

Science and Technology: Friend or foe?

- ❑ The contents of school subjects is not only “the discipline” itself, but also mirrors prevailing **public ideologies, Zeitgeist, Worldviews**
- ❑ “The hidden curriculum”: often implicit images about science -- and scientists
- ❑ It changes over time, varies between countries
- ❑ Visible (in hindsight!) in curricula, textbooks, teacher training, media and culture
- ❑ **Examples** from Norwegian textbooks follow: S&T as heroes, later as anti-heroes
- ❑ Important:
Norway had a state-run approval system for textbooks until 2000. Books were scrutinized on several criteria before certified for use

School science in Norway in the postwar decades (1945 → 1975+)

- ❑ Science and technology presented as positive and unproblematic
- ❑ Paving the road to progress
- ❑ Engineers and scientists as heroes
- ❑ Textbooks illustrate S&T in society, to motivate students

- ❑ Examples follows....

School science in Norway in the postwar decades (1945 -- 1975):

”Chemicals increase the yield in farming, and the use of machines ease the workload.



Kjemiske stoffer øker jordas avkastning, og maskiner letter arbeidet.

In Norway (until 2000):
All school textbooks: Public scrutiny by Ministerial committee before publication

Efficient explosives and large machinery enables the building of roads and railroads



Effektivt sprengstoff og store arbeidsmaskiner gjør det mulig å bygge veier og jernbaner.

Pictures from Alfsen & Wang-Lund:
Naturfag for grunnskolen, Grade 7,8 and 9,
Gyldendal 1973

The demand for fast transport has led to the construction of monorails

Krav om rask transport har ført til konstruksjoner av en-skinnebaner.



Medicine has made great progress.
At any time, the Pharmacies must sell us the best medicines



Også på legevitenkapsens område er det gjort store framskritt siden århundreskiftet. Apotekene må til enhver tid selge oss de beste medisinerne.

The textbooks also mirror the gender roles of the time :

Moderne vaskemidler er et viktig produkt fra organisk kjemisk industri.

Modern detergents are important products from organic chemical industry

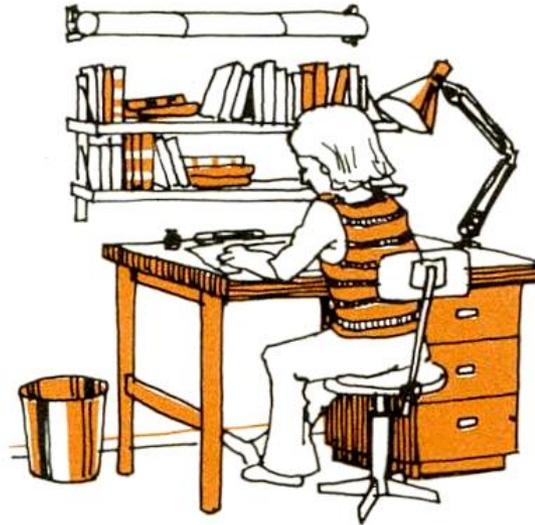


Modern chemical products like plastics can be used to provide us with comfortable vacation and leisure time.



Moderne kjemiske stoffer som plast kan også brukes til å gi oss en behagelig ferie og fritid.

Godt lys er nødvendig når du
leser leker. En elektrisk kom-
fyr er god å ha til matlagning.



Sufficient light is important
when doing homework.
An electric stove is good
for cooking.

I vaskeriene utfører strømmen
et nyttig arbeid.

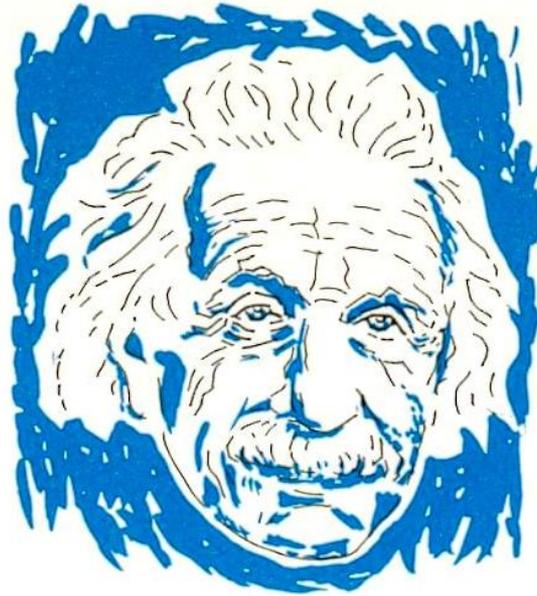


The electricity does useful
work in the laundries

Gender equity – by numbers! (and as role models)

Albert Einstein la det teoretiske grunnlaget for utnyttning av atomenergien.

Albert Einstein laid the theoretical foundation for the use of atomic energy



Praktisk anvendelse av lysrefleksjon.

Practical use of light reflection



Gradually: 1970s

**A concern for the
environment and the
problematic aspects of
technological
development**

Science and Technology since the 1970's

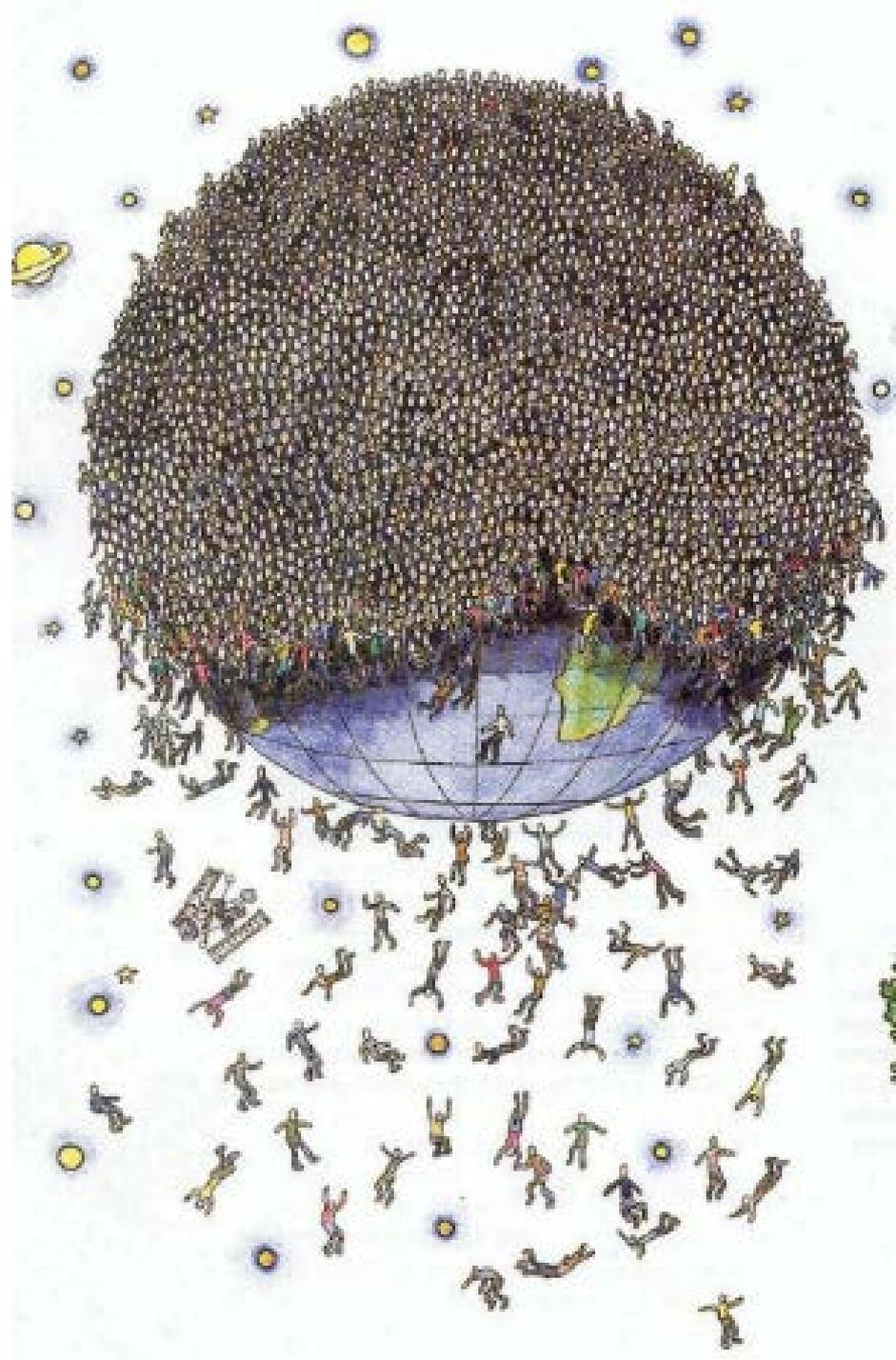
The downsides of development become obvious

- ❑ **1962 Rachel Carsons *Silent Spring***, Den tause våren, miljøgiftene
- ❑ 1970-75 Vietnam-war: ***Napalm*** and ***Agent Orange***
- ❑ **1972 *Limits to growth***. *Hvor går grensen?* Forskningsrapport
- ❑ 1972 *Framtiden i våre hender*, bok. 1974: organisasjon
- ❑ **1979 Three Mile Island** –accident : Nuclear power
- ❑ **1986 Tsjernobyl. 2011: Fukushima**. Nuclear power
- ❑ **1984 Bophal-accident**, India, 20 000 died (Dow Chemical)
- ❑ **1987 Brundtland- commission, *Our Common Future*** ,
"sustainable development"
- ❑ Deforestation, desertification, acid rain, "hole" in ozone-layer, pollution, depletion of resources ...
- ❑ And Now: Climate change, carbon emissions, biodiversity challenged, GMO and genetic engineering, cloning, "the Anthropocene" era
- ❑ **S&T: Friend or foe? Cause or Solution?**

The pendulum swings to the opposite extreme.

Environmental concerns (and catastrophes) replaced the image of science, technology and progress

Also in schools





Orienteering (O-fag)

(“integrated” social and natural science)
in primary schools (grade 1-6)

Current debate on “O-subject syndrome”: the rise and fall of a school subject

Kapittel i Merethe Roos og Johan Tønnesson (red) (2017). *Sann opplysning? Naturvitenskap i nordiske offentligheter gjennom fire århundrer*. Oslo: Cappelen Damm Akademisk

Svein Sjøberg

«O-fagssyndromet»

Et skolefags vekst og fall

Skolen er utvilsomt den viktigste kilden til hele folkets opplysning. I den obligatoriske fellesskolen har hver ny generasjon fått sin innføring i landets kultur og tradisjoner, historier og verdier. På skolen har også elevene fått sitt første, og ofte eneste, møte med de ulike vitenskapsfagene, deriblant naturvitenskapen. Skolens lærebøker i naturfag er den viktigste kilden til barns læring om vitenskapsfagene, deriblant naturfag. Lærebøkene i naturfag er prototypen på naturvitenskapelig folkeopplysning.



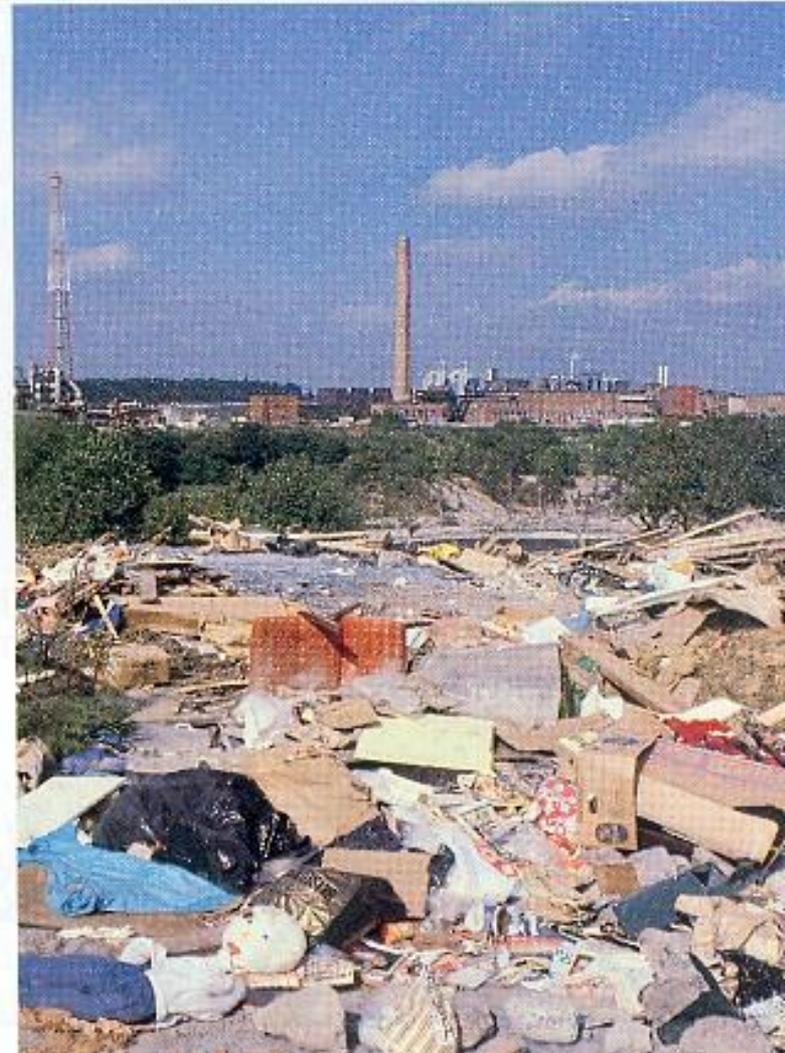
The world-view of O-fag

The curses of industry

Hvis leveforholdene forandres, klarer ikke plantene og dyra seg.
Det kan ta tusenvis av år før skadene blir borte.

Katastrofer

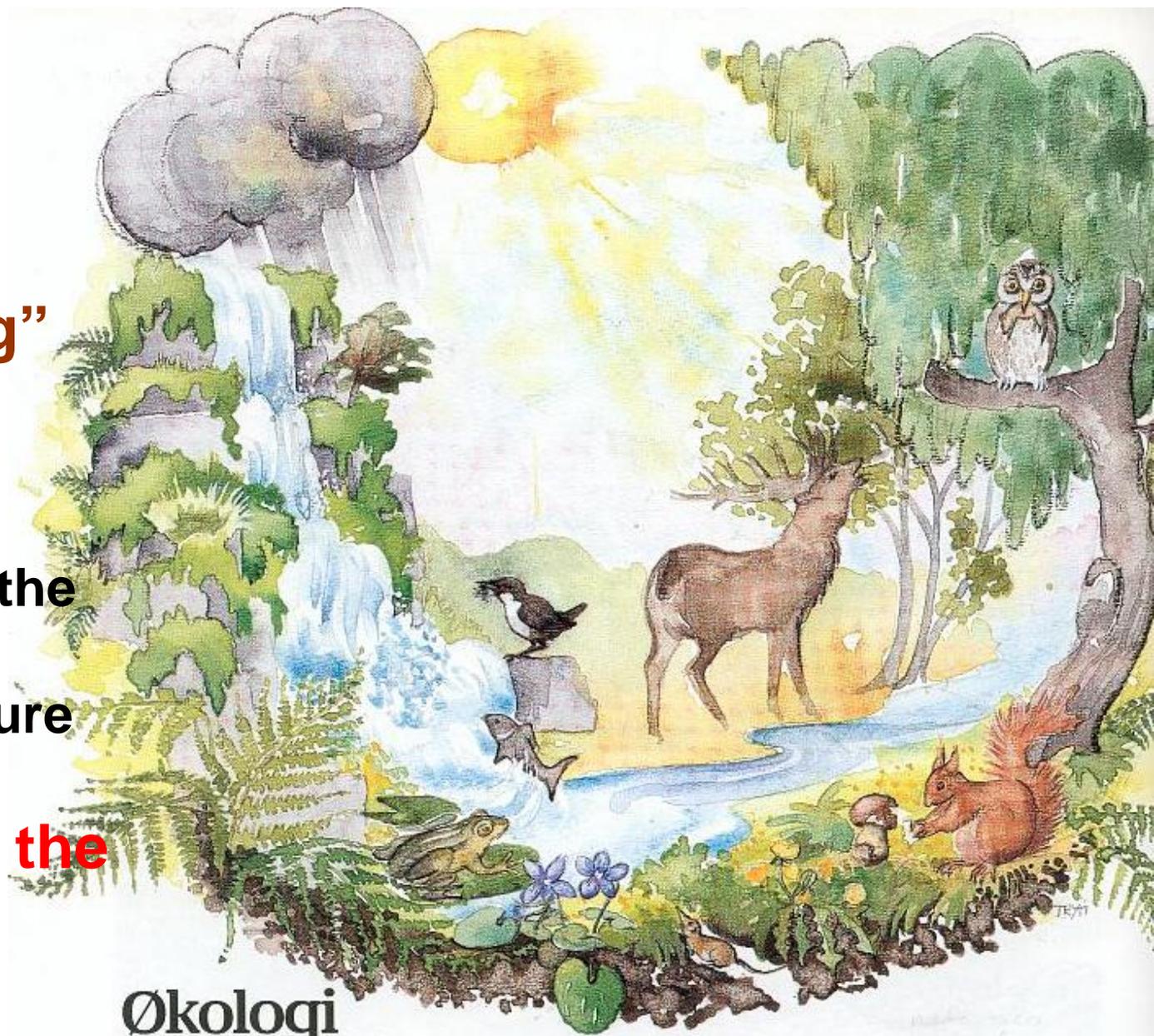
Det hender at naturkatastrofer, vulkanutbrudd, jordskjelv, orkan og tyfon, flom eller ras, forandrer naturen og ødelegger svære områder. I våre dager er det likevel menneskene selv som steller til de største ødeleggelsene i naturens veksthus. Gift i jorda, sur røyk i luften, farlige stoffer i havet, og radioaktivt nedfall truer vekstlivet.



The subject “Orienteering”

The Curses of
Industry – and the
Harmony of
untouched Nature

Approved by the
Ministry of
Education



Økologi

Økologi betyr FORTELLING OM Huset,
naturens veksthus.

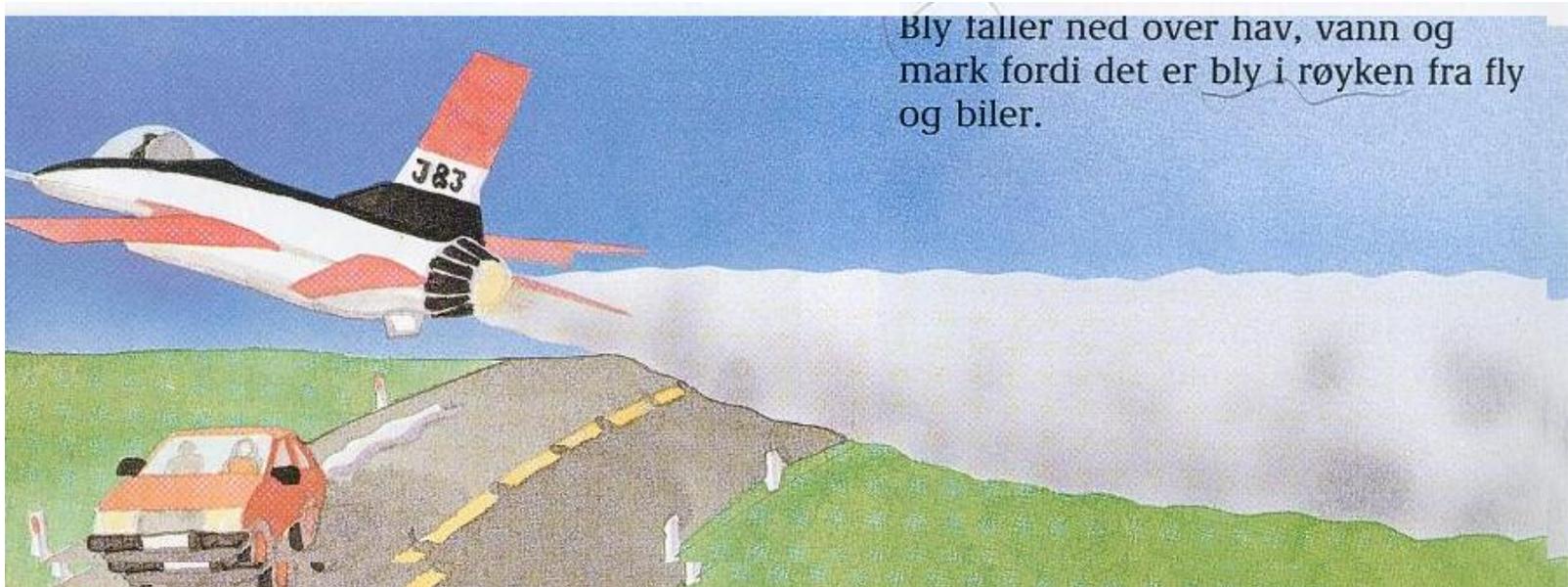
SOLA gir lys, varme og energi.
Den er kraftverket som driver alt.

The world-view of O-faget



Oil leakage can give large pollution. Fish may suffer

Lead falls over oceans, water and fields because there is lead in in the smoke from airplanes and cars.



Radioactivity is spread by the wind after tests with nuclear weapons and accidents in nuclear power plants



Poison used against insects and diseases may poison other plants and animals.



Gifter som sprøytes mot skadedyr eller plantesykdommer, kan forgifte andre planter og dyr.

Dirty sewage may destroy animal and plant life in lakes and oceans



Poisoning nature:

Many factories and houses use oil and coal for heating. In the smoke there is sulphuric acid. That makes the water acid and kills the forest.

46 FORGIFTING AV NATUREN



Mange fabrikker og hus fyrer med olje og kull. I røyken er det svovelsyre. Den gjør vannet surt og marka sur og dreper skogen.

The science contents in o-fag:

Prejudice and errors.

(20 authors. None of them with *any* science background)

32 ELEKTRISITET

ALT KAN BLI ELEKTRISK
Alle ting rundt oss kan bli elektriske.
Det gjelder bortover et

UBRUKELIG ELEKTRISITET
Hvis du går på golvteppet, eller gnir
en kam med en tørr klut, lager du
elektrisitet, men så lite at den ikke

The electricity in your lamp comes from a generator.

This is machine that whirls around and tears out electricity and puts it into the wires. In this way we get electric current in the wires. (like the comb in the hair.)

ELEKTRISITET ER MANGEL PÅ NOE
Når du gnir kammen din, stjeler du
«noe» fra kammen. Da blir den sint!
Den vil ha tilbake det den mistet, og
derfor strømmer det «noe» tilbake
når kammen kommer bort i håret
ditt eller noe annet.
Denne strømmen er elektrisitet.



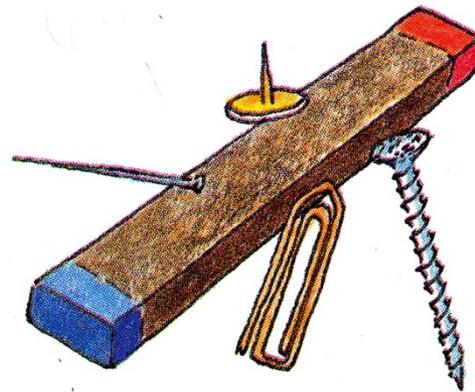
ELEKTRISITETSVERK
Den elektriske strømmen i lampen
din kommer fra en generator. Det er
en maskin som går rasende fort
rundt og «river løs» strøm. På den
måten blir det strøm i ledningene.



Magnetism is a force that can only be in iron

Magnetiske steiner

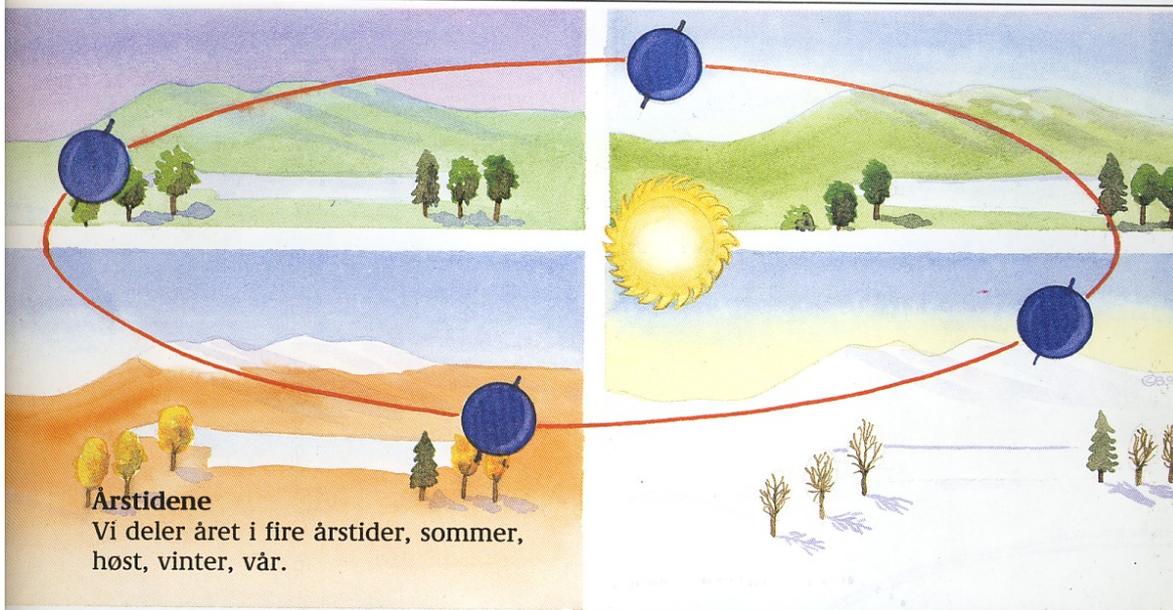
Det fins stein med jernmalm i som kan dra til seg knappenåler. Vi sier at disse steinene er magnetiske.

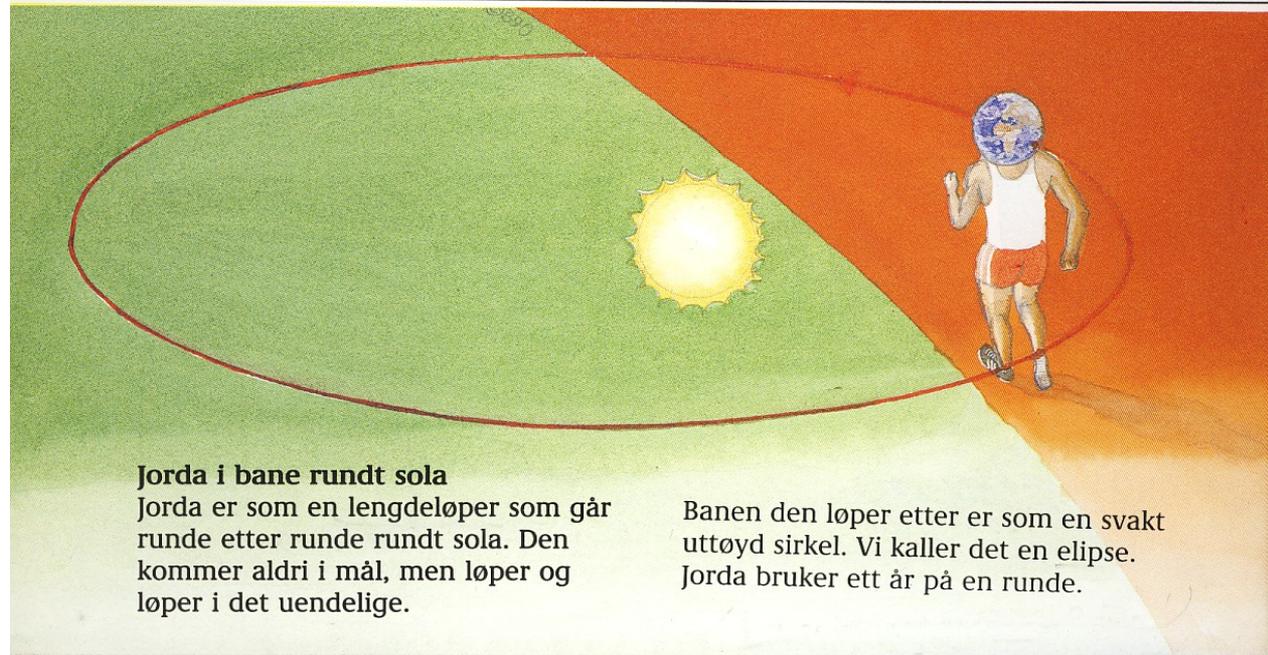


Hva er magnetisme?

At et jernstykke er magnetisk, vil si at det drar til seg andre ting av jern. Magnetisme er en kraft som bare kan være i jern. Ikke alle jernting er magneter.

"Explaining" the universe

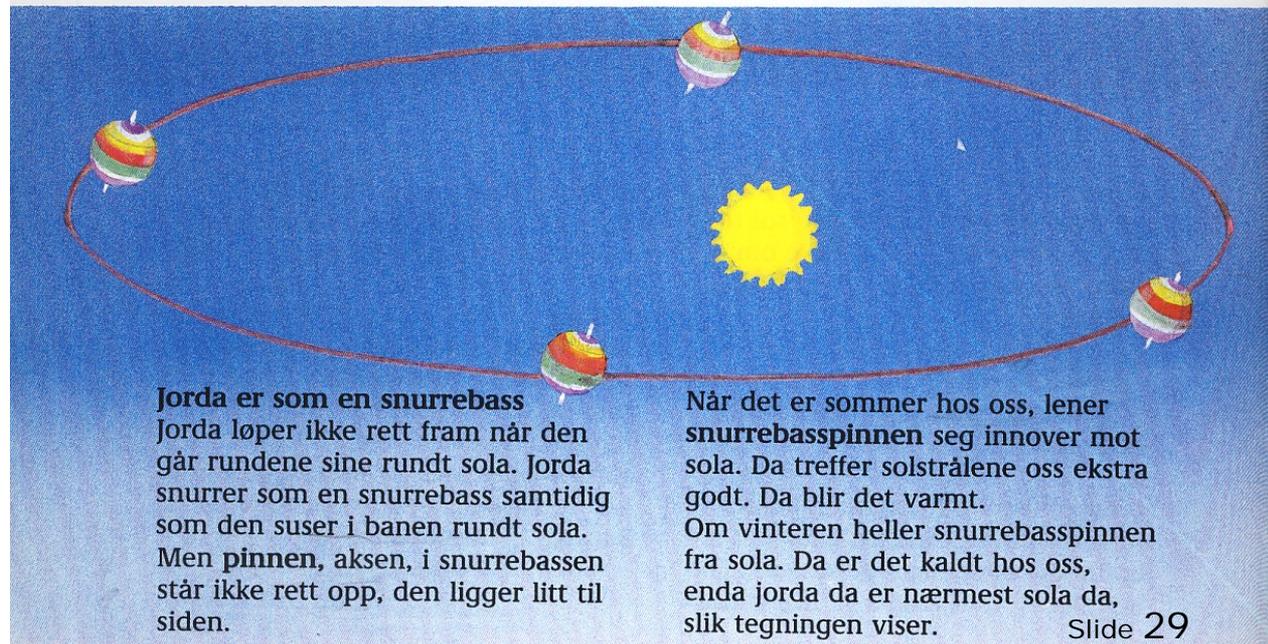




Jorda i bane rundt sola

Jorda er som en lengdeløper som går runde etter runde rundt sola. Den kommer aldri i mål, men løper og løper i det uendelige.

Banen den løper etter er som en svakt uttøyd sirkel. Vi kaller det en elipse. Jorda bruker ett år på en runde.



Jorda er som en snurrebass

Jorda løper ikke rett fram når den går rundene sine rundt sola. Jorda snurrer som en snurrebass samtidig som den suser i banen rundt sola. Men **pinnen**, aksen, i snurrebassen står ikke rett opp, den ligger litt til siden.

Når det er sommer hos oss, lener **snurrebasspinnen** seg innover mot sola. Da treffer solstrålene oss ekstra godt. Da blir det varmt. Om vinteren heller snurrebasspinnen fra sola. Da er det kaldt hos oss, enda jorda da er nærmest sola da, slik tegningen viser.

O-fag Textbook “dictionary”



- ❑ "Energy = force"
- ❑ "Watt = strength of light" (grade 3)
- ❑ "Watt = strength of current" (same book, grade 4!)
- ❑ "Magnetism is a force found in iron"
- ❑ "Electricity is lack of “something”"
- ❑ "The moon is a mirror star"
- ❑ "Glaciers are remains from the ice age"
- ❑ "Bacteria are viruses"
- ❑ "Bacteria: cells that make you ill"
- ❑ "Temperature = heat"
- ❑ Radiation = radioactive waste
- ❑ (Illustrations show mercury thermometers, forbidden in schools a long time ago)

Norwegian primary school from mid 70-s. Industry, science and technology as the evil enemy

dei hadde brukt *kjemiske stoff* til å fjerna lukta.

Kjemiske
menneske

stoff i vatn

They had used **chemicals** to remove the smell. **Chemicals** do not belong in nature. They are artificial and are made by humans.

Folk tømmer nok ikkje tøtkiosetta sine i sjøen lenger.

Vi veit meir om korleis dei forskjellige kjemiske stoffa verkar på livet i naturen. Før trudde vi at naturen tok

Waiste that belongs in nature is broken down and become useful. But nature does not like artificial chemicals. They do harm to nature.

nyttige

nd og laga

ikkje

naturen ha noko med å gjera. Dei gjer skade på naturen.

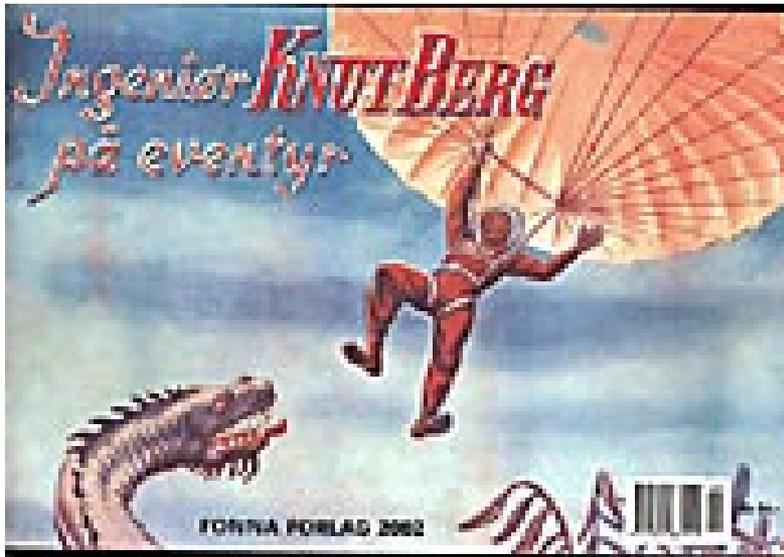
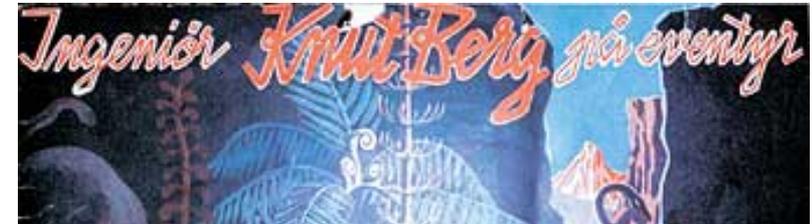
"Kompass: O-fag for grade 6."

Gyldendal 1978, Approved by Ministry of Education

The old heroes: Those who changed the world and solved our problems..

In Norwegian boys' room since 1945:

The adventures of engineer Knut Berg



Last issue around 1970
The hero became a villain!

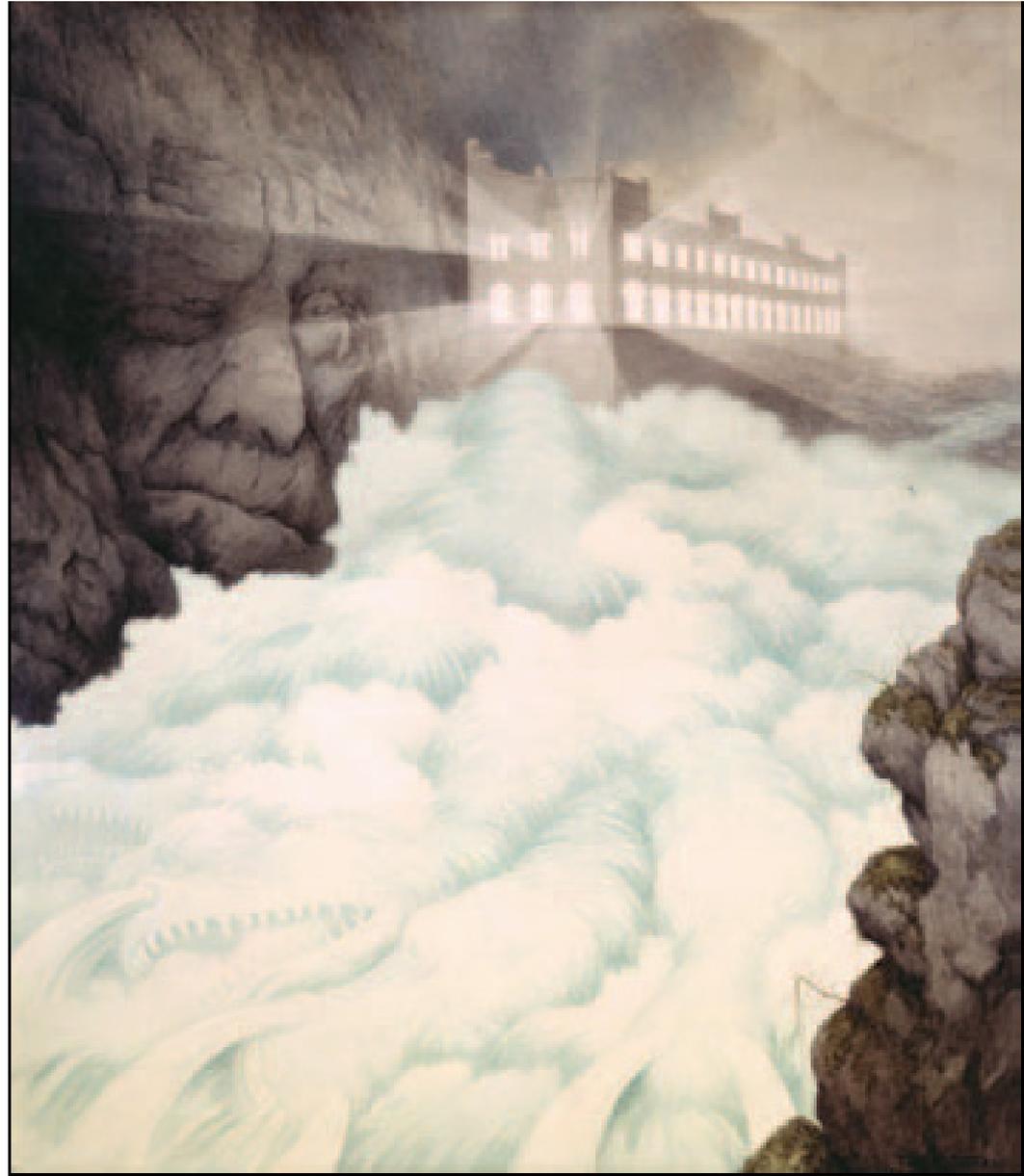
Happy New Year (anno 1902)



Changes in the perception of S&T, also in art.

**Th. Kittelsen (1906):
The emergence of
Norwegian hydropower
(Rjukan waterfall) and
Norsk Hydro:**

**The trolls are fought
back.
Science and technology
provide light and
progress**



**Post-war optimism:
science, technology → progress
Arbeiderpartiets election campaign ca 1950**

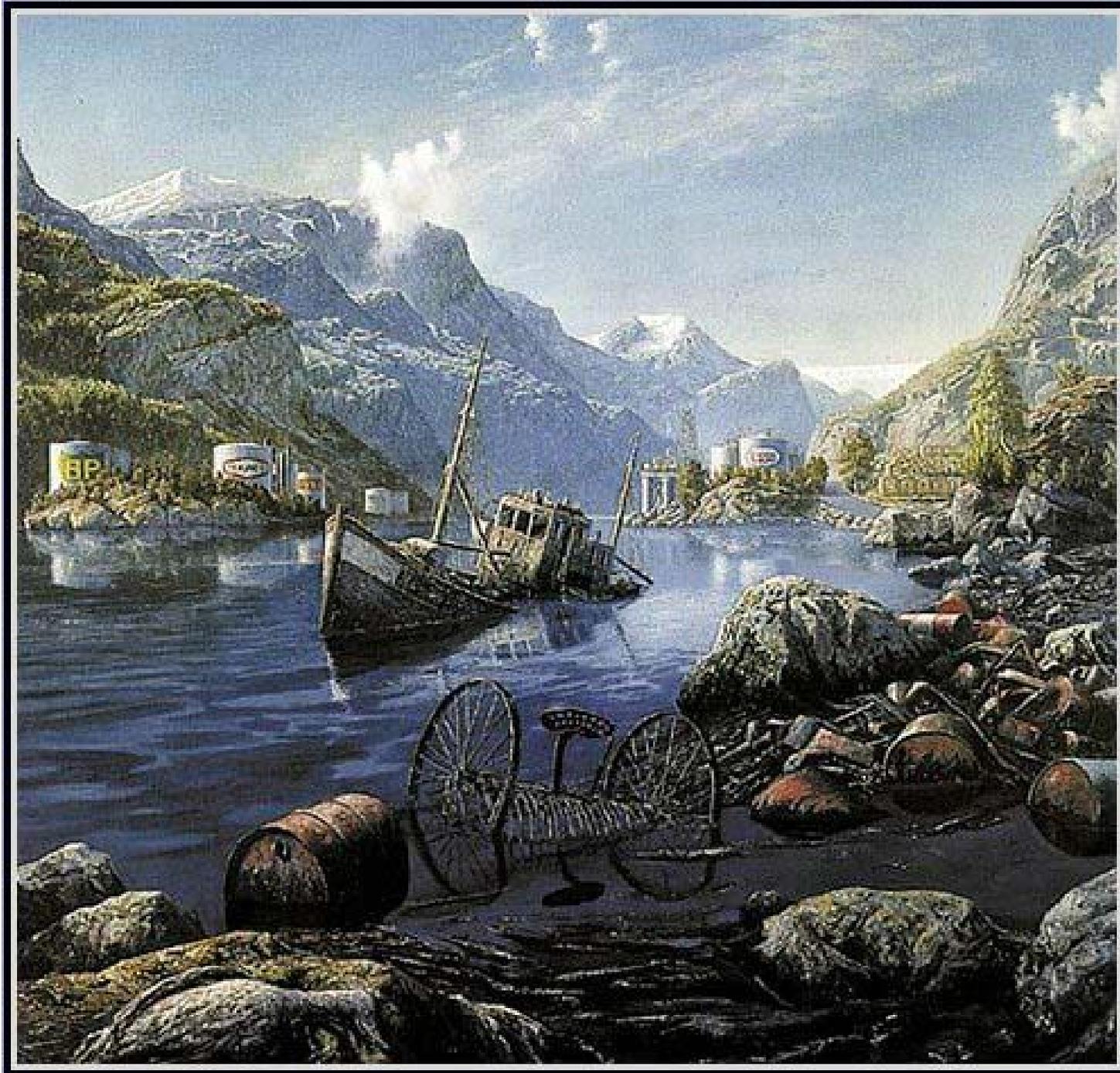


The Norwegian romantic icon: wedding in Hardanger

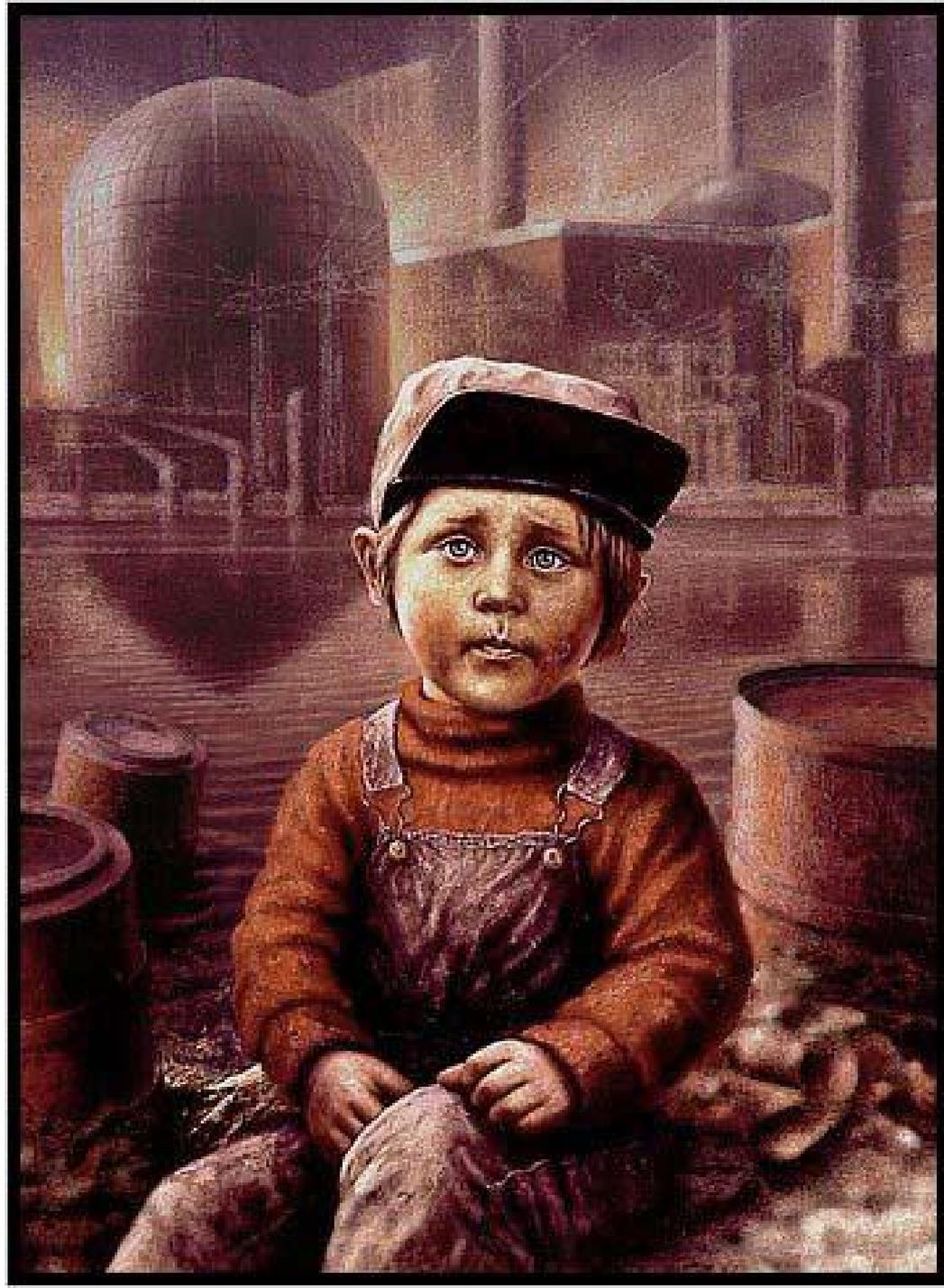


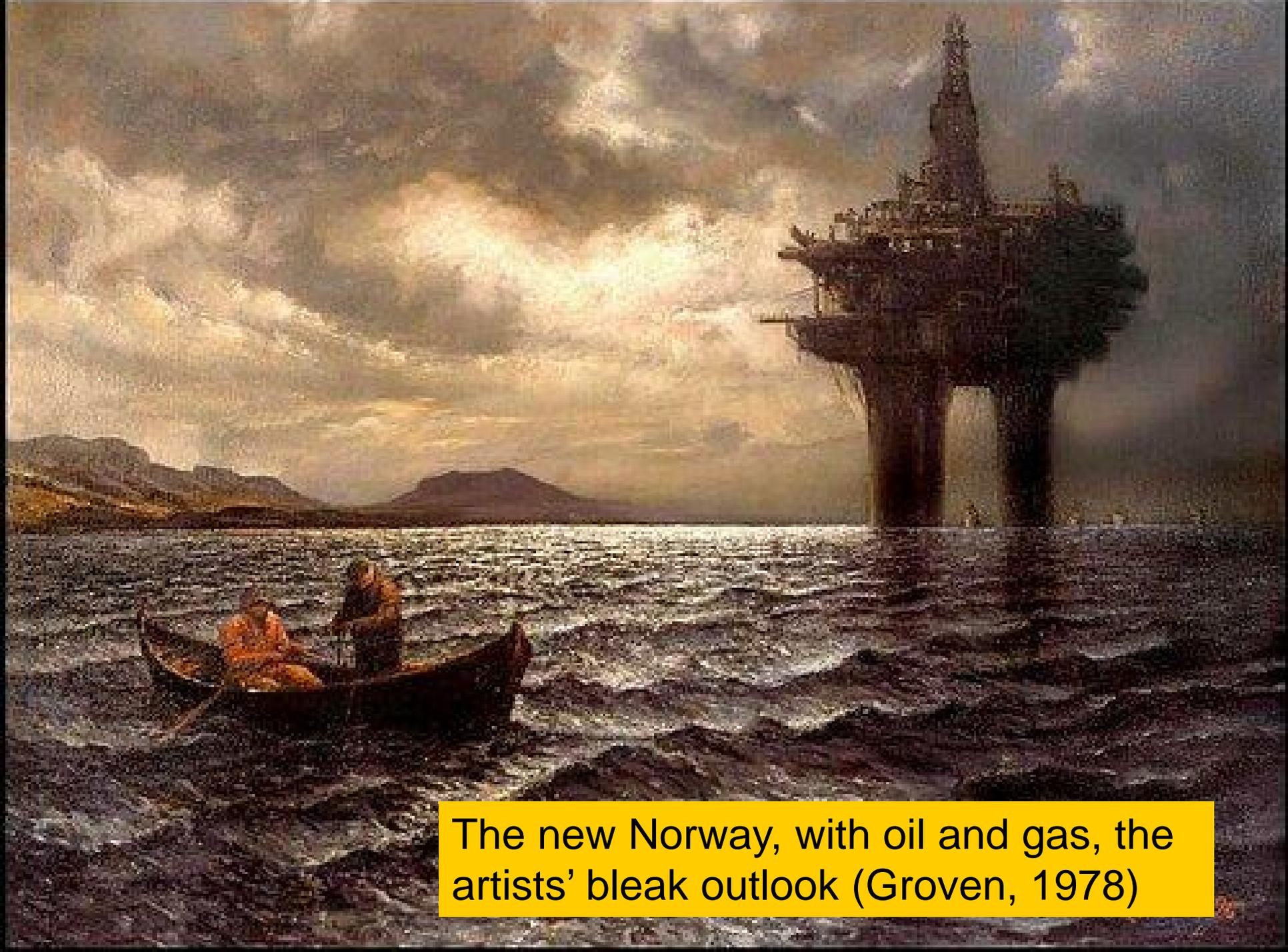
**New times,
new
images:**

**Rolf
Groven,
1975**



**Dystopia 1978:
Brave new science:
A future with nuclear
science and
technology**

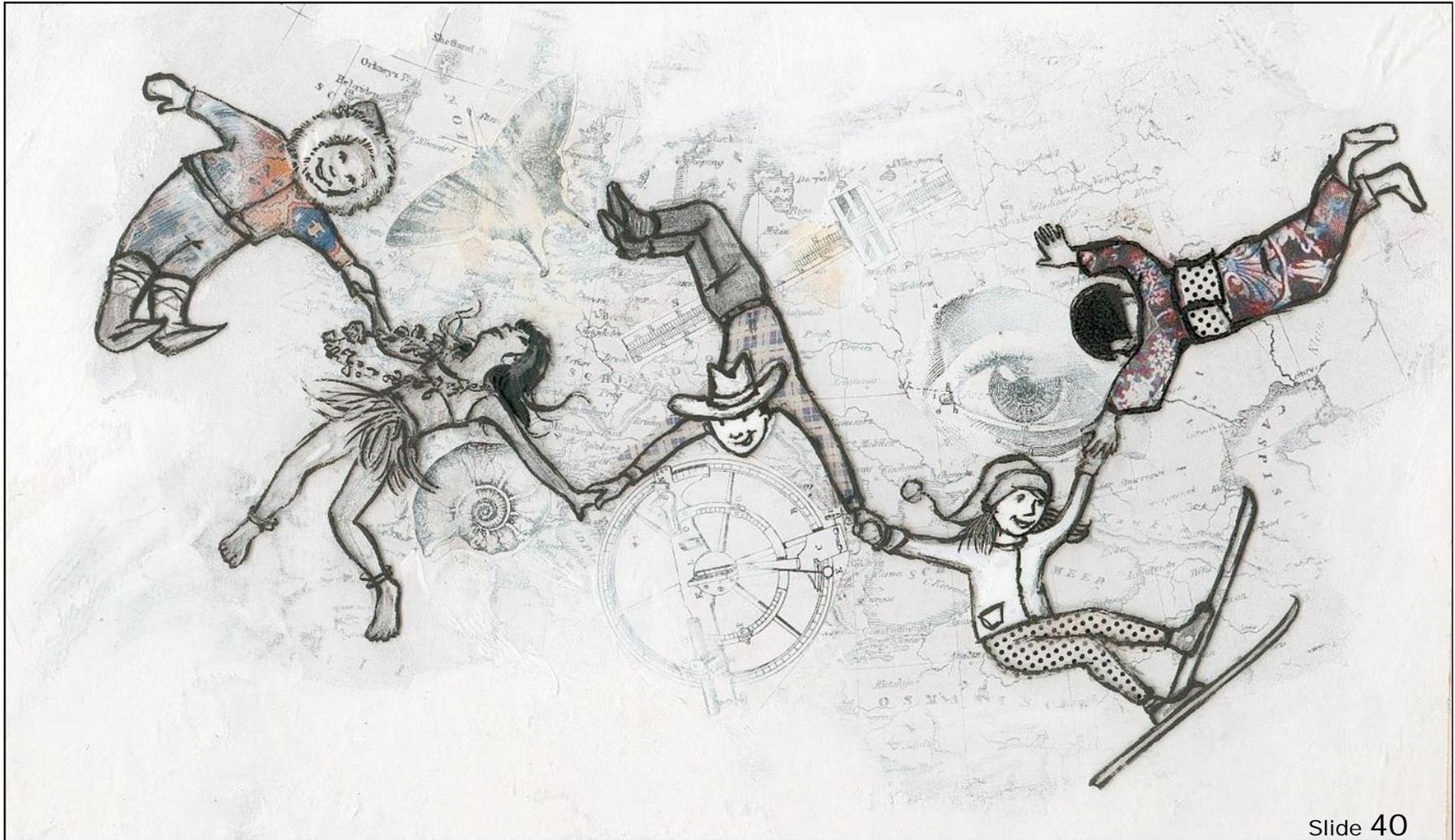




The new Norway, with oil and gas, the artists' bleak outlook (Groven, 1978)

Children's perceptions of Science and Scientists

(Sjøberg, 2002)



Images of scientists

"Draw a scientist at work"

From international project (40 countries):
Science and Scientists (Sjøberg 2002)

- *"Draw a scientist at work, and explain what he/she does"*
- Children (13 years) in developing countries: A very positive image
- Many children in developed countries: A negative and stereotyped image of scientists. ('The crazy scientists')
- Examples follow...

Girl, Norway

They are putting mice's ears on people, and they open people's heads.



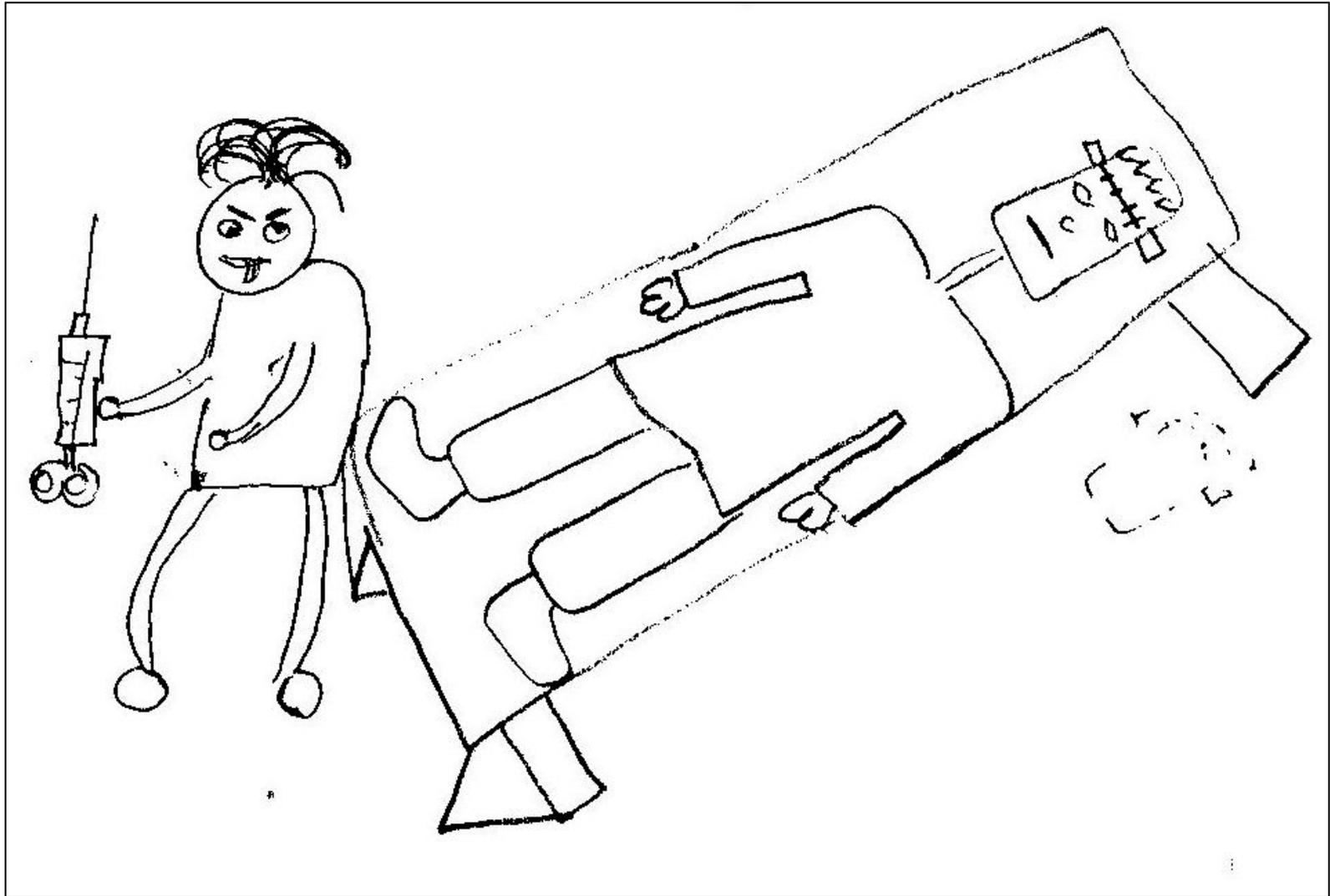
Skriv

Skriv noen ord om hva du tror forskere gjør og hvilke saker de arbeider med

SETTE MUSKEDØRER PÅ MUS, OG ÅPNE OPP
HODENE TIL FOLK

A scientist at work

Boy from Norway, 13 year (SAS-study)



Girl, Norway

Tegn

Slik ser jeg for meg en forsker i arbeid



A scientist at work

(Boy from Norway, 13 years)

"I think they experiment with animals and kill them. And then they develop poisonous gases and atomic bombs"

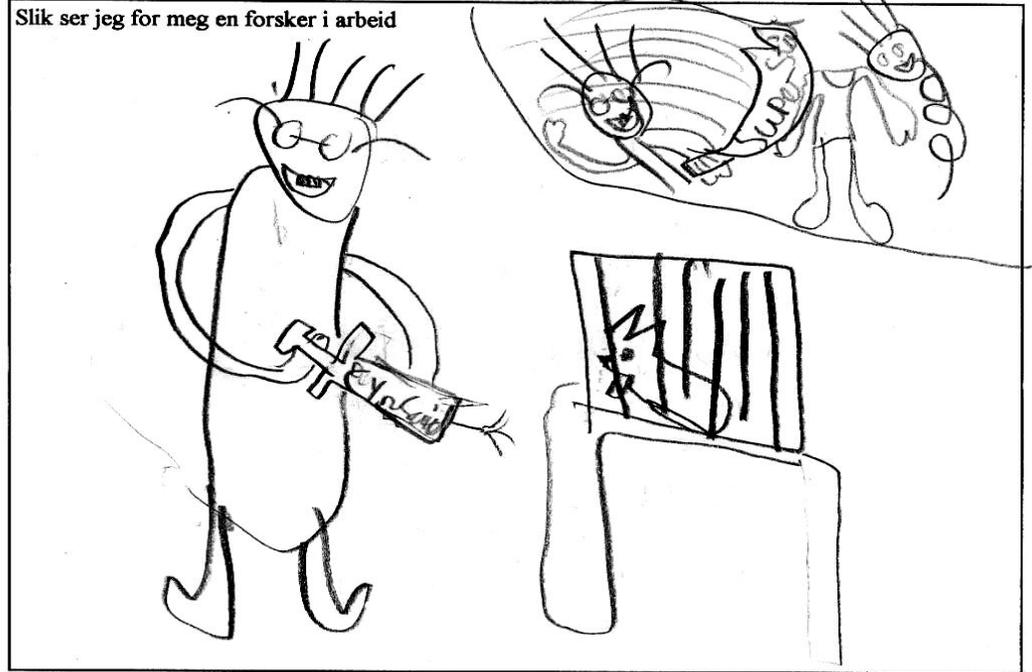
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Boy Norway

6. Forskere i arbeid

Tegn

Slik ser jeg for meg en forsker i arbeid



Skriv

Skriv noen ord om hva du tror forskere gjør og hvilke saker de arbeider med

Jeg tror de eksperimenterer
med dyr og drener dem!
Og de utviker de nye gift
og Atom Bomber

Girl, Norway

I think scientists try to make false body parts to handicapped people, like ears, liver etc.

They also make chemical experiments

6. Forskere i arbeid

Tegn

Slik ser jeg for meg en forsker i arbeid



Skriv

Skriv noen ord om hva du tror forskere gjør og hvilke saker de arbeider med

Jeg tror at forskere prøver å lage falske kroppsdeler til den handicappede mennesker, som f.eks. Øre, lever osv.

Boy, Norway

- They try to invent new things to kill people or to help people

Tegn

Slik ser jeg for meg en forsker i arbeid



Skriv

Skriv noen ord om hva du tror forskere gjør og hvilke saker de arbeider med

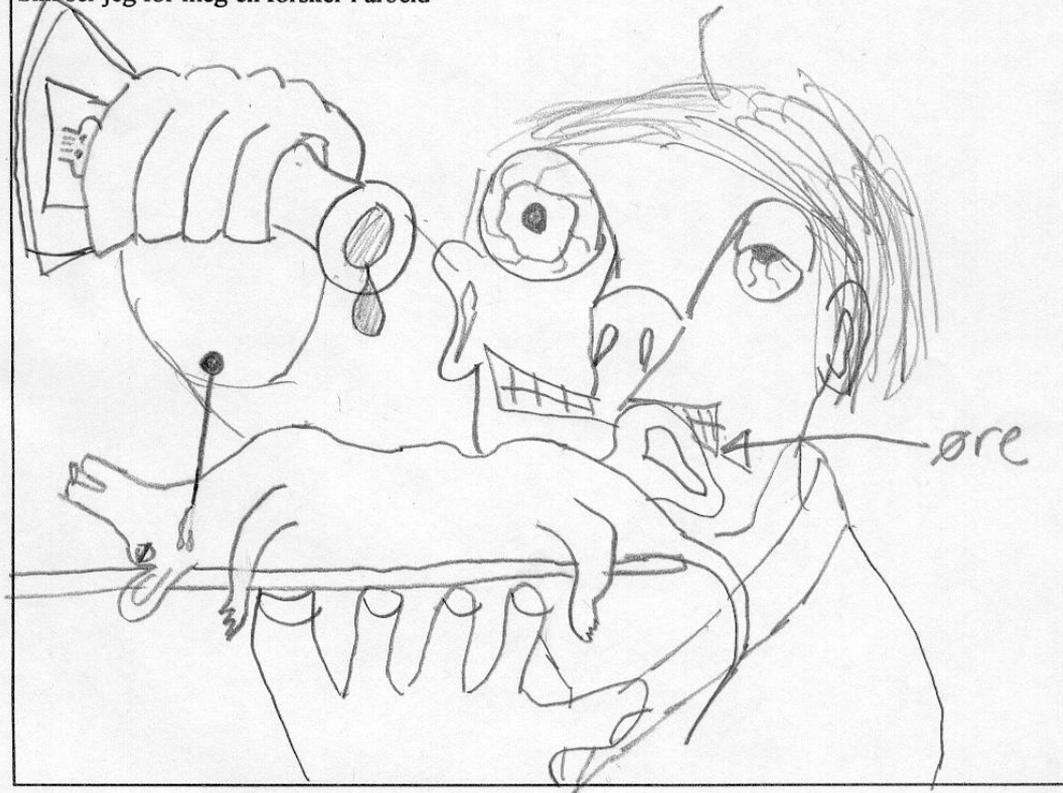
De prøver å finne opp nye ting
til å hjelpe folk å hjelpe
slik.

Boy, Norway

They research on things that they think may help or destroy the world.

Tegn

Slik ser jeg for meg en forsker i arbeid



Skriv

Skriv noen ord om hva du tror forskere gjør og hvilke saker de arbeider med

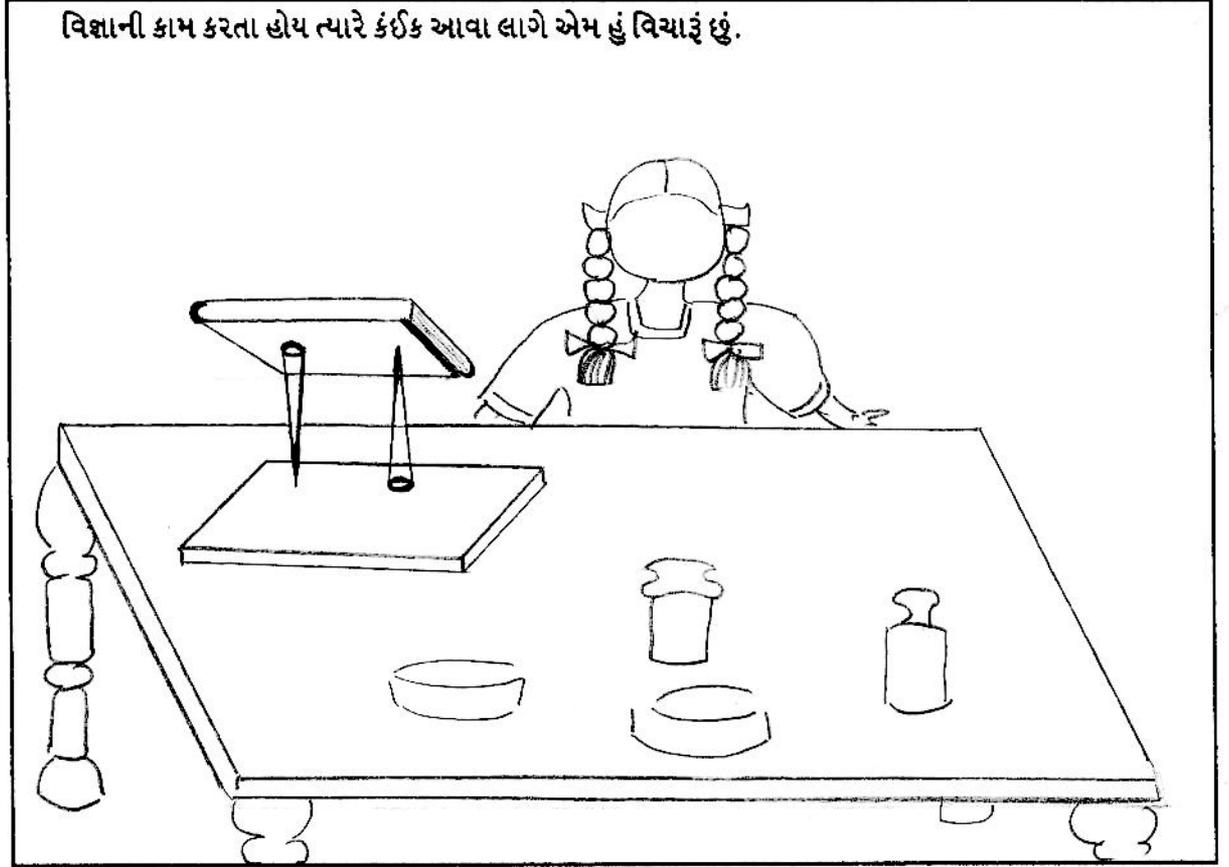
Forsker ut ting de tror
kan hjelpe verden eller
ødelte verden med

Girl, India

6. પોતાનું કામ કરતા વિજ્ઞાની

ચિત્ર.

વિજ્ઞાની કામ કરતા હોય ત્યારે કંઈક આવા લાગે એમ હું વિચારું છું.



લખાણ.

વિજ્ઞાની શું કરે છે અને કઈ બાબતો ઉપર તે કામ કરે છે તે વિશે તમારા વિચારો થોડા શબ્દોમાં લખો.
વિજ્ઞાની વિશ્વો ખુલું જાણવાની નવી પદ્ધતિ ઉપર
ઓછ પ્રયાગ કરી છે. તે પ્રયાગ આમ છે

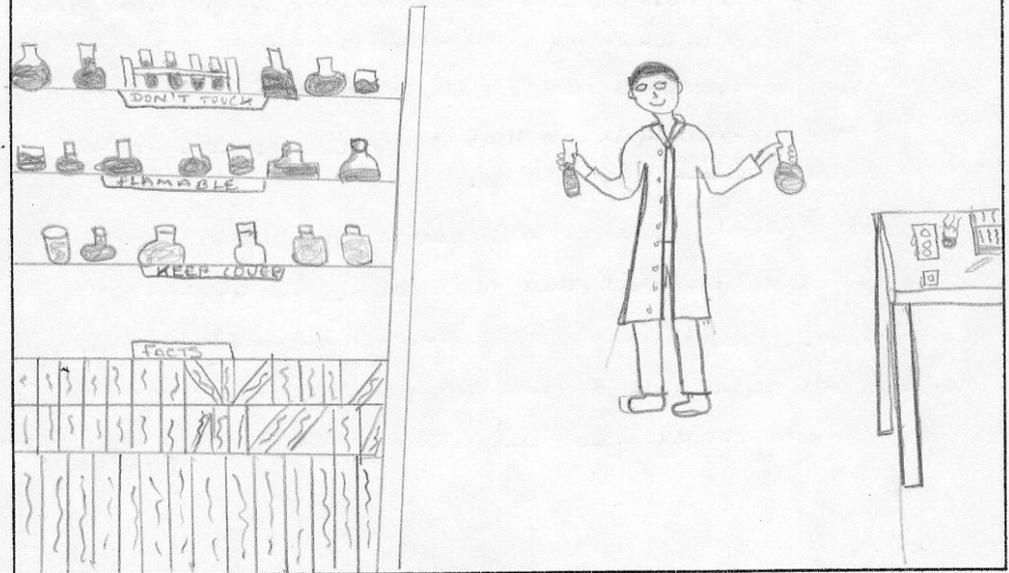
Girl Trinidad

6. Scientists at work

Drawing

Girl Trinidad

This is how I think a scientist at work may look like



Writing

Write some words about what you think scientists do and what issues they work on

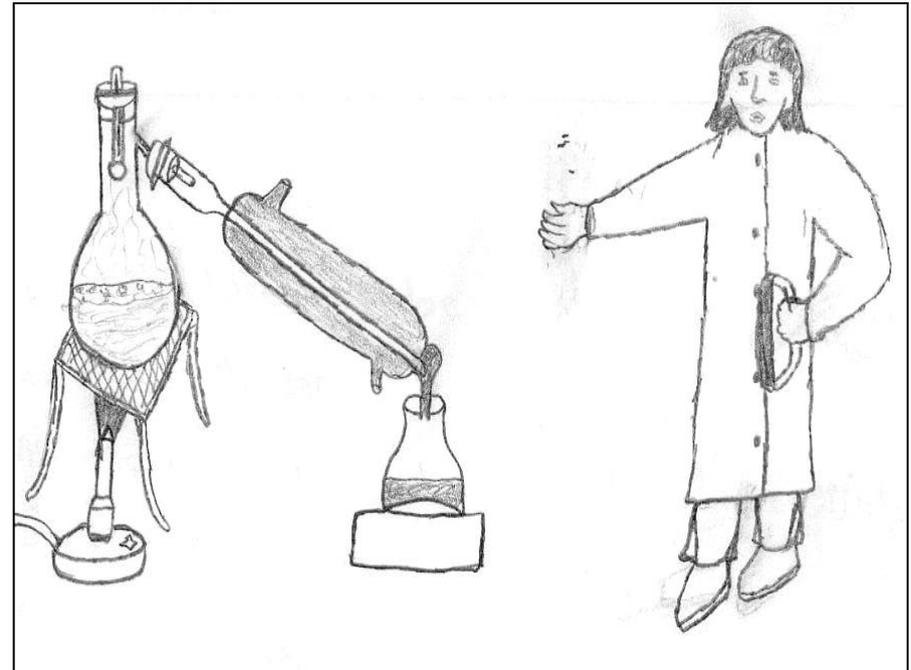
Scientists help people by inventing and creating experiments which is useful for everyday life. They also help to ensure safety to the environment and to lessen the causes of sicknesses and death.

A scientist works on ways to and investigate possibilities. They observe and examine living things to record how it function and it's characteristics. They also help in finding cures to diseases and illness to help the society.

Scientists at work: Developing countries



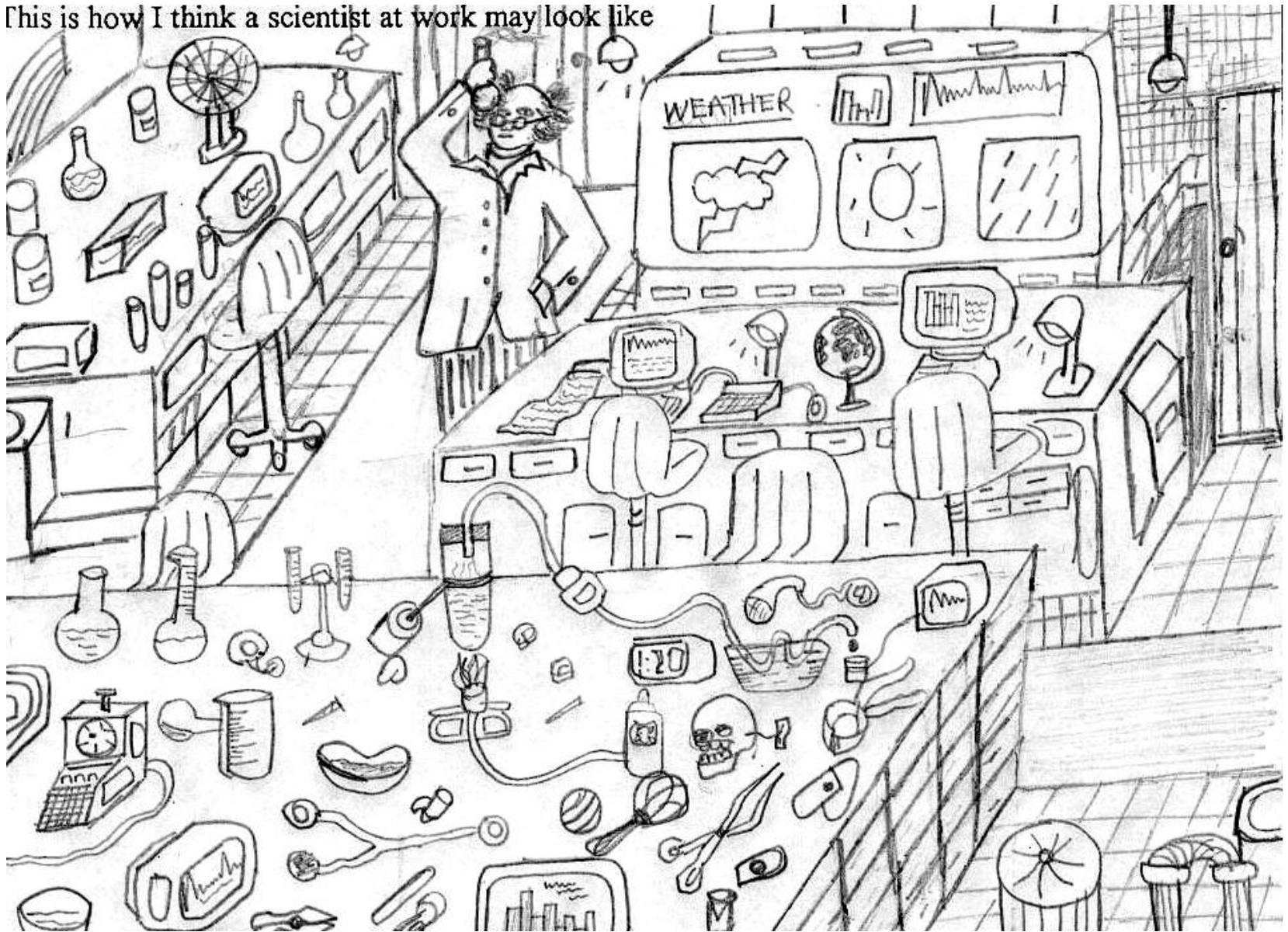
1. They are always thinking
2. They always have ideas
3. They (most) are brilliant people.
- 4 They are always making experiments new discoveries
5. If scientists were not here we ordinary people wouldn't know anything. (Girl Trinidad)



Scientists helps people regain their health.
They help those that are sick or ill to get well.
They are fund of discoveries.
They are also kept in the hospital to take care of those that are not healthy. (Girl, Nigeria)

Boy, Uganda

This is how I think a scientist at work may look like

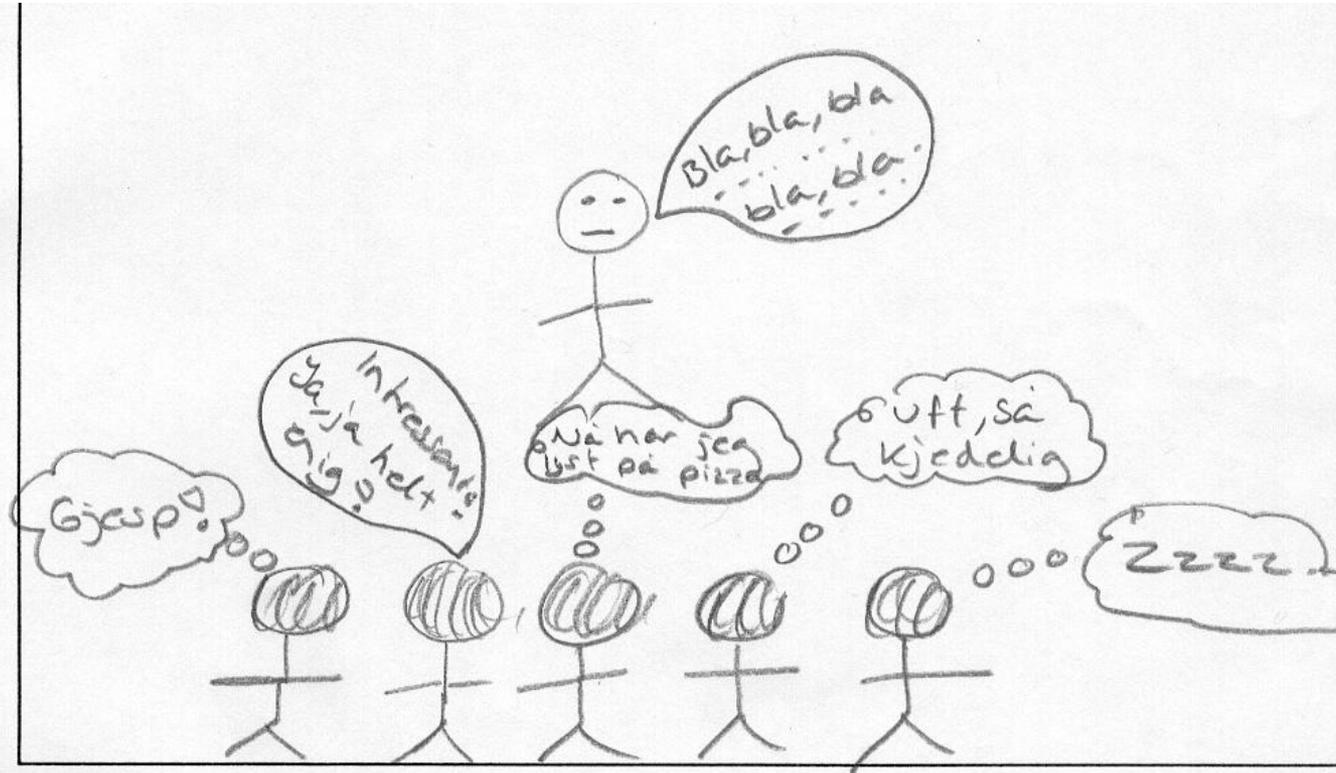


What scientists usually do...

- ❑ "Scientists travel around and collect facts. They write all facts in a report." (Boy, Norway)
- ❑ "Some scientists do experiments. Others use their brains." (Boy, England)
- ❑ "Scientists divide many things out of particular thing. One is animal without backbone and another is animal with backbone." (Boy, Papua New Guinea)
- ❑ "Scientists work hard long hours every single day for a whole week." (Girl, England)
- ❑ "I think scientists are nuts because they say they have a cure but it never works." (Boy, England)
- ❑ "Most scientists are just doing completely stupid things." (Boy, Norway)
- ❑ "They try to blow up the world with an atomic bomb." (Boy, Norway)
- ❑ "Scientists make tests on chemicals and test perfume on helpless rabbits and rats." (Boy, England)

Girl, Norway

I think that researchers often are bored at work. Making a lot of lectures and talks etc.



Skriv

Skriv noen ord om hva du tror forskere gjør og hvilke saker de arbeider med

Jeg tror at forskere ofte kjeder seg på jobben.
Holder masse foredrag o.s.v.

Current challenges

- "Alternative facts", "fake news"
- Rejection of science
- Trump's war on science
- Eroding trust in science?