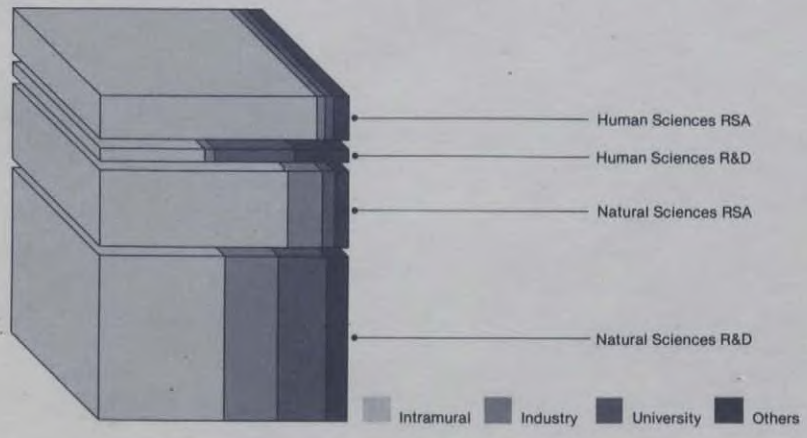
Canada's R&D Target in the Natural Sciences

- Canada's 1985 target for investment in research and development (R&D) in the natural sciences is 1.5% of our Gross National Product (GNP).
- This R&D investment reached 1.07% of GNP in 1981. It has grown substantially from its 1976 level of 0.94% and its 1979 level of 1.00%.
- The combined investment by government, industry and universities in R&D (natural sciences) has increased by 34% since the target and the R&D Planning Framework were established . . . . from $2.63 billion in 1979 to $3.52 billion in 1981.
- Investment by industry in R&D (natural sciences) has risen by 43% since 1979.
- Investment by the federal government in research and development increased by 34% during the same period.

1982/83 Federal Science Expenditures

- Total federal science expenditures for both human and natural sciences will be $2.94 billion in 1982/83. This is an increase of about 13% over the $2.6 billion spent in 1981/82.
- In the natural sciences federal budgetary expenditures on R&D will increase by $250 million to a total of $1.8 billion in 1982/83 . . . . an increase of over 16%.
- Federal funding of R&D performed by industry will be about $390 million.
- Direct federal support to R&D performed in the universities will reach $350 million.
- Federal funding for energy R&D will increase by 26% over the previous year to reach $338 million in 1982/83.
- R&D and related scientific activities in the human sciences are estimated at $578.9 million in 1982/83.
- University research in the human sciences will increase by 18% to $61.7 million.

Federal Budgetary Science Expenditures by Activity and Performer. (1982/83)



Some Terminology

Departmental Missions — refer to R&D undertaken in support of the objectives of specific federal departments such as Agriculture Canada or Energy, Mines and Resources.

Envelope — represents the resources available to a particular policy sector for all elements of departmental spending that relate to that sector.

Extramural Research — is research funded but not performed by the federal government.

GERD — Gross Expenditures on Research and Development — is the total national expenditure on R&D during a specific period.

Granting Councils — are agencies set up by the federal government to finance university research. e.g. the Natural Sciences and Engineering Research Council, the Social Sciences and Humanities Research Council and the Medical Research Council.

GNP — Gross National Product — refers to the value of all the goods and services produced within the country during a given period.

Human Sciences — include the disciplines involving the study of human actions and conditions as well as the social, economic and institutional mechanisms affecting humans. The human sciences include such disciplines as anthropology, business administration and commerce, communications, criminology, demography, economics, geography, history, languages, literature and linguistics, law, library science, philosophy, political science, psychology, religious studies, social work, sociology, and urban and regional studies.

Intramural Research — is research funded and performed by federal departments and agencies.

Main Estimates — refer to the documents tabled before Parliament detailing the government's planned annual expenditures. Supplementary Estimates are sometimes required during the year to increase the amounts approved by Parliament in the Main Estimates.

Natural Sciences — consist of disciplines concerned with understanding, exploring, developing or utilizing the natural world. Included are the engineering, mathematical, life and physical sciences.

Real Terms — refers to the evaluation, from a defined base period, of the value of goods and services discounting inflationary costs.

R&D — Research and Development — research is original investigation undertaken to acquire new knowledge. Development is systematic work, drawing on the knowledge gained through research, to produce or improve products or processes.

RSA — Related Scientific Activities — covers such activities as data collection and information services, testing and standardization procedures, food and drug quality control.

The R&D Planning Framework

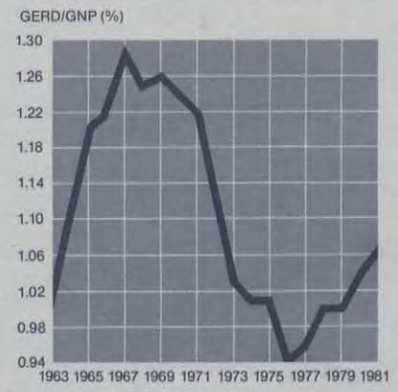
In 1980, the Ministry of State for Science and Technology reviewed the contribution R&D makes to the economic and social development of Canada. The federal government subsequently endorsed an R&D Planning Framework for the natural sciences. The Framework established a national target for R&D investment to reach 1.5% of GNP by 1985. To meet the target, overall expenditures on R&D in Canada must increase by 20% annually.

The required rate of increase varies from sector to sector. Industry faces the greatest challenge and must increase its R&D investment by 27% per year to reach its target. The target increase for the federal government is 17% per year.

The Planning Framework and Canada's Gross Expenditures on R&D

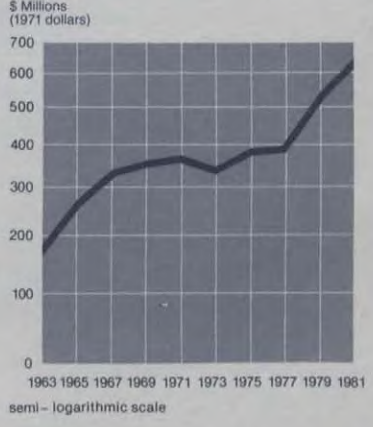
Statistics Canada recently estimated that Canada's Gross Expenditures on R&D (GERD) have increased by 34% since 1979 from $2.63 billion to $3.52 billion in 1981. The GERD is now estimated at 1.07% of GNP in 1981 compared to 1.00% in 1979. The downward trend in the GERD/GNP ratio which was evident in the early seventies has been arrested and reversed in recent years.

Canada's Gross Expenditures on R&D (GERD) — Natural Sciences — 1963-81.



From 1979 to 1981, the increases in R&D investment by the private sector and the federal government have been particularly impressive. Investment in R&D by industry has risen by 43% ($447 million) from $1034 million to $1481 million in these two years. The 21.3% growth rate achieved by industry in 1981 was higher than the 18.1% rate achieved in 1980. In real terms, these growth rates are higher than in any period since the early 1960's.

Gross Expenditures on R&D (GERD) — by Industry Sector



The federal government's gross expenditures on R&D in the natural sciences have also increased dramatically since 1979, rising from $936 million in 1979 to $1254 million in 1981. This represents an increase of $318 million or 34%. This GERD estimate of $1254 million for 1981 is actually slightly understated as it does not take into account the additional federal R&D expenditures contained in the Supplementary Estimates for the 1981/82 fiscal year.

In spite of this demonstrated progress towards the target, neither the rates of increase in each sector nor the overall rate of increase quite met the planned rate of increase for 1980 and 1981. The only exceptions were the categories of "other funders" whose investments exceeded the planned rate and the federal government which virtually met it.

A Comparison of Planned and Actual Increases in GERD by Funder

Funder Sector	1979	1980	1981	Annual Average Rate of Growth Planned	Actual
	($ millions)				
Federal Government	936	1105	1254	17%	16%
Provincial Government	173	194	213	19%	11%
Industry	1034	1221	1481	27%	20%
University	344	346	387	9%	6%
Other	144	163	183	9%	13%
Total	**2631**	**3029**	**3518**	**20%**	**16%**

The Planning Framework and the Budget for R&D in the Natural Sciences

Due to definitional, timing and reporting differences, the GERD statistics published by Statistics Canada and the budgetary science expenditure data derived from the Main Estimates do not match. For example, the R&D expenditures of the Canadian International Development Agency (CIDA) and the International Development Research Centre (IDRC) are not included in GERD.

The difference between these two series of data is significant. Federal budgetary expenditures on R&D in the natural sciences in 1980/81 totalled $1240 million while the Statistics Canada estimate of the federal contribution to GERD for 1980 was only $1105 million. The difference of $135 million represents an amount equivalent to 11% of total federal R&D expenditures in the natural sciences.

The gap between the two expenditure series was taken into account in calculating the federal budgetary expenditures required to meet the R&D Planning Framework objectives. The target track for federal expenditures on R&D and the expenditures budgeted in the Estimates are compared below.

R&D in the Natural Sciences Actual and Estimated Expenditures

Year	Target Track	Original Estimate	Revised Estimate	Above (Below) Track
		($ millions)		
1979/80	1100	1100	1100	—
1980/81	1282	1298	1240	(42)
1981/82	1493	1495	1534	41
1982/83	1738	—	1784	46

The estimated 1982/83 expenditures for R&D in the natural sciences are $1784 million, $46 million above the target track level of $1738 million established in the Planning Framework. Expenditures in 1981/82, estimated at $1534 million, also exceed the track by $41 million. In the first year of the Planning Framework, expenditures were originally estimated at $1298 million. Actual expenditures for that year were $1240 million, $42 million below the target track.

The federal government's high priority on R&D investment is evident when compared to other federal demands for funds. During the first two years of the planning framework, R&D expenditures in the natural sciences increased by about 39%. In the same period the government's total operating and capital expenditures for all departments and agencies increased by about 22%.

The Planning Framework and the Allocation of New Funds for R&D in the Natural Sciences

All funds for program development or for new projects must be financed from the reserves of the various expenditure envelopes of the government. Between 1979/80 and 1981/82, $325 million has been allocated from these reserves for R&D activities in the natural sciences.

To encourage private sector investment in R&D, the R&D Planning Framework suggested that 47% of new federal funds for research and development be applied to support R&D in industry, 21% to support R&D in universities and the remaining 32% to support departmental missions.

New funds allocated to industrial R&D support from the reserves of the expenditure envelopes totalled $225.6 million or 69%; new funds to support research in universities totalled $59.2 million or 18%; and, new funds going to departmental mission research totalled $39.9 million or 12%. This estimate assumes that $68 million of the $98 million for energy R&D has been allocated to industrial R&D support and the rest to mission-oriented research.

Allocations from Reserve Funds (1979/80 to 1981/82)

Program	Two-Year R&D Increase ($ millions)	
Direct Industry Support (R&D Component)		
Defence Industry Productivity Program	24.6	
Enterprise Development Program	46.3	
Industrial Research Assistance Program	5.8	
Program for Industry Laboratory Projects	7.3	
New Technology Employment Program	1.0	
Source Development Fund	1.0	
Unsolicited Proposals	0	86.0
Government Programs with Industry		
Space	40.9	
Telidon	10.9	
David Florida Lab.	6.6	
Industrial Materials Institute	8.5	
Arctic Vessel Institute	4.7	71.6
Government Programs Impacting Industry		
Energy R&D	97.9	
Transportation R&D	3.0	100.9
Support to University		
Medical Research Council (MRC)	11.6	
Natural Sciences and Engineering Research Council (NSERC)	47.6	59.2
Intramural Programs	7.0	7.0
Grand Total		**324.7**

In summary, planned and actual performance of R&D in the natural sciences compares very favourably and considerable progress has been made towards achieving the R&D target. The federal government has increased its expenditures in line with the target. The industry sector has also increased its own R&D investment at a very high rate by historical standards. Although the overall growth in R&D investment has not quite met the expenditure target, the past downward trend in Canada's R&D expenditures as a percentage of GNP has been reversed, and the GERD/GNP ratio is now rising steadily.

R&D and Innovation

The costs of innovation include many more costs than those directly related to R&D. Most federal departments take this into account in their industrial support programs. The chart below illustrates the R&D component of a few of the major industry support programs.

The R&D Component of the Industrial Innovation Support Programs (1981/82)

Direct Industry Support	Total Program	R&D Component
	($ Millions)	
Defence Industry Productivity Program (IT&C)	151.6	55.9
Enterprise Development Program (IT&C)	142.0	76.7
Industrial Research Assistance Program (NRC)	31.6	25.4
Program for Industry Laboratory Projects (NRC)	16.4	16.4
New Technology Employment Program (EIC)	8.0	1.0
Source Development Fund (DSS)	10.0	1.0
Unsolicited Proposals (DSS)	15.0	12.0
Total	**374.6**	**188.3**

The Federal Science Budget: Main Estimates 1982/83

The federal science budget, as expressed in the Main Estimates, covers several areas of science expenditure. In addition to expenditures on R&D in the natural sciences, which is the measure used in the R&D Planning Framework, it also outlines expenditures on related scientific activities (RSA) in the natural sciences and both RSA and R&D in the human sciences.

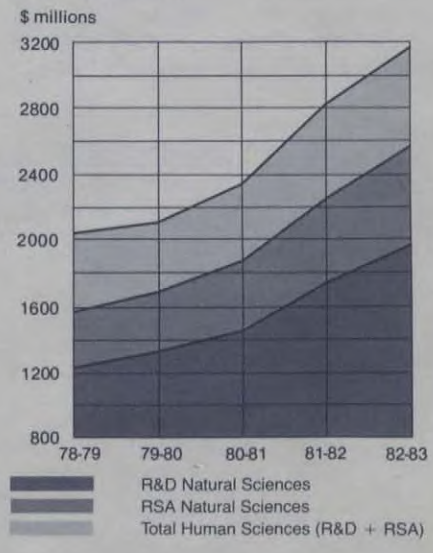
Total federal budgetary expenditures in both the natural and the human sciences will be $2.94 billion in 1982/83, representing an increase of about 13% over the corresponding $2.60 billion in 1981/82. Total R&D and related scientific activities (RSA) in the natural sciences will be $2.3 billion in 1982/83, an increase of almost 17% over 1981/82. Total R&D and related scientific activities (RSA) in the human sciences will remain at $579 million, approximately the same level as the year before.

Federal Science Expenditures (1981/82 to 1982/83)

	1981/82	1982/83	Increase (Decrease)
	($ millions)		
Human Sciences			
R&D	109.5	130.4	19%
RSA	469.7	448.5	(5%)
Total	579.2	578.9	—
Natural Sciences			
R&D	1533.9	1784.3	16%
RSA	491.4	578.3	18%
Total	2025.3	2362.5	17%
Total	**2604.9**	**2941.4**	**13%**

Over the past five years, expenditures for R&D in the natural sciences grew faster, at about 15% per annum, than any other component of the science expenditures. The annual growth rate of total federal science expenditures has been about 13%.

Federal Budgetary Science Expenditures — 1978/79 to 82/83 (in current dollars)



The Federal Budget for the Natural Sciences

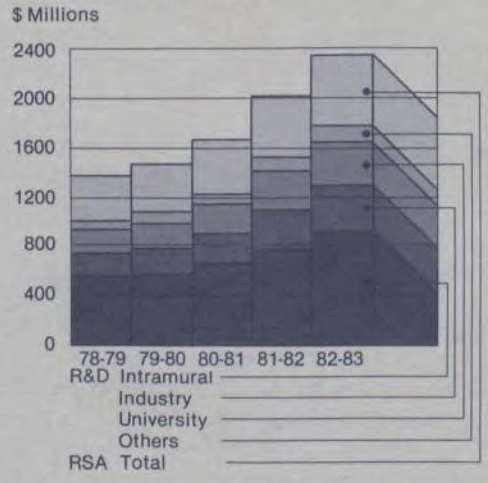
Since 1978/79 federal expenditures on R&D in the natural sciences have grown at an average annual rate of 15% from $1011 million to $1784 million in 1982/83. This is a cumulative increase of 76%. The average annual growth rate for related scientific activities (RSA) has been somewhat slower over this period at 11%, going from $387 million in 1978/79 to a total of $578 million in 1982/83.

Federally funded R&D and related scientific activities are performed in-house (intramurally) and in other sectors (extramurally). The major extramural performers are industry, university, provincial governments, private non-profit organizations, and the foreign sector. The latter is funded primarily by the Canadian International Development Agency (CIDA) and the International Development Research Centre (IDRC).

Over the past five years, federal expenditures on intramural R&D activities grew more slowly, at about 14% per annum, than extramural expenditures at 20%. Thus, while federal intramural expenditures accounted for 58% of total federal R&D expenditures in 1978/79, they now represent a 51% share in 1982/83.

During this same period, federal expenditures for R&D performed in industry have been increasing by 22% per year. They more than doubled between 1978/79 and 1982/83, from $182 million to $389 million.

R&D and RSA Expenditures in the Natural Sciences by Performing Sector



Since 1978-1979, the proportion of R&D funded by the federal government but performed extramurally has risen from 42% to 49%. The amount of federally funded R&D performed by industry has risen from 18% to 22% of total natural sciences R&D funded by the government. Intramural RSA expenditures have remained quite stable at about 77% of total RSA expenditures.

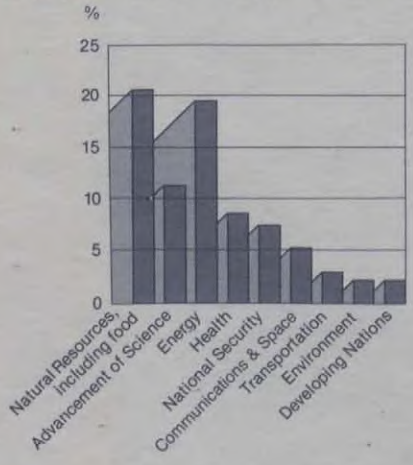
Support for university R&D has grown at a 17% per annum rate over the past five years. It has maintained a relatively constant share of the total R&D budget at about the 20% level. Most of the current federal support for R&D performed in the universities, $351.2 million in 1982/83, is provided through the granting councils. In the natural sciences, about 80% of the federal funds are channelled through the Medical Research Council (MRC) and the Natural Sciences and Engineering Research Council (NSERC).

Growth in the Granting Councils' Budgets

	1979/ 1980	1980/ 1981	1981/ 1982	1982/ 1983	Three Year Cumulative Increase
	($ Millions)				(%)
Medical Research Council	70	82	100	113	61
Natural Sciences and Engineering Research Council	121	163	202	227	88
Total	**191**	**245**	**302**	**340**	**78**

The following chart shows the distribution of the 1982/83 R&D expenditures in the natural sciences among the major areas of application. Natural resources R&D and energy R&D account for 40% of total expenditures. Energy R&D is now the fastest growing component, increasing 26% from $268.5 million in 1981/82 to $338.2 million in 1982/83.

Federal R&D Expenditures in the Natural Sciences — 1982/83 — by Application Area



The Federal Budget for the Human Sciences

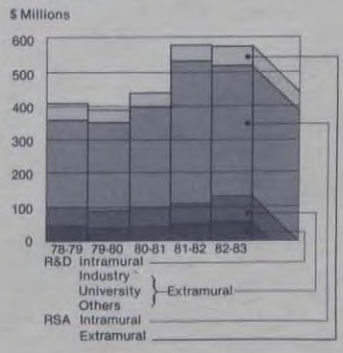
Total expenditures in the human sciences are estimated to be $579 million in 1982/83, a cumulative increase of 40.7% since 1978/79.

R&D expenditures in the human sciences will total $130 million in 1982/83, up from $110 million in 1981/82. RSA expenditures will be down to $449 million from $470 million for the same period reflecting, in part, the decrease in Statistics Canada's budget by $43 million with the completion of the 1981 Decennial census.

Federally funded R&D in the human sciences has increased from $100.3 million in 1978/79 to $130.4 million in 1982/83, while related scientific activities over that same period have gone from $311.1 million to $448.5 million. This latter amount represents a cumulative increase of 44%.

The distribution of expenditures on human sciences among performers in 1982-83 is compared with the distribution in 1978-79 in the chart below.

R&D and RSA Expenditures in the Human Sciences by Performing Sector



The proportion of R&D performed intramurally by the federal government has remained relatively stable at 42% of total human sciences R&D since 1978/79. Intramural expenditures on RSA have risen slightly to 88% of the total from 86% over this same period.

The primary funder of extramural research in the human sciences is the Social Sciences and Humanities Research Council (SSHRC). SSHRC received a three-year cumulative budget increase of 55% from $36.6 million in 1979/80 to $46.6 million in 1981/82 and $56.7 million in 1982/83.

Human Resources

Human resources for R&D and related scientific activities in federal departments and agencies remained relatively stable for the five years before 1982/83. The budgeted total person-years of 34,300 is only about 1,200 person-years over the 1980/81 level. This modest increase of 3.6% in two years reflects the government's policy to restrain growth in the Public Service. The considerably higher increase in science expenditures between 1978/79 and 1982/83 compared to person-years reflects the government's policy of "contracting-out" science activities and the redirection of funds to encourage industrial and university R&D.

Federal Expenditures on the Natural and Human Sciences

($ millions)

Department	1978/79	1979/80	1980/81	1981/82	1982/83
Total Science	**1,809.0**	**1,891.8**	**2,121.2**	**2,604.6**	**2,941.5**
Economic Development	**1,019.9**	**1,088.5**	**1,221.3**	**1,511.2**	**1,754.7**
Agriculture	127.2	143.9	152.4	168.5	196.1
Communications	61.9	58.6	65.3	81.3	66.7
Energy, Mines & Resources	124.5	162.7	179.1	229.7	280.5
Atomic Energy of Canada Ltd.	92.0	88.9	96.8	114.2	132.4
Environment Canada					
Forestry Service	29.8	39.8	50.3	58.3	69.4
Fisheries & Oceans	122.5	112.7	116.4	130.0	145.8
Industry, Trade & Commerce	61.4	83.5	97.5	143.5	173.3
National Research Council	197.2	201.4	226.1	297.4	360.7
Natural Sciences & Engineering					
Research Council	111.9	121.0	162.9	201.8	227.1
Supply & Services	12.4	14.9	15.0	15.1	15.1
Transport	42.1	27.7	17.2	21.4	24.0
Others	37.0	33.4	42.3	50.0	63.6
Social Development	**454.0**	**473.0**	**526.9**	**604.4**	**693.4**
National Library	13.1	14.7	17.2	21.6	25.8
National Museums of Canada	55.1	50.1	54.0	58.7	61.8
Social Sciences & Humanities					
Research Council	34.6	36.6	42.4	46.6	56.7
Employment & Immigration	10.0	16.0	17.3	18.9	18.3
Environment	176.6	180.3	196.9	220.7	264.7
National Health & Welfare	58.2	58.0	63.8	72.6	80.9
Medical Research Council	64.2	70.1	82.0	100.2	112.9
Others	42.2	47.2	53.3	65.1	72.3
External Affairs & Defence	**160.5**	**166.1**	**187.1**	**207.9**	**251.4**
CIDA	35.6	37.4	36.5	40.4	45.0
IDRC	36.7	36.5	39.8	46.0	56.6
National Defence	83.3	87.1	102.6	112.0	139.6
Others	4.9	5.1	8.2	9.5	10.2
Services to Government	**174.7**	**163.7**	**185.9**	**281.1**	**242.0**
Statistics Canada	133.3	122.2	144.1	230.0	187.2
Treasury Board	10.5	10.0	10.7	12.9	15.4
Others	30.9	31.5	31.1	38.2	39.4

R&D and RSA Expenditures in the Natural Sciences by Performing Sector

	1978/79		1979/80		1980/81		1981/82		1982/83	
	($ millions and (%))									
Total Natural Sciences	**1397.8**		**1494.5**		**1677.6**		**2025.3**		**2362.5**	
R&D Expenditures (Total)	1011.2	(100)	1100.3	(100)	1240.0	(100)	1533.9	(100)	1784.3	(100)
Intramural	583.	(58)	587.8	(53)	665.3	(54)	771.2	(50)	912.8	(51)
Extramural (Total)	427.8	(42)	512.5	(47)	574.7	(46)	762.7	(50)	871.5	(49)
Industry	181.8	(18)	213.4	(19)	237.2	(19)	337.3	(22)	389.4	(22)
University	190.3	(19)	200.6	(18)	254.1	(20)	312.6	(20)	351.2	(20)
Others	55.7	(4)	98.7	(10)	83.4	(7)	112.7	(8)	131.0	(7)
RSA Expenditures (Total)	386.6	(100)	394.2	(100)	437.6	(100)	491.4	(100)	578.2	(100)
Intramural	296.1	(77)	313.4	(79)	342.1	(78)	381.6	(78)	448.0	(77)
Extramural (Total)	90.4	(23)	80.8	(21)	95.5	(22)	109.8	(22)	130.2	(23)
Industry	58.0	(15)	45.8	(12)	55.4	(13)	63.2	(13)	74.7	(13)
University	13.7	(4)	15.0	(4)	19.9	(5)	25.4	(5)	28.3	(5)
Others	18.7	(4)	20.2	(5)	20.1	(4)	21.3	(4)	27.3	(5)

R&D and RSA Expenditures in the Human Sciences by Performing Sector

	1978/79		1979/80		1980/81		1981/82		1982/83	
	($ millions and (%))									
Total Human Sciences	**411.3**		**397.3**		**443.7**		**579.2**		**578.9**	
R&D Expenditures (Total)	100.3	(100)	90.7	(100)	95.1	(100)	109.5	(100)	130.4	(100)
Intramural	42.2	(42)	36.4	(40)	39.8	(42)	47.2	(43)	55.3	(42)
Extramural (Total)	58.1	(58)	54.3	(60)	55.3	(58)	62.3	(57)	75.1	(58)
Industry	4.9	(5)	4.7	(5)	3.3	(3)	4.6	(4)	5.0	(4)
University	26.0	(26)	26.9	(30)	30.5	(32)	34.6	(32)	42.4	(33)
Others	27.2	(27)	22.8	(25)	21.5	(23)	23.1	(21)	27.7	(21)
RSA Expenditures (Total)	311.1	(100)	306.6	(100)	348.6	(100)	469.7	(100)	448.5	(100)
Intramural	266.6	(86)	264.7	(86)	303.7	(87)	418.3	(89)	392.5	(88)
Extramural (Total)	44.5	(14)	41.8	(14)	44.9	(13)	51.4	(11)	56.0	(12)
Industry	9.6	(3)	9.6	(3)	10.2	(3)	12.0	(3)	13.9	(3)
University	14.9	(5)	13.6	(4)	15.5	(4)	17.7	(4)	19.3	(4)
Others	20.0	(6)	18.6	(7)	19.2	(6)	21.7	(4)	22.7	(5)